



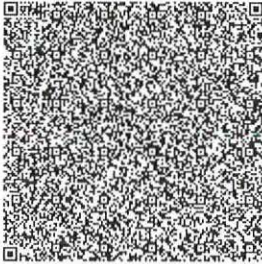
सत्यमेव जयते

INDIA NON JUDICIAL

Government of National Capital Territory of Delhi

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Certificate No. : IN-DL36350178918511P
Certificate Issued Date : 27-Sep-2017 03:23 PM
Account Reference : IMPACC (IV)/ dl808403/ DELHI/ DL-DLH
Unique Doc. Reference : SUBIN-DL80840374672746341531P
Purchased by : UPJN AND NMCG
Description of Document : Article 5 General Agreement
Property Description : Not Applicable
Consideration Price (Rs.) : 0
(Zero)
First Party : UPJN AND NMCG
Second Party : VARANASI STP PROJECT PRIVATE LIMITED
Stamp Duty Paid By : UPJN AND NMCG
Stamp Duty Amount(Rs.) : 500
(Five Hundred only)



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CONCESSION AGREEMENT

This Concession Agreement (**Agreement**) is executed on this Eleventh day of October Two Thousand and Seventeen at Delhi:

AMONGST

- (1) **UTTAR PRADESH JAL NIGAM**, a statutory body constituted under the Uttar Pradesh Water Supply and Sewerage Act, 1975, with its registered office at 6, Rana Pratap Marg, Lucknow - 226001 (hereinafter referred to as the **Jal Nigam**, which expression shall, unless it be repugnant to the context or meaning thereof, include its successors and permitted assigns);

Statutory Alert:

1. The authenticity of this Stamp Certificate should be verified at "www.ecilstamp.com". Any discrepancy in the details on this Certificate should be reported to the Competent Authority.
2. The onus of checking the legitimacy is on the users of the certificate.
3. In case of any discrepancy please inform the Competent Authority.

Jal Nigam

Hitesh Kumar S. Makwana, I.A.S.
कार्यकारी निदेशक (परियोजना)
Executive Director (Projects)
Minister for Clean Ganga



AND

- (2) **NATIONAL MISSION FOR CLEAN GANGA**, a statutory body constituted under the Environment (Protection) Act, 1986, with its registered office at 1st Floor, Major Dhyanchand National Stadium, India Gate, New Delhi - 110002 (hereinafter referred to as **NMCG**, which expression shall, unless it be repugnant to the context or meaning thereof, include its successors and permitted assigns);

AND

- (3) **VARANASI STP PROJECT PRIVATE LIMITED**, a company organized, incorporated, registered and existing under the Companies Act, with its registered office at 513/a, 5th floor, Kohinoor City, Kirod Road Kurla (West), Mumbai, Mumbai City, Maharashtra, India, 400070 acting through Kamal Maheshwari, President Business Development, duly authorized by resolution dated September 28, 2017 (hereinafter referred to as the **Concessionaire**, which expression shall, unless it be repugnant to the context or meaning thereof, include its successors and permitted assigns).

The Jal Nigam, NMCG and the Concessionaire shall collectively be referred to as the **Parties** and individually as a **Party**.

WHEREAS:

- A. The GoI, recognizing that long-term rejuvenation of the river Ganga will have significant social and economic benefits on the lives of the 500 million people living along its basin, has identified cleaning of the river Ganga as one of its priorities. For this purpose, in May 2015, the GoI approved the flagship Namami Gange programme for cleaning, rejuvenation, and protection of the river Ganga. In January 2016, the GoI approved a hybrid annuity model to implement STP projects under the Namami Gange programme on a PPP basis.
- B. Subsequently, the MoWR issued the River Ganga (Rejuvenation, Protection and Management) Authorities Order, 2016 (**Ganga 2016 Order**) to constitute various authorities to assist the GoI in achieving its aim of effective abatement of pollution in the river Ganga. The Ganga 2016 Order designated NMCG as the nodal agency for the implementation of the Ganga 2016 Order.
- C. The Jal Nigam has the power to develop, maintain and regulate water supply and sewerage works in Uttar Pradesh. With a view to implement the Namami Gange programme and the Ganga 2016 Order, the Jal Nigam, in association with NMCG, has decided to undertake the development of an STP with a proposed Design Capacity of 50 MLD along with other Facilities and Associated Infrastructure at Varanasi on a PPP basis, through a hybrid annuity model.
- D. For this purpose, the Jal Nigam intends to engage a concessionaire who will: (i) design, develop, finance, construct, operate and maintain the Facilities on the Site; and (ii) rehabilitate, operate, and maintain the Associated Infrastructure on the Site, and after the expiry of the Term, transfer the Facilities and the Associated Infrastructure to the Jal Nigam, in accordance with this Agreement (collectively the **Project**).

- E. On 22nd February, 2017, the Jal Nigam commenced a competitive Bid Process for the Project by issuing a request for proposal (the **RFP**), inviting interested parties to submit their qualification proposals and financial proposals to the Jal Nigam for undertaking the Project.
- F. Pursuant to the terms of the RFP, the Jal Nigam received proposals from various bidders, including a proposal submitted by the Selected Bidder on 12 June, 2017.
- G. Following a process of evaluation of qualification proposals and financial proposals submitted by the bidders (including the Selected Bidder), the Jal Nigam has accepted the proposal submitted by the Selected Bidder for the development of the Project and issued the letter of award dated 28 August, 2017 to the Selected Bidder (the **LOA**).
- H. The Selected Bidder has accepted the LOA and has agreed to undertake the Project in accordance with the terms of this Agreement.
- I. The Selected Bidder has incorporated a special purpose vehicle to act as the Concessionaire, to implement the Project and perform the obligations and exercise the rights of the Concessionaire, including the obligation to enter into this Agreement.
- J. The Jal Nigam and NMCG have agreed to enter into this Agreement with the Concessionaire for implementation of the Project, subject to and on the terms and conditions set out in this Agreement.

IT IS AGREED as follows:

1. DEFINITIONS AND INTERPRETATION

1.1 Definitions

Acres	means a unit of land area equal to 43,560 sq.ft.
Adjoining Property	means any land and/or property adjoining or adjacent to the Site, including all conduits, roads, footpaths, walls, fences, buildings and other erections, structures and other apparatus on, under or within such land and/or property.
Adjusted DG Set Units	has the meaning ascribed to it in Clause 9.4(g)(ii)(B)(II).
Affected Party	means the Party affected by a Force Majeure Event.
Applicable Laws	means the Constitution of India and all and any laws, enacted or brought into force and effect by the GoI, any State Government (including the GoUP), any Government Authority or any local government having jurisdiction over the Parties, the Site or the Project, including rules, regulations and notifications made thereunder, and judgments, decrees, injunctions, writs and orders of any court of record, as may be applicable to the execution of this Agreement and the performance of the respective rights and obligations of the

Parties, as may be in force and effect during the subsistence of this Agreement. For the avoidance of doubt, and without in any way limiting the generality of the foregoing, Applicable Laws shall include the EPA, the EPA Rules, Ganga 2016 Order, and the UPWSS Act.

Applicable Permits

means any permissions, clearances, concessions, authorizations, consents, licenses, permits, rulings, exemptions, no objections, resolutions, filings, orders, notarizations, registrations or approvals of whatsoever nature that are required to be obtained from time to time in connection with the Project, and for generally performing the obligations contemplated by this Agreement in accordance with the Applicable Laws, as set out in Schedule 7.

Appointed Date

means the date of signing of this Agreement.

Arbitration Act

means the Arbitration and Conciliation Act, 1996, as amended from time to time.

Article

means an article of this Agreement.

Associate

means, in relation to the Concessionaire or a Member of the Selected Bidder, a Person who Controls, or is Controlled by, or is under the common Control of the same Person who controls the Concessionaire or Member of the Selected Bidder, as the case may be.

Associated Infrastructure

means the supporting infrastructure facilities for the Varanasi STP, including the main pumping station, and the 6.68 kilometres rising main existing at the Site as described in greater detail in the Technical Specifications, which need to be rehabilitated, operated and maintained by the Concessionaire in accordance with this Agreement.

Availability

means the availability of the Facilities and the Associated Infrastructure to convey, accept and treat the Sewage, as determined in accordance with Clause 8.12(a)(i) and the term 'Available' shall be construed accordingly.

Availability Liquidated Damages

means the liquidated damages payable by the Concessionaire to the Jal Nigam for failure to achieve the Guaranteed Availability, in accordance with Clause 8.12(a)(v).

Basic Engineering Designs

means the following designs and documents to be submitted by the Concessionaire and approved by the Jal Nigam as a Condition Precedent:

- (a) process description, process calculations, and hydraulic calculations;

- (b) list of design codes and standards;
- (c) master drawing schedule;
- (d) drainage design;
- (e) STP Facilities layout;
- (f) process flow diagram;
- (g) hydraulic flow diagram;
- (h) mass balance diagram;
- (i) process and instrumentation diagram;
- (j) single line diagram;
- (k) electrical load list; and
- (l) general arrangement diagrams of all units of Facilities and Associated Infrastructure.

Bid means the bid consisting of the Qualification Proposal and the Financial Proposal submitted by a Bidder for qualification and award of the Project.

Bid Due Date means the last date of submission of the Bids as set out in the RFP.

Bid Process means the single-stage bidding process, with two sub-stages, undertaken by the Jal Nigam to award the Project to the Selected Bidder on the terms and conditions set out in the RFP. The Bid Process commenced with the issuance of the RFP and ends on the Appointed Date.

Bid Project Cost means INR 102,00,00,000 / - (Rupees One Hundred and Two Crores), being the cost of construction of the Facilities and the rehabilitation of the Associated Infrastructure, as quoted by the Selected Bidder in its Bid, which includes the interest during construction, Taxes and all other pre-operative expenses in relation to the Facilities and the Associated Infrastructure.

BOD means biochemical oxygen demand.

Capex Annuity means the amount payable to the Concessionaire per quarter during the O&M Period, towards reimbursement of 60% of the Completion Cost.

Capital means, in respect of the Concessionaire, the total capital of the Concessionaire that will be raised by the issuance of equity shares, preference shares and convertible instruments.

Change in Law means the occurrence of any of the following events after the Bid Due Date:

- (a) the modification, amendment, variation, alteration or repeal of any existing Applicable Law;

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- (b) the enactment of any new Applicable Law or the imposition, adoption or issuance of any new Applicable Law by any Government Authority;
- (c) changes in the interpretation, application or enforcement of any Applicable Law or judgement by any court/Government Authority;
- (d) the introduction of a requirement for the Concessionaire to obtain any new Applicable Permit or the unlawful revocation of an Applicable Permit; or
- (e) the introduction of any new Tax (including goods and services tax) or a change in the rate of an existing Tax.

It is clarified that Change in Law shall not include any change in the (Indian) Income Tax Act, 1961 with regard to the taxes on the income of the Concessionaire.

Clause	means a clause of this Concession Agreement.
COD Certificate	means the certificate issued by the Jal Nigam to the Concessionaire upon issuance or deemed issuance of Trial Operations Completion Certificate for the Facilities and the Associated Infrastructure and satisfaction of the conditions set out in Clause 7.15(a).
Commercial Operations Date or COD	means the date on which the COD Certificate is issued or deemed to be issued to the Concessionaire in accordance with Clause 7.15(a).
Companies Act	means the (Indian) Companies Act, 1956 or the (Indian) Companies Act, 2013, as amended from time to time, as the context may require.
Completion Cost	means the cost of completing the construction and rehabilitation of the Facilities and the Associated Infrastructure, as calculated in accordance with Clause 9.4(b).
Concessionaire	has the meaning ascribed to it in the array of Parties.
Concessionaire Applicable Permits	means the Applicable Permits which are required to be obtained and maintained by the Concessionaire to develop, operate and maintain the Facilities and the Associated Infrastructure, as set out in Schedule 7.
Concessionaire Event of Default	has the meaning ascribed to it in Clause 16.1.

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Concessionaire Related Parties	means any of the following: <ul style="list-style-type: none"> (a) the Selected Bidder or Associates of the Selected Bidder; (b) an officer, servant, employee or agent of the Concessionaire acting in that capacity; (c) any Subcontractor engaged by the Concessionaire and their directors, officers, servants, employees or agents acting in that capacity; or (d) any Person acting on behalf of the Concessionaire.
Concessionaire's Representative	means the Person nominated by the Concessionaire, from time to time, to act on its behalf and liaise with the Jal Nigam and NMCG for the purposes of this Agreement and notified as such in writing to the Jal Nigam and NMCG.
Conditions Precedent	means collectively, the obligations of the Concessionaire that are set out at Clause 3.2, the obligations of the Jal Nigam that are set out at Clause 3.3 and the obligations of NMCG that are set out at Clause 3.4, and ' Condition Precedent ' means any one of these.
Confidential Information	means any part of this Agreement, or any information contained therein or any material provided to any Party pursuant to this Agreement, all of which information shall be deemed to be confidential, except to the extent that this Agreement otherwise requires.
Construction Completion Certificate	means the certificate issued by the Jal Nigam to the Concessionaire to certify completion of construction of the Facilities, rehabilitation of the Associated Infrastructure and the satisfaction of all other conditions required to be fulfilled by the Concessionaire, in accordance with Clause 7.13(c).
Construction Completion Date	means the date on which the Construction Completion Certificate is issued or deemed to be issued to the Concessionaire in accordance with Clause 7.13(c)(iii).
Construction Payments	means the payments to be made to the Concessionaire during the Construction Period, upon satisfactory completion of the Payment Milestones, which shall, in aggregate, be equivalent to 40% of the Bid Project Cost, as adjusted from time to time to reflect the variation in the Construction Price Index.
Construction Period	has the meaning ascribed to it in Clause 7.1.
Construction Plan	means the detailed construction plan for the Facilities and the

Associated Infrastructure to be prepared by the Concessionaire, which will set out the work to be performed by the Concessionaire to achieve each of the 4 Payment Milestones, in a manner such that the Facilities and the Associated Infrastructure are completed on or prior to the Scheduled Construction Completion Date. The Construction Plan shall be approved by the Jal Nigam in accordance with Clause 7.3.

Construction Price Index

shall comprise:

- (a) 70% of WPI; and
- (b) 30% of CPI(IW),

which constituents may be substituted by such alternative index or indices as the Parties may mutually agree.

Control

means, with respect to a Person:

- (a) the ownership, directly or indirectly, of more than 50% of the voting shares of such Person; or
- (b) the power, directly or indirectly, to direct or influence the management and policies of such Person by operation of law, contract or otherwise,

and the term '**Controlled**' shall be construed accordingly.

Cost

means all documented expenditure reasonably incurred by the Concessionaire, whether on or off the Site, including overhead and similar charges, but does not include profit.

CP Long-Stop Date

has the meaning ascribed to it in Clause 3.5(a).

CPI(IW)

means the Consumer Price Index for Industrial Workers published by the Labour Bureau, GoI and shall include any index which substitutes the CPI(IW), and any reference to CPI(IW) shall, unless the context otherwise requires, be construed as a reference to the CPI(IW) published on the last date of the preceding quarter.

Debt Due

means the aggregate of the following sums expressed in Rupees outstanding on the date of issuance of the Notice of Intent to Terminate:

- (a) the principal amount of the debt provided by the Lenders under the Financing Documents for financing 45% of the Bid Project Cost but excluding any part of the principal that had fallen due for repayment 2 years prior to the date of the Notice of Intent to Terminate, as set out in the Financial Package; and

- (b) all accrued interest, financing fees and charges payable under the Financing Documents on, or in respect of, the debt referred to in (a) above until the date of the Notice of Intent to Terminate but excluding (i) any interest, fees or charges that had fallen due 1 year prior to the date of the Notice of Intent to Terminate, (ii) any penal interest or charges payable under the Financing Documents to any Lender, and (iii) any pre-payment charges in relation to accelerated repayment of debt except where such charges have arisen due to a Jal Nigam Event of Default or an NMCG Event of Default,

provided that if all or any part of the Debt Due is convertible into equity at the option of Lenders and/or the Concessionaire, it shall for the purposes of this Agreement be deemed to be Debt Due even after such conversion and the principal shall be dealt with as if such conversion had not been undertaken.

For the purpose of calculating Debt Due:

- (A) the aggregate of the principal amounts of the debt provided by the Lenders under the Financing Documents shall, in no event, exceed 45% of the Bid Project Cost; and
- (B) any amount of Debt Due in foreign currency as on the date of the Notice of Intent to Terminate shall be converted to Rupees at the exchange rate published on the official website of the Reserve Bank of India as at 12 noon on the relevant date.

Delay Event	has the meaning ascribed to it in Clause 7.11(b).
Delay Liquidated Damages	has the meaning ascribed to it in Clause 7.12(a).
Designs and Drawings	means, collectively, the Phase I Designs and Drawings and the Phase II Designs and Drawings.
Design Capacity	means the average flow of Sewage that the Facilities and the Associated Infrastructure should be designed to handle and treat in a day, which shall be 50 MLD.
DG Sets	means the backup diesel generators set maintained by the Concessionaire at the Site, to ensure continuous supply of power for the operation of the Facilities and the Associated Infrastructure, when the supply of power from the grid is not

available.

Digested Sludge	means the sludge which is obtained after the treatment and digestion of the Sewage at the Varanasi STP.
Direct Political Force Majeure Events	has the meaning ascribed to it in Clause 14.1(b)(iii).
Discharge Point	means the point at which the Effluent Disposal Pipeline shall discharge the Treated Effluent, as set out in Schedule 8.
Discharge Standards	means the minimum standards set out in the Technical Specifications that the Treated Effluent and Digested Sludge must comply with.
Dispute	has the meaning ascribed to it in Clause 21.1.
Dispute Notice	has the meaning ascribed to it in Clause 21.1.
Dispute Meeting	has the meaning ascribed to it in Clause 21.1.
Effective Date	means the date on which all the Conditions Precedent have been satisfied by the Jal Nigam, NMCG and the Concessionaire in accordance with this Agreement.
Effluent Disposal Pipeline	means the 5.5 km pipeline to be laid by the Concessionaire as part of the Project, to transport and convey Treated Effluent from the Varanasi STP to the Discharge Point.
EHS Plan	means the environment management and health and safety plan prepared by the Concessionaire and approved by the Jal Nigam in accordance with Clause 7.4.
EHS Standards	means the environmental, social, labour, health and safety related requirements, including any requirements, which the Concessionaire is required to comply with in developing, operating and maintaining the Facilities and the Associated Infrastructure, as set out in Schedule 9.
Emergency	means a condition or situation that endangers, or which in the reasonable opinion of the Jal Nigam, the Project Engineer or the Concessionaire, may endanger the environment or lives or security of people at or around the Site or that poses an imminent threat of material damage to any property (including the Facilities and the Associated Infrastructure) at or around the Site.
Encumbrance(s)	means mortgage, charge, pledge, lien (statutory or otherwise), assignment by way of security, hypothecation, right of set-

off, trust, priority, retention of title or ownership or other security interest and any other agreement or arrangement having substantially the same effect.

EPA	means the Environment (Protection) Act, 1986, as amended from time to time.
EPA Rules	means the Environment (Protection) Rules, 1986, as amended from time to time.
Equity	means the sum expressed in INR representing the paid up equity share capital of the Concessionaire for meeting the equity component of its financial obligations under this Agreement and the Financing Documents, which, for the purpose of this Agreement, shall include convertible instruments that shall compulsorily convert into equity share capital and any loans provided by any shareholder of the Concessionaire.
Escrow Account	means the interest-bearing account opened by NMCG with the Escrow Bank in accordance with the Escrow Agreement, which shall be operational until the expiry of the Term.
Escrow Agreement	means the agreement to be executed among the Jal Nigam, NMCG, the Concessionaire, and the Escrow Bank in relation to the opening and operations of the Escrow Account, in the form set out at Schedule 3.
Escrow Bank	means the Scheduled Bank with which NMCG opens the Escrow Account, pursuant to the Escrow Agreement.
Event of Default	means a Jal Nigam Event of Default, NMCG Event of Default or a Concessionaire Event of Default, as the context may require.
Facilities	means, collectively, the Varanasi STP, the Effluent Disposal Pipeline, the Online Monitoring System, the on-site testing laboratory facilities and such other facilities associated with the Varanasi STP, required to be set up by the Concessionaire, as described in greater detail in the Schedule 11 (<i>Technical Specifications</i>) and Schedule 1 (<i>Scope of Work</i>).
Financial Assistance	means all funded and non-funded financial assistance, including loans, advances and guarantees or any re-financing that the Concessionaire may avail of for the Project from the Lenders.
Financial Capacity	means the financial capacity and strength of the Member(s) determined in accordance with the RFP.

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Financial Close	means, the date on which the Financing Documents become effective, the conditions precedent under the Financing Documents for disbursements are fulfilled and the Concessionaire has access to the Financial Assistance.
Financial Package	means the financing package indicating the means of financing the Facilities and the Associated Infrastructure, and includes all Financial Assistance specified in the Financing Documents and the Equity.
Financial Proposal	means the financial proposal submitted by the Selected Bidder in accordance with the RFP for undertaking the Project.
Financial Year	means each 12-month period commencing on 1 April of one calendar year and ending on 31 March of the next calendar year; and if different for a company, then the 12-month period for which such company files its statutory audited accounts in the normal course of its business.
Financing Documents	means, collectively, the documents entered into or to be entered into by the Concessionaire with the Lenders, in respect of all funded and non-funded financial assistance, including loans, advances and or any re-financing that the Concessionaire may avail of for the Project from the Lenders and includes any document providing Security to the Lenders.
First Breach	has the meaning ascribed to it in Clause 8.12(b)(iii)(A).
First Breach Notice	has the meaning ascribed to it in Clause 8.12(b)(iii)(A).
FM Notice	has the meaning ascribed to it in Clause 14.2(a).
Force Majeure Event	means a Non-Political Force Majeure Event, an Indirect Political Force Majeure Event or a Direct Political Force Majeure Event, as the case may be.
Forced Unavailability	means an interruption of or a reduction in the Availability of the Facilities and/or the Associated Infrastructure that is the result of: <ul style="list-style-type: none"> (a) a maximum capacity utilization of the Facilities or the Associated Infrastructure, as notified by the Concessionaire to the Jal Nigam in accordance with Clause 8.9; (b) a suspension of the performance of the O&M services pursuant to Clause 15.1(a)(i) or Clause 15.2(a)(i), to the extent any such event is not attributable to the Concessionaire; or

(c) unavailability or breakdown of the Supporting Infrastructure.

Fuel Price means the prevailing price of diesel at Indian Oil Corporation or Hindustan Petroleum Corporation Limited's retail outlets in Varanasi, as determined on the 15th day of a month.

Fundamental Change in Law means any Change in Law that:

- (a) renders unenforceable, illegal, invalid or void any material right or material obligation of the Concessionaire under this Agreement; or
- (b) renders a material part of this Agreement invalid, illegal or unenforceable; or
- (c) results in the Concessionaire being deprived of the whole or a substantial part of the benefit of this Agreement.

Ganga 2016 Order has the meaning ascribed to it in Recital B.

GoI means the Government of India.

Good Industry Practices means the exercise of such degree of skill, diligence and prudence, and those practices, methods, specifications and standards of equipment, safety and performance, as may change from time to time and which would reasonably and ordinarily be expected to be used by a skilled and experienced developer engaged in construction, management, and maintenance of STPs in India of the type and size similar to the Facilities and the Associated Infrastructure.

GoUP means the Government of Uttar Pradesh.

Government Authority means the GoI, any State Government (including the GoUP), any local government or any other ministry, governmental department, commission, board, body, bureau, agency, authority, instrumentality, inspectorate, statutory corporation or body corporate over which the GoI or the GoUP exercises control, court, tribunal or other judicial or administrative body or official or person, having jurisdiction over the Concessionaire, the Site, the Project and the performance of obligations and exercise of the rights of the Parties in accordance with the this Agreement.

Grace Period has the meaning ascribed to it in Clause 7.12(e).

Guaranteed Availability has the meaning ascribed to it in Clause 8.12(a)(i).

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Guaranteed Energy Consumption

means the maximum number of units of power (in kWh) per MLD quoted by the Selected Bidder in the Financial Proposal, which it expects the Concessionaire to consume during the O&M Period (other than any units expected to be generated and consumed from the Power Plant), to operate and maintain the Facilities, at varying volumes and BOD of Sewage. The Guaranteed Energy Consumption for any quarter during the O&M Period will be determined on the basis of the number of units of power (in kWh) per MLD quoted by the Selected Bidder in the Financial Proposal for the average volume and BOD of Sewage treated at the Varanasi STP in such quarter (such average to be calculated in accordance with the KPI Adherence Report).

Hand-back Conditions

mean the condition in which the Site, the Facilities, the Associated Infrastructure and the Power Plant, if any, shall be handed back to the Jal Nigam or any entity nominated by the Jal Nigam on expiry or early termination of this Agreement, which is consistent with the due performance of the Concessionaire's obligations under this Agreement and are described in greater detail in the Technical Specifications.

Hand-back Requirements

means the obligations of the Concessionaire in relation to transfer of the Facilities and the Associated Infrastructure upon termination of the Project, as set out in Clause 19.3.

IFC Performance Standards

means the IFC Performance Standards on Environmental and Social Sustainability dated 1 January, 2012 available at <http://www.ifc.org/performancestandards>.

Indirect Political Force Majeure Events

has the meaning ascribed to it in Clause 14.1(b)(ii).

Influent Standards

means the permissible standards and characteristics set out in the Technical Specifications for the incoming Sewage.

Inlet Point

means the point mutually agreed to between the Jal Nigam and the Concessionaire at the Varanasi STP where: (a) the Sewage sample shall be drawn to test compliance with the Influent Standards; and (b) meters shall be installed for the purpose of determining the volume and concentration of the Sewage delivered at the Facilities.

Intellectual Property Rights

means patents, copyrights, database rights, design rights, trade-marks, service marks, trade names, domain names, rights in reputation, rights in undisclosed or confidential information (such as know-how, trade secrets and inventions, whether patentable or not), and other rights of a like nature (whether registered or unregistered) and all applications for

such rights as may exist anywhere in the world.

Invoice	means an invoice for payment of: (a) the Construction Payments during the Construction Period; or (b) the Capex Annuity (along with interest), the O&M Charges and the Power Charges during the O&M Period, submitted by the Concessionaire to the Jal Nigam (with a copy to NMCG) in accordance with Article 9.
Jal Nigam	has the meaning ascribed to it in the array of Parties.
Jal Nigam Applicable Permits	means the Applicable Permits which are required to be obtained by the Jal Nigam to undertake the Project, as set out in Schedule 7.
Jal Nigam Event of Default	has the meaning ascribed to it in Clause 16.3.
Jal Nigam Related Parties	means any of the following: (a) an officer, servant, employee or agent of the Jal Nigam, acting in that capacity; (b) any contractor or subcontractor of the Jal Nigam and their directors, officers, servants, employees or agents, acting in that capacity; or (c) any Person acting on behalf of the Jal Nigam. For the avoidance a doubt, 'Jal Nigam Related Parties' does not include the Concessionaire or NMCG.
Jal Nigam's Representative	means any officer nominated by the Jal Nigam, from time to time, to act on its behalf and liaise with the Concessionaire and NMCG for the purposes of this Agreement and notified as such in writing to the Concessionaire and NMCG.
KPI Adherence Report	has the meaning ascribed to it in Clause 8.12(b)(vi).
KPIs	means the key performance indicators set out in Schedule 10, which the Facilities and the Associated Infrastructure must achieve during the O&M Period.
Lead Member	means the Member nominated by the Members of the Selected Bidder to act as the lead member in accordance with the RFP.
Lenders	includes banks, financial institutions, funds and agents or trustees of debenture holders, including their successors and

assignees, who have agreed to guarantee or provide Financial Assistance to the Concessionaire under the Financing Documents but does not include any shareholder or Associates of the Concessionaire who have provided any shareholder loans to the Concessionaire.

Liquidated Damages	means the Delay Liquidated Damages, the Availability Liquidated Damages, the Performance Liquidated Damages and the Power Consumption Liquidated Damages.
LOA	has the meaning ascribed to it in Recital G.
Material Adverse Effect	means the effect of any act or event, which materially and adversely affects the ability of any Party to exercise its rights or perform any of its obligations under and in accordance with this Agreement and which act or event causes a material financial burden or loss to any Party.
Member	means, where the Selected Bidder is a Consortium, a member of the Selected Bidder.
Milestone Completion Certificate	means, in respect of any Payment Milestone, a certificate issued by the Jal Nigam in accordance with Clause 7.13(a), to certify that such Payment Milestone has been achieved in accordance with the requirements of this Agreement.
Minimum Escrow Balance	has the meaning ascribed to it in Clause 9.5(b).
Minor Casualty	means any fire or other casualty that results in physical damage to the Facilities to the extent that the total cost (as estimated by the Project Engineer) of repairing and/or replacing the damaged portion of the Facilities to the same condition as previously existed would not exceed the amount of INR 25,00,000 (Rupees twenty-five lakhs).
MLD	means million litres per day.
Mobilization Advance	means an amount equivalent to 10% of the Bid Project Cost that is to be paid in advance to the Concessionaire for mobilization and execution of the construction and rehabilitation works for the Facilities and the Associated Infrastructure in accordance with Clause 9.3(d).
Mobilization Advance Guarantee	has the meaning ascribed to it in Clause 5.16.
MoWR	means the Ministry of Water Resources, River Development and Ganga Rejuvenation, GoI.
Net Worth	means the net worth of a company, which shall be determined

as follows:

- (a) subscribed and paid up equity share capital; and
- (b) reserves;

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- (c) revaluation reserves;
- (d) miscellaneous expenditure not written off;
- (e) reserves not available for distribution to equity shareholders; and
- (f) aggregate value of accumulated losses.

NMCG	has the meaning ascribed to it in the array of Parties.
NMCG Event of Default	has the meaning ascribed to it in Clause 16.4.
NMCG's Representative	means any officer nominated by NMCG, from time to time, to act on its behalf and liaise with the Concessionaire and the Jal Nigam for the purposes of this Agreement and notified as such in writing to the Concessionaire and the Jal Nigam.
Non-Political Force Majeure Event	has the meaning ascribed to it in Clause 14.1(b)(i).
Notice of Arbitration	has the meaning ascribed to it in Clause 21.2(a).
Notice of Intent to Terminate	means, a notice of intent to terminate issued by the Jal Nigam in case of a Concessionaire Event of Default (in accordance with Clause 16.2) or a notice of intent to terminate issued by the Concessionaire in case of a Jal Nigam Event of Default or an NMCG Event of Default (in accordance with Clause 16.5), stating its intention to terminate this Agreement.
O&M	means operation and maintenance.
O&M Charges	means the amount required by the Concessionaire per quarter to operate and maintain the Facilities and the Associated Infrastructure, excluding the Power Charges, during the O&M Period. The O&M Charges for the first quarter after the COD will be determined on the basis of the O&M Charges quoted by the Selected Bidder (in the Financial Proposal) for the first month from the COD, which amount shall then be adjusted to reflect the variation in the O&M Price Index.
O&M Manual	means the manual required to be prepared by the Concessionaire and approved by the Jal Nigam for the operation and maintenance of the Facilities and the Associated Infrastructure in accordance with Clause 8.2.

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O&M Payments	means, collectively the: (a) Capex Annuity; (b) interest on the reducing balance of 60% of the Completion Cost; (c) O&M Charges; (d) Power Charges for the Facilities, subject to the cap of the Power Charges based on the Guaranteed Energy Consumption; and (e) Power Charges at actuals for the Associated Infrastructure, to be paid by NMCG to the Concessionaire during the O&M Period, in accordance with this Agreement.
O&M Period	means the period of 15 years from the COD during which the Concessionaire is required to operate and maintain the Facilities and the Associated Infrastructure.
O&M Price Index	shall comprise: (a) 70% of CPI(IW); and (b) 30% of WPI, which constituents may be substituted by such alternative index or indices as the Parties may mutually agree.
O&M Security	has the meaning ascribed to it in Clause 5.4.
Online Monitoring System	means the monitoring system to be set up by the Concessionaire as part of the Facilities for continuous monitoring of the volume, specifications and characteristics of the Sewage and the Treated Effluent.
Outlet Point	means the outlet of the Varanasi STP where the sample of the Treated Effluent shall be drawn periodically to test compliance with the Discharge Standards.
Payment Certificate	has the meaning ascribed to it in Clause 9.3(e)(v) for Construction Payments and Clause 9.4(k) for O&M Payments.
Payment Milestones	means the 4 milestones listed in Clause 9.3(e) for release of the Construction Payments to the Concessionaire, and ' Payment Milestone ' shall mean any one of them, as the context may require.
Performance Liquidated Damages	means the liquidated damages payable by the Concessionaire to the Jal Nigam for a failure to meet the Discharge Standards in accordance with Clause 8.12(b)(iii).
Performance Security	has the meaning ascribed to it in Clause 5.1.
Person	means any individual, company, corporation, partnership, joint venture, trust, society, sole proprietor, limited liability partnership, co-operative society, government company, unincorporated organization or any other legal entity.

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Phase I Designs and Drawings	means the Basic Engineering Designs and the detailed 'good for construction' designs and drawings, technical information, plans, samples, patterns, models and specifications for the works required for achieving the first Payment Milestone.
Phase II Designs and Drawings	means the detailed 'good for construction' designs and drawings, technical information, plans, samples, patterns, models and specifications for the works required for achieving the second, third and fourth Payment Milestones.
Power Charges	means the cost of the power consumed by the Concessionaire to operate and maintain the Facilities and the Associated Infrastructure during the O&M Period, which will be calculated on the basis of the prevailing Power Unit Rate, the Fuel Price, to the extent applicable and such other applicable charges as per the guidelines of the relevant Government Authorities.
Power Consumption Liquidated Damages	has the meaning ascribed to it in Clause 9.4(g)(ii)(C).
Power Outage	means any interruption in the supply of electricity from the grid or any DG Sets maintained by the Concessionaire at the Site, which disrupts the continuous operation of the Facilities and/or the Associated Infrastructure.
Power Plant	means a biogas power plant or a rooftop solar plant that the Concessionaire decides to set up at the Site as part of the Project for production of clean energy.
Power Unit Rate	means the cost per unit of power drawn from the grid (through the relevant distribution licensee for the Site), which will be the prevailing tariff per unit of power charged by the relevant distribution licensee in the relevant month during the O&M Period.
PPP	means public private partnership.
Price Index	means, for the Construction Payments, the Construction Price Index, and for the O&M Payments, the O&M Price Index.
Price Index Multiple	means, the variation multiple in the Price Index occurring between the Reference Index Date preceding the Bid Due Date and the Reference Index Date preceding the date of the Invoice, which is calculated by dividing the Price Index on the Reference Index Date preceding the date of the Invoice by the Price Index on the Reference Index Date preceding the Bid Due Date.

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For the avoidance of doubt and by way of illustration, if (a) the Price Index on the Reference Index Date preceding the Bid Due Date, say 30 April, 2017, is 200; (b) the Invoice is submitted on 15 April, 2020; and (c) the Price Index as on 31 March, 2020 is 210, then the Price Index Multiple for determination of the amount due in respect of such Invoice shall be 1.05.

Project	has the meaning ascribed to it in Recital D.
Project Engineer	means the engineering firm appointed by NMCG in accordance with Article 6.
Proposed Technology	means the proven technology proposed to be used by the Concessionaire to develop the Varanasi STP, as specified by the Concessionaire in its Designs and Drawings. The proposed technology for the Varanasi STP must be the same as the technology adopted for at least one of the STP(s) for which the Selected Bidder claimed technical experience in its Bid.
Qualifying Change in Law	means any Change in Law, which: <ul style="list-style-type: none">(a) is directly applicable to the Project;(b) impacts the Cost or time for undertaking the Project; and(c) which was not reasonably foreseeable by the Concessionaire as on the Bid Due Date.
Reference Index Date	means, in respect of a specified date, the last date of the preceding month with reference to which the Construction Price Index or the O&M Price Index is revised.
Residual Grit	means the grit which is obtained as residual matter after the treatment of the Sewage at the Varanasi STP.
RFP	has the meaning ascribed to it in Recital E.
Rupee or Rs. or INR	means Indian Rupees, the lawful currency of India.
SBI MCLR	means the prevailing marginal cost of fund based lending rate for a tenor of 1 year, notified by the State Bank of India.
Schedule	means a schedule of this Agreement.
Scheduled Bank	means a bank as defined under section 2(e) of the Reserve Bank of India Act, 1934, as amended from time to time.

Scheduled COD	means the date which is 4 months from the Construction Completion Date, by which the Concessionaire is required to achieve the COD.
Scheduled Construction Completion Date	means the date which is 21 months from the Effective Date, by which the Concessionaire is required to complete the construction and rehabilitation works for the Facilities and the Associated Infrastructure.
Scheduled Maintenance Programme	means, for each year of the O&M Period, the schedule for undertaking preventive and corrective maintenance of the Facilities and the Associated Infrastructure, as prepared by the Concessionaire and approved by the Jal Nigam in accordance with Clause 8.11(f).
Scheduled Maintenance	means a planned maintenance of the Facilities and Associated Infrastructure that: <ul style="list-style-type: none"> (a) has been scheduled and allowed by the Jal Nigam in accordance with the Scheduled Maintenance Programme; and (b) is for inspection, testing, preventive and corrective maintenance, repairs, replacement or improvement of the Facilities or the Associated Infrastructure, as the case may be.
Scheduled Payment Milestone Completion Date	means the scheduled date of completion of the construction work corresponding to the relevant Payment Milestone.
Scope of Work	means the scope of work for construction and O&M of the Facilities and the Associated Infrastructure as set out in Schedule I.
Screenings	means solids such as fibres, plastic and other products or things, which need to be removed from the Sewage, prior to the treatment of Sewage at the Varanasi STP.
Second Breach	has the meaning ascribed to it in Clause 8.12(b)(iii)(B).
Second Breach Notice	has the meaning ascribed to it in Clause 8.12(b)(iii)(B).
Security	means and includes any Encumbrance, or any other agreement or arrangement having substantially the same economic effect.
Selected Bidder	means the Bidder selected by the Jal Nigam for award of the Project.
Sewage	means the sewage that is in liquid, solid or semi-solid form

and brought for treatment to the Facilities.

Site	means: (i) the STP Site; and (ii) the site for setting up the Associated Infrastructure.
Sq. ft.	means square feet.
STP	means a sewage treatment plant.
STP By-Products	means the by-products of the treatment process after the Sewage has passed through the Facilities and the Associated Infrastructure comprising the Digested Sludge, the Residual Grit and the Screenings.
STP Site	means the land admeasuring 6 (Six) Acres at the Site required by the Concessionaire to develop the Varanasi STP, based on the 'Land Requirement' as quoted by the Selected Bidder in the Financial Proposal.
Subcontract	means a contract entered into by the Concessionaire to subcontract any part of its scope of work in relation to the Project under this Agreement.
Subcontractor	means the Concessionaire's counterparty under any Subcontract.
Substitution Agreement	means the substitution agreement to be executed by the Jal Nigam, NMCG, the Concessionaire and the Lenders, in the format set out in Schedule 2.
Supporting Infrastructure	means the supporting infrastructure facilities required for the operation of the Facilities and the Associated Infrastructure, which will be provided, operated and maintained by the Jal Nigam during the Term.
Taxes	means all taxes, levies, imposts, cesses, duties and other forms of taxation, including (but without limitation) income tax, sales tax, goods and service tax, value added tax, service tax, octroi, entry tax, corporation profits tax, advance corporation tax, capital gains tax, residential and property tax, customs and other import and export duties, excise duties, stamp duty or capital duty, and any interest, surcharge, penalty or fine in connection therewith which may be payable by the Concessionaire or the Subcontractors and the term Tax shall be construed accordingly.
Technical Capacity	means the technical capacity and experience of the Member(s) determined in accordance with the RFP.

Technical Specifications	means the technical specifications for design, construction, rehabilitation, operation and maintenance of the Facilities and the Associated Infrastructure, as set out in Schedule 11.
Term	has the meaning ascribed to it in Clause 3.7.
Termination Compensation	means the compensation payable by NMCG upon termination of this Agreement, in accordance with Article 18.
Third Breach	has the meaning ascribed to it in Clause 8.12(b)(iii)(C).
Third Breach Notice	has the meaning ascribed to it in Clause 8.12(b)(iii)(C).
Threshold Limit	has the meaning ascribed to it in Clause 13.2(e)(i).
Total Casualty	means any fire or other casualty that results in physical damage to the Facilities to the extent that the total cost of repairing, replacing or restoring the damaged portion of the Facilities (as determined by the Project Engineer) to the same condition as existed previously would be more than 25% or more of the then total replacement cost of the Facilities.
Treated Effluent	means the water which is obtained after the treatment of the Sewage at the Varanasi STP.
Trial Operations	means the operation of the Facilities and the Associated Infrastructure on a trial basis for a period of 3 months from the Construction Completion Date or such longer period as may be determined in accordance with Clause 7.14.
Trial Operations Completion Certificate	means the certificate issued by the Jal Nigam to the Concessionaire upon successful completion of the Trial Operations.
Trial Operation Procedures	means the procedures for conducting the Trial Operations, as set out in the Technical Specifications.
Unscheduled Outage	means an interruption of or a reduction in the Availability of the Varanasi STP that is not the result of a Forced Unavailability.
UPWSS Act	means the Uttar Pradesh Water Supply and Sewerage Act, 1975, as may be amended from time to time.
Varanasi STP	means the STP of 50 MLD to be set up at the Site as part of the Project.
Variation	means any alteration in the Scope of Work, Technical Specifications or the Designs and Drawings, as instructed by the Jal Nigam or proposed by the Concessionaire, in

accordance with Article 20.

Variation Order	means an order issued by the Jal Nigam certifying its approval of a proposed Variation and recording the terms and condition on which the proposed Variation is required to be implemented.
Waste Disposal Site	means the site identified by the Jal Nigam for disposal of the STP By-Products and other waste material (including silt) from the Varanasi STP.
Website	means the web portal of the Jal Nigam available at the url: www.upjn.org .
Wilful Misconduct	means an intentional or reckless breach or disregard by a Party of any of its obligations under this Agreement.
WPI	means the Wholesale Price Index for all 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.

1.2 Rules of Interpretation

In this Agreement, unless the context otherwise requires:

- (a) Any reference to a statutory provision shall include such provision as modified or re-enacted or consolidated from time to time.
- (b) The words importing the singular shall mean the plural and vice-versa; and words importing the masculine shall include the feminine and neuter and vice-versa.
- (c) Headings in this Agreement are for convenience of reference only.
- (d) The references to the word 'include' or 'including' or to the phrase 'in particular', shall be construed without limitation.
- (e) References to any date or time of day are to Indian Standard Time; any reference to day shall mean a reference to a calendar day; any reference to a month shall mean a reference to a calendar month, any reference to a year shall mean a reference to a calendar year.
- (f) The references to any agreement, deed or other instrument shall be construed as a reference to such agreement, deed, or other instrument as may be amended, varied, supplemented or novated, from time to time.
- (g) Unless otherwise provided, any late payment charges to be calculated and payable

under this Agreement shall accrue *pro rata* on a monthly basis and from the respective due dates as provided for in this Agreement.

- (h) A requirement that a payment be made on a day which is not a business day shall be construed as a requirement that the payment be made on the next business day.
- (i) Whenever provision is made for the giving or issuing of any notice, endorsement, consent, approval, permission, certificate or determination by any Person, such notice, etc., shall be reasonably given, shall not be unreasonably withheld or delayed and shall be in writing and the words 'notify', 'endorse', 'approve', 'permit', 'certify' or 'determine' shall be construed accordingly. Where any notice, consent or approval is to be given by any Party, the notice, consent or approval shall be given on their behalf only by any authorized persons.
- (j) The words written and in writing include a facsimile transmission and any means of reproducing works in a tangible and permanently visible form.
- (k) The terms of the RFP 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. In the event of any discrepancy between this Agreement and the RFP, the provisions set out in this Agreement shall prevail.
- (l) The provisions of the Articles, Clauses and the Schedules of this Agreement shall be interpreted in such a manner that will ensure that there is no inconsistency in interpretation between the intent expressed in the Articles, Clauses and the Schedules.
- (m) In the event of any ambiguities or discrepancies within this Agreement, the following shall apply:
 - (i) between two Clauses of this Agreement, the provisions of the specific Clause relevant to the issue under consideration shall prevail over those in other Clauses;
 - (ii) between the requirements of two or more Schedules of this Agreement, the provisions of the specific Schedule relevant to the issue under consideration shall prevail over the more general; and
 - (iii) between the Clauses and the Schedules, unless specified otherwise, the Clauses shall prevail over the Schedules.
- (n) In the event of any discrepancy between various documents issued by or provided to the Jal Nigam as a part of the Bid Process, the following order of priority shall apply:
 - (i) this Concession Agreement;
 - (ii) the Schedules to the Concession Agreement;
 - (iii) the Financial Proposal submitted by the Selected Bidder;

- (iv) the LOA issued to the Selected Bidder;
 - (v) the written clarifications, if any, issued to the bidders; and
 - (vi) the RFP.
- (o) Subject to the provisions of this Agreement, the Concessionaire shall be responsible to and indemnify, the Jal Nigam and NMCG for the acts and omissions of the Concessionaire Related Parties as if they were the acts and omissions of the Concessionaire and the Jal Nigam and NMCG shall be responsible to and indemnify the Concessionaire for the acts and omissions of the Jal Nigam Related Parties and the NMCG Related Parties, respectively, as if they were the acts and omissions of the Jal Nigam or NMCG, as the case may be.
- (p) Neither the giving of any approval or consent, the review, knowledge or acknowledgement of the terms of any document by or on behalf of the Jal Nigam or NMCG, nor the failure to do so, shall, unless expressly stated in this Agreement, relieve the Concessionaire of any of its obligations under this Agreement or of any duty which it may have under this Agreement to ensure the correctness, accuracy or suitability of the matter or thing which is the subject of the approval, consent, review, knowledge or acknowledgement.
- (q) The rule of construction, if any, that an agreement should be interpreted against the Party responsible for the drafting and preparation thereof shall not apply to this Agreement.
- (r) The Parties acknowledge that damages for specific defaults prescribed under this Agreement (including the Delay Liquidated Damages, the Performance Liquidated Damages, the Availability Liquidated Damages and the Power Consumption Liquidated Damages) are a genuine pre-estimate of and reasonable compensation for the loss and damage that shall be suffered by the non-defaulting Party due to failure of the defaulting Party to perform its obligations in accordance with this Agreement, and are not in the nature of a penalty.

1.3 Units of Measurement

All measurements and calculations shall be in the metric system and calculations done to 4 decimal places, with the 5th digit of 5 or above being rounded up and below being rounded down.

2. SCOPE OF THE PROJECT AND GRANT OF THE CONCESSION

2.1 Scope of the Project

The scope of the Project shall be as set out in Schedule 1 and shall include:

- (a) designing, financing, constructing and completing the Facilities by the Scheduled Construction Completion Date, in accordance with Applicable Laws, Applicable Permits, Technical Specifications, Designs and Drawings, the Construction Plan, the

EHS Plan and Good Industry Practices;

- (b) designing, financing, rehabilitating, restoring, upgrading the Associated Infrastructure in accordance with Applicable Laws, Applicable Permits, Technical Specifications, Designs and Drawings, the Construction Plan, the EHS Plan and Good Industry Practices;
- (c) operating and maintaining the Facilities and the Associated Infrastructure in accordance with Applicable Laws, Applicable Permits, Technical Specifications, Designs and Drawings, the O&M Manual, EHS Plan and Good Industry Practices to ensure compliance with the KPIs; and
- (d) handback of the Facilities and the Associated Infrastructure upon expiry or early termination of this Agreement in accordance with the Hand-back Conditions and the Hand-back Requirements.

2.2 Grant of Concession

- (a) On and from the Effective Date and subject to the terms of this Agreement, Applicable Laws and Applicable Permits, the Jal Nigam grants to the Concessionaire the exclusive right to:
 - (i) design, finance, construct and complete the Facilities;
 - (ii) design, finance, rehabilitate and upgrade the Associated Infrastructure; and
 - (iii) upon completion of construction of the Facilities and the rehabilitation of the Associated Infrastructure, operate and maintain the Facilities and the Associated Infrastructure during the O&M Period.
- (b) The grant of the concession set out in Clause 2.2(a) shall oblige or entitle the Concessionaire, as the case may be, to the following:
 - (i) access to the Site from the Effective Date, for the sole purpose of implementing the Project;
 - (ii) apply for and obtain all the Concessionaire Applicable Permits and utilities required to undertake the Project;
 - (iii) raise funds (through both debt and equity financing) to finance 60% of the Bid Project Cost;
 - (iv) complete the construction of the Facilities and the rehabilitation of the Associated Infrastructure on or before the Scheduled Construction Completion Date;
 - (v) upon completion of construction of the Facilities and the rehabilitation of the Associated Infrastructure, undertake Trial Operations;

- (vi) upon successful completion of the Trial Operations, operate and maintain the Facilities and the Associated Infrastructure for 15 years;
- (vii) receive, treat and process Sewage up to the Design Capacity;
- (viii) store, treat, market, sell or dispose of the STP By-Products and the Treated Effluent subject to and in accordance with this Agreement;
- (ix) transfer the Facilities and the Associated Infrastructure to the Jal Nigam upon the expiry of the Term or termination of this Agreement, after rectification of any defects in the Facilities or the Associated Infrastructure, in accordance with the Hand-back Conditions and the Hand-back Requirements;
- (x) receive the Construction Payments during the Construction Period and the O&M Payments during the O&M Period, subject to compliance with the terms and performance of the obligations under this Agreement;
- (xi) appoint Subcontractors, agents, advisors and consultants and enter into Subcontracts to undertake the Project, with the prior approval of the Jal Nigam; and
- (xii) construct a Power Plant at the Site, at its sole option and discretion.

2.3 Description of the Facilities and Associated Infrastructure

- (a) The Facilities shall include the Varanasi STP, a 5.5 km pipeline to dispose the Treated Effluent at the Discharge Point (i.e., the Effluent Disposal Pipeline), the Online Monitoring System, the on-site testing laboratory facilities and all other such facilities necessary or associated with the Varanasi STP for treatment, processing and disposal of the Sewage, as described in greater detail in Schedule I (*Scope of Work*) and Schedule II (*Technical Specifications*).

The Associated Infrastructure shall include a 6.68 km rising main to convey the Sewage from the sewers to the Varanasi STP and the main pumping station to pump the Sewage into the Varanasi STP.

- (b) The Concessionaire shall operate the Facilities and the Associated Infrastructure and treat the Sewage in a manner such that the KPIs are achieved, and the Treated Effluent and Digested Sludge comply with the Discharge Standards.

- (c) The by-products of the Sewage treated at the Varanasi STP (i.e., STP By-Products) will be bifurcated into the Screenings, the Digested Sludge and the Residual Grit. The Concessionaire will be required to dispose the STP By-Products and silt as follows:

- (i) the Residual Grit, the Screenings and silt will be disposed at the Waste Disposal Site to be identified by the Jal Nigam within a radius of 10 km from the STP Site, in accordance with the Technical Specifications; and

- (ii) the Concessionaire shall dry the Digested Sludge at a sludge handling facility to be provided by the Concessionaire at the Site, and have the option to sell the Digested Sludge to farmers/other third party buyers or dispose the Digested Sludge at the Waste Disposal Site. Provided that if the Concessionaire sells the Digested Sludge to any third party, the Concessionaire shall be required to share 50% of the revenues from such sale with the Jal Nigam.
- (d) The Concessionaire shall transfer the Treated Effluent through the Effluent Disposal Pipeline to the Discharge Point, for discharge in to the river Ganga, sale to third parties or utilization for irrigation purposes. Provided that if the Concessionaire sells the Treated Effluent to any third party, the Concessionaire shall be required to share 50% of the revenues from such sale with the Jal Nigam.

2.4 Use of Proposed Technology

- (a) The Concessionaire shall design and develop the Varanasi STP on the basis of the Proposed Technology, approved by the Jal Nigam as part of the Designs and Drawings.
- (b) If the Selected Bidder is the owner of the Proposed Technology, then the Concessionaire shall enter into a technology license agreement with the Selected Bidder, under which the Selected Bidder will grant to the Concessionaire an irrevocable, perpetual, assignable, non-exclusive and royalty-free license to use the Proposed Technology to develop and operate the Facilities.
- (c) If the Selected Bidder does not own the Proposed Technology, then the Concessionaire shall, at its own cost, enter into a technology license agreement with the technology provider, under which the technology provider will grant to the Concessionaire an irrevocable, perpetual, assignable and royalty-free license to use the Proposed Technology. At no point will the Jal Nigam or NMCG be obliged to make any payments to the Concessionaire towards the licensing and use of the Proposed Technology.
- (d) Upon the expiry or early termination of this Agreement, the Concessionaire shall assign the license and related rights to use the Proposed Technology for the sole purpose of operating and maintaining the Varanasi STP to the Jal Nigam at no additional cost to the Jal Nigam.
- (e) The Concessionaire shall indemnify the Jal Nigam and NMCG for any claims, losses, damages and costs suffered by the Jal Nigam and/or NMCG as a result of an infringement of any third party's Intellectual Property Rights caused by the operation and use of the Varanasi STP.



3. CONDITIONS PRECEDENT, EFFECTIVENESS AND TERM

3.1 Effectiveness

- (a) The day on which all of the Conditions Precedent have been satisfied in accordance with this Article 3 shall be the Effective Date.
- (b) This Article 3 and Article 2 (*Scope of the Project and Grant of the Concession*), Article 5 (*Performance Security, O&M Security and Mobilization Advance Guarantee*), Article 6 (*Project Engineer*), Article 10 (*Financing Arrangements and Security*), Clause 11.1 (*Indemnity and Limitation of Liability*), Article 12 (*Change in Ownership*), Article 13 (*Change in Law*), Article 14 (*Force Majeure*), Article 21 (*Dispute Resolution*), Article 22 (*Representations and Warranties*) and Article 23 (*Miscellaneous*) and the related Schedules, shall come into full force and effect and be binding on the Parties on and from the Appointed Date and continue until such time as this Agreement expires or is terminated in accordance with its terms. The other provisions of this Agreement shall come into full force and effect and be binding on the Parties on and from the Effective Date and continue until such time as this Agreement expires or is terminated in accordance with its terms.

3.2 Conditions Precedent to be satisfied by the Concessionaire

The Concessionaire shall satisfy the following Conditions Precedent (if not already fulfilled on the Appointed Date):

- (a) submit the Phase I Designs and Drawings to the Jal Nigam for its approval in accordance with Clause 7.2;
- (b) prepare the Construction Plan within 30 days from the Appointed Date and submit the Construction Plan to the Jal Nigam for its approval in accordance with Clause 7.3;
- (c) prepare the EHS Plan within 45 days from the Appointed Date and submit the EHS Plan to the Jal Nigam for its approval in accordance with Clause 7.4;
- (d) obtain all Concessionaire Applicable Permits that are required for achieving Financial Close and for commencement of construction of the Facilities and rehabilitation of the Associated Infrastructure at its own cost and expense and if such Concessionaire Applicable Permits are subject to any conditions, then, to the extent relevant, comply with all such conditions, such that the Concessionaire Applicable Permits are and shall be kept in full force and effect for the entire Construction Period, or such longer period as may be required under Applicable Laws;
- (e) execute and provide a copy to the Jal Nigam of the technology license agreement executed with the Selected Bidder or the third party technology supplier for setting up the Varanasi STP;
- (f) submit to the Jal Nigam certified true copies of all resolutions adopted by the board

of directors of the Concessionaire authorising execution, delivery and performance of this Agreement, Substitution Agreement and the Escrow Agreement by the Concessionaire;

- (g) execute the Substitution Agreement with the Jal Nigam, NMCG and the Lenders in the agreed form set out at Schedule 2;
- (h) achieve Financial Close and submit a copy of the Financing Documents and the Financial Package to the Jal Nigam, duly certified by a director of the Concessionaire;
- (i) execute a shareholders' agreement amongst the shareholders of the Concessionaire, and deliver to the Jal Nigam a certified true copy of the shareholders' agreement (attested by a director of the Concessionaire);
- (j) execute the Escrow Agreement with the Jal Nigam, NMCG, and the Escrow Bank in the agreed form set out at Schedule 3;
- (k) submit to the Jal Nigam certified true copies of the constitutional documents of the Concessionaire;
- (l) submit to the Jal Nigam a legal opinion stating that: (i) this Agreement, the Substitution Agreement and the Escrow Agreement have been duly executed and are legally valid, binding and enforceable in accordance with their terms against the Concessionaire; and (ii) all actions, conditions and things required by Applicable Laws to be taken, fulfilled and done (including the obtaining of any necessary Concessionaire Applicable Permits and resolutions of the board of directors) in order for the Concessionaire to enter into and comply with its obligations under this Agreement, the Substitution Agreement and the Escrow Agreement have been taken, fulfilled or done;
- (m) if a Member has submitted unaudited annual accounts along with the Bid, the Concessionaire shall submit to the Jal Nigam, within 60 days of the Appointed Date: (i) a certified copy of such Member's duly audited balance sheet, annual report and profit and loss account for the latest Financial Year occurring prior to the Bid Due Date; and (ii) certificate(s) issued by the statutory auditor(s) stating that the Member continues to meet the Financial Capacity specified in the RFP; and
- (n) submit to the Jal Nigam a certificate, duly attested by a director, certifying the shareholding pattern of the Concessionaire.

3.3 Conditions Precedent to be satisfied by the Jal Nigam

The Jal Nigam shall satisfy the following Conditions Precedent (if not already fulfilled on the Appointed Date):

- (a) grant access to the Site and all necessary rights of way to the Concessionaire, free of Encumbrances and encroachments;



- (b) to the extent relevant, obtain any change in land use permission from the relevant Government Authority to enable the Concessionaire to undertake the Project at the Site;
- (c) hand over the Associated Infrastructure to the Concessionaire;
- (d) subject to Clause 3.2(a), review and approve the Phase I Designs and Drawings in accordance with Clause 7.2;
- (e) subject to Clause 3.2(b), review and approve the Construction Plan in accordance with Clause 7.3;
- (f) subject to Clause 3.2(c), review and approve the EHS Plan in accordance with Clause 7.4;
- (g) obtain all approvals and consents, including the Jal Nigam Applicable Permits and any approvals from the National Green Tribunal, required for Jal Nigam to enter into this Agreement and undertake the Project;
- (h) execute the Substitution Agreement with the Concessionaire, NMCG and the Lenders in the agreed form set out at Schedule 2; and
- (i) execute the Escrow Agreement with the Concessionaire, NMCG and the Escrow Bank in the agreed form set out at Schedule 3.

3.4 **Conditions Precedent to be satisfied by NMCG**

NMCG shall satisfy the following Conditions Precedent (if not already fulfilled on the Appointed Date):

- (a) obtain all approvals and consents that may be required for NMCG to enter into this Agreement and undertake the Project;
- (b) appoint the Project Engineer in accordance with Article 6;
- (c) execute the Substitution Agreement with the Concessionaire, the Jal Nigam and the Lenders in the agreed form set out at Schedule 2;
- (d) execute the Escrow Agreement with the Concessionaire, the Jal Nigam, and the Escrow Bank in the agreed form set out at Schedule 3 and open the Escrow Account with the Escrow Bank; and
- (e) fund the Escrow Account with an amount equivalent to the first 2 Payment Milestones.

3.5 **Satisfaction of Conditions Precedent**

- (a) Unless otherwise specified, each Party shall satisfy or procure the satisfaction of the Conditions Precedent that it is responsible for, within 120 days from the Appointed Date (the **CP Long-stop Date**).

- (b) If any Party fails to satisfy any Condition Precedent that it is required to fulfil by the CP Long-stop Date due to:
- (i) a Force Majeure Event;
 - (ii) a Qualifying Change in Law;
 - (iii) in case of the Concessionaire, undue delay by the relevant Government Authority in granting any Concessionaire Applicable Permit, despite the Concessionaire having applied for such Concessionaire Applicable Permit within the specified timelines, on payment of the prescribed fees and having complied with the requirements of Applicable Laws in making such application; or
 - (iv) delay by the other Parties in fulfilling any Condition Precedent required to be satisfied by them or in performing any other obligation under this Agreement, which impacts its ability to satisfy its Conditions Precedent,
- then the CP Long-stop Date shall be extended on a day-for-day basis for the period of such delay, provided that the CP Long-stop Date shall not be extended beyond the date which is 6 months from the Appointed Date.
- (c) Each Party shall cooperate and use its reasonable efforts to assist the other Parties in satisfying the Conditions Precedent.

3.6 Consequences of failure to satisfy Conditions Precedent

- (a) Subject to this Clause 3.6:
- (i) If the Concessionaire fails to satisfy any of the Conditions Precedent that it is required to fulfil by the CP Long-stop Date, as may be extended in accordance with Clause 3.5(b), any Party may terminate this Agreement forthwith by issuing a notice to the other Parties.
 - (ii) If either the Jal Nigam or NMCG fails to satisfy any of the Conditions Precedent that they are required to fulfil by the CP Long-stop Date, as may be extended in accordance with Clause 3.5(b), any Party may terminate this Agreement forthwith by issuing a notice to the other Parties.
 - (iii) No Party shall be permitted to waive any Condition Precedent required to be fulfilled by any other Party.
- (b) If the Concessionaire has failed to satisfy any of the Conditions Precedent required to be satisfied by it other than due to the reasons set out in Clause 3.5(b) and this Agreement is terminated in accordance with this Clause 3.6, then:
- (i) the Jal Nigam shall be entitled to forfeit the Performance Security up to INR 2,00,00,000 (Rupees two crores) as a genuine pre-estimate of and reasonable compensation for loss and damage caused to the Jal Nigam as

a result of the Concessionaire's failure to satisfy any of the Conditions Precedent and the consequent termination of this Agreement;

- (ii) the Concessionaire shall not be entitled to receive any payment or compensation from the Jal Nigam or NMCG for the costs and expenses incurred by the Concessionaire in performing any of its obligations under this Agreement (including preparing any Phase I Designs and Drawings, the Construction Plan and the EHS Plan) prior to the termination of this Agreement;
 - (iii) the Concessionaire shall hand over to the Jal Nigam all documents, designs, plans, data and any Confidential Information provided by the Jal Nigam or NMCG to the Concessionaire prior to termination of this Agreement;
 - (iv) the Jal Nigam shall hand over to the Concessionaire the Phase I Designs and Drawings, the Construction Plan, the EHS Plan and any other document and Confidential Information submitted by the Concessionaire to the Jal Nigam or NMCG prior to termination of this Agreement; and
 - (v) if the access to any part of the Site has been granted to the Concessionaire prior to termination of this Agreement, then upon termination of this Agreement, the Concessionaire shall clear the Site and remove all debris, hazardous materials, construction materials, equipment, temporary works, work sheds, labour camps and all other temporary installations on the Site, and thereafter, the Site will be deemed to automatically vest with the Jal Nigam, free from all Encumbrances.
- (c) If the Jal Nigam or NMCG has failed to satisfy any of the Conditions Precedent required to be satisfied by it or the Concessionaire has failed to satisfy any of the Conditions Precedent required to be satisfied by it due to the reasons set out in Clause 3.5(b), and this Agreement is terminated in accordance with this Clause 3.6, then:
- (i) the Jal Nigam shall return the Performance Security submitted by the Concessionaire;
 - (ii) the Concessionaire shall hand over to the Jal Nigam all documents, designs, plans, data and any Confidential Information provided by the Jal Nigam or NMCG to the Concessionaire prior to termination of this Agreement;
 - (iii) the Jal Nigam shall hand over to the Concessionaire the Phase I Designs and Drawings, the Construction Plan, the EHS Plan and any other document and Confidential Information submitted by the Concessionaire to the Jal Nigam or NMCG prior to termination of this Agreement; and
 - (iv) if the access to any part of the Site has been granted to the Concessionaire prior to termination of this Agreement, then upon termination of this Agreement, the Concessionaire shall clear the Site and remove all debris,

hazardous materials, surplus construction materials, equipment, temporary works, work sheds, labour camps and all other temporary installations on the Site, and thereafter, the Site will be deemed to automatically vest with the Jal Nigam, free from all Encumbrances.

- (d) Upon termination of this Agreement pursuant to this Clause 3.6, other than to the extent specified in this Clause 3.6, no Party shall have any liability to the other Parties in connection with this Agreement and the Concessionaire shall not be entitled to receive any termination compensation from NMCG or the Jal Nigam.

3.7 **Term**

Subject to early termination in accordance with Article 14 (*Force Majeure*) or Article 16 (*Events of Default*), this Agreement shall come into full force and effect on the Effective Date and remain in full force and effect until the expiry of the O&M Period (i.e., 15 years from the COD) (**Term**).

4. **SITE AND ASSET OWNERSHIP**

4.1 **Grant of License over the Site**

- (a) The Jal Nigam shall grant the Concessionaire a license over the Site, along with all necessary rights of way, to enter upon, access and occupy the Site free of all Encumbrances in accordance with this Clause 4.1, Applicable Laws, and Applicable Permits. The license granted to the Concessionaire shall include the exclusive right to:
- (i) design, construct and commission the Facilities and rehabilitate the Associated Infrastructure at the Site;
 - (ii) operate and maintain the Facilities and the Associated Infrastructure during the O&M Period;
 - (iii) install, operate, use, maintain, and remove such equipment, devices or other structures and improvements on, over, or under the Site, as may be necessary or appropriate for the operations and activities required or permitted under this Agreement;
 - (iv) use access roads, gates, fences and utilities at or about the Site;
 - (v) discharge, store, treat and manage the STP By-Products and the Treated Effluent produced by the Facilities; and
 - (vi) construct, use, operate, maintain, replace and repair electric lines, telecommunication lines, water supply networks and other utilities required to undertake the Project at the Site.
- (b) On and from the Effective Date and subject to the provisions of this Agreement, the Jal Nigam shall grant the Concessionaire: (i) a license over the Site including the exclusive right to occupy and use the Site; and (ii) all necessary rights of way,

to construct and rehabilitate the Facilities and the Associated Infrastructure. Any charges payable for obtaining the right of way will be paid directly by the Jal Nigam.

- (c) The Jal Nigam shall provide the Site to the Concessionaire free of Encumbrances and encroachments as a Condition Precedent. If the Concessionaire discovers any hazardous substances at the time of handover of the Site by the Jal Nigam, the Jal Nigam will remove such hazardous substances at its own cost and expense.
- (d) The Concessionaire shall not, without the prior written consent or approval of the Jal Nigam, use the Site for any purpose other than to undertake the Project and purposes incidental thereto, as permitted under this Agreement or as may be otherwise approved by the Jal Nigam.
- (e) The full ownership and title over the Site shall vest with the Jal Nigam for the entire Term.
- (f) The Jal Nigam warrants that the Concessionaire shall, subject to complying with the terms and conditions of this Agreement, occupy the Site from such time that access is granted to the Concessionaire and until the expiry of the Term. If the Concessionaire is obstructed by any Person claiming any right, title or interest in or over the Site or any part thereof or in the event of any enforcement action including any attachment, distraint, appointment of receiver or liquidator being initiated by any Person claiming to have a charge on the Site or any part thereof, the Jal Nigam shall, if called upon by the Concessionaire, defend such claims and proceedings.
- (g) Subject to any substitution rights exercised by the Lenders, the license granted by the Jal Nigam shall automatically terminate upon termination of this Agreement or expiry of the Term.

4.2 **Right, Title and Interest in the Facilities and Associated Infrastructure**

- (a) The full ownership, rights and title to the Facilities and Associated Infrastructure constructed, installed, rehabilitated or restored by the Concessionaire pursuant to this Agreement shall vest with the Jal Nigam during the entire Term and thereafter. The Concessionaire shall have the right to enter upon the Site, access and operate the Facilities and the Associated Infrastructure during the Term, to exercise its rights and fulfil its obligations under this Agreement.
- (b) Except as otherwise provided in this Agreement, the Concessionaire shall not:
 - (i) sell or otherwise dispose or create any Security over the Facilities or the Associated Infrastructure or any part thereof;
 - (ii) dispose any assets forming part of the Facilities or the Associated Infrastructure, other than for the purposes of replacement due to normal wear and tear; or
 - (iii) transfer, assign or novate all of its rights and obligations under this

Agreement,

without the prior written consent of the Jal Nigam (such consent not being unreasonably withheld or delayed).

4.3 Site Data and Verification

- (a) The Jal Nigam has made available to the Concessionaire, the layout plans, load flow studies and all other relevant data, studies and reports in the Jal Nigam's possession in connection with the Site, the Facilities and the Associated Infrastructure.
- (b) The Concessionaire shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the implementation of the Project at the Site.
- (c) The Concessionaire shall also be deemed to have inspected and examined the Site and its surroundings, analyzed and verified the accuracy and reliability of the studies, reports and data provided by the Jal Nigam and any other information available with respect to the Facilities, the Site and the Associated Infrastructure and to have satisfied itself as to all the relevant matters including:
 - (i) the nature of the Site, including the subsurface, hydrological, climatic and general physical conditions of the Site;
 - (ii) the suitability of the Site for undertaking the construction and operation of the Facilities and the Associated Infrastructure;
 - (iii) the condition of the utilities available till the battery limits of the Site;
 - (iv) the extent, nature and availability of labour, material, transport, accommodation, storage facilities and other facilities and resources necessary to undertake the Project;
 - (v) the nature of design, construction work and O&M services necessary for the performance of its obligations under this Agreement;
 - (vi) Applicable Laws and Applicable Permits required to be obtained and maintained to undertake the Project;
 - (vii) the risk of injury or damage to Adjoining Property and to the occupiers of such property or any other risk;
 - (viii) the suitability and adequacy of any access roads to the Site and other utilities and facilities to be provided by the relevant Government Authority; and
 - (ix) all other matters that may affect the performance of its obligations under this Agreement.

The Concessionaire acknowledges and agrees that if any error or discrepancy is subsequently discovered in the data made available by the Jal Nigam, then, such error or discrepancy shall not entitle the Concessionaire to any extension of the Scheduled Payment Milestone Completion Date, the Scheduled Construction Completion Date and/or compensation for additional costs incurred. Further, any misinterpretation of the data, studies and reports provided by the Jal Nigam shall not relieve the Concessionaire from the performance of its obligations under this Agreement on the ground that it could not reasonably be expected to have foreseen any of the matters listed in Clause 4.3(c) (i) to (ix) above, which affect or may affect the Project or the performance of any of its obligations under this Agreement.

4.4 Unforeseen Site Conditions

Without prejudice to Clause 4.3 above, if during the execution of the Project, the Concessionaire encounters any adverse physical conditions, which could not have been reasonably foreseen by acting in accordance with Good Industry Practices, the Concessionaire may seek a Variation in accordance with Clause 20.3. Upon receipt of a request for a Variation due to unforeseen Site conditions, if, in the opinion and sole discretion of the Jal Nigam, such conditions could not have been reasonably foreseen by a prudent developer acting in accordance with Good Industry Practices, then the Jal Nigam shall issue a Variation Order in accordance with Article 20. Any decision of the Jal Nigam regarding the existence of any unforeseen Site conditions shall be final and binding.

4.5 Site Related Covenants

The Concessionaire agrees and undertakes that:

- (a) the Concessionaire shall not transfer, alienate, assign, dispose of, sub-license or create any Security over any part of the Site or its rights and interest in the Site, other than as specifically permitted under this Agreement;
- (b) the Concessionaire shall not allow any encroachment on, or unauthorized occupation of any part of the Site and in the event of any encroachment or unauthorized occupation, the Concessionaire shall immediately cause such encroachment or any unauthorized occupants to be removed from the Site. The Concessionaire shall not be entitled to any extension of time or costs incurred in removal of any encroachment or any unauthorized occupants from the Site;
- (c) the grant of any rights to a Subcontractor or any other third party shall not interfere with or hinder the performance of the Concessionaire's obligations under this Agreement;
- (d) the Concessionaire shall be wholly responsible for safety at and security of the Site, the Facilities and the Associated Infrastructure;
- (e) the Concessionaire shall take all necessary measures to confine its operations, personnel and equipment to the Site and not encroach on any Adjoining Property;
- (f) all minerals, fossils, articles of value or antiquity, structures and other remains or things of geological or archaeological interest and other objects with historic,

antique or monetary value discovered at, on or under the Site shall be dealt with in accordance with Applicable Laws and the Concessionaire shall take all necessary precautions to prevent its or its Subcontractor's personnel from removing or damaging any such article or thing. Further, immediately upon the discovery of any such article or thing of value, the Concessionaire shall inform the Jal Nigam of such discovery and carry out the instructions of the Jal Nigam in this regard;

- (g) the Concessionaire shall make good any damage to any roads, footpaths, conduits, and other works on any Adjoining Property, which is caused by the Concessionaire or the Concessionaire Related Parties;
- (h) the Concessionaire shall use all reasonable endeavours not to do or permit to be done anything which might:
 - (i) cause destruction, scarring or defacing of natural surroundings in the vicinity of the Site;
 - (ii) be or become a danger or nuisance or give rise to liability in tort to any owners or occupiers of the Adjoining Property or to members of the public; or
 - (iii) cause any contamination or damage to any Adjoining Property,

and the Concessionaire shall, at its own expense, take all reasonable measures and precautions to avoid any such danger, nuisance, tort, damage or interference and shall make good any damage so caused.

If the construction and/or rehabilitation works and/or the O&M services cannot be carried out without interfering with the rights of the owner or occupier of any Adjacent Property, the Concessionaire shall promptly and at its own cost obtain all necessary third party consents and/or the approval of any Government Authority to undertake such construction/rehabilitation works and/or the O&M services. The Jal Nigam shall provide all assistance to the Concessionaire for procuring such approvals.

4.6 Access to Jal Nigam Related Parties, NMCG Related Parties and Government Authorities

The Concessionaire shall ensure that the Jal Nigam Related Parties, the NMCG Related Parties and the relevant Government Authorities have access to the Site and the license granted to the Concessionaire over the Site shall always be subject to:

- (a) the rights of the Jal Nigam, the Jal Nigam's Representative, NMCG's Representative, the Project Engineer, and other Jal Nigam Related Parties and NMCG Related Parties to enter upon and access the Site to inspect and monitor the progress of the Project, and for the exercise of their rights and the performance of their obligations under this Agreement, provided that the Jal Nigam and/or NMCG shall ensure that the exercise of the inspection or monitoring rights do not

impede or obstruct the construction and/or operation of the Facilities or the Associated Infrastructure in any manner whatsoever; and

- (b) the rights of the Government Authorities or other utility providers to enter upon and access the Site for laying or installing telegraph lines, electric lines or for any other public purpose.

If any physical damage is caused to the Site, the Facilities or the Associated Infrastructure as a result of such access and use of the Site by the Jal Nigam, the Project Engineer, the Jal Nigam Related Parties, the NMCG Related Parties, or Government Authorities then the Jal Nigam shall bear the costs of remedying such damage and restoring the Site and the Facilities and/or the Associated Infrastructure.

5. PERFORMANCE SECURITY, O&M SECURITY AND MOBILIZATION ADVANCE GUARANTEE

- 5.1 The Concessionaire shall have submitted to the Jal Nigam, prior to the Appointed Date, an unconditional and irrevocable bank guarantee for an amount equal to INR 10,20,00,000 / - (Rupees Ten Crores and Twenty Lakhs only), corresponding to 10% of the Bid Project Cost (the **Performance Security**).
- 5.2 The Performance Security shall remain valid until 25 months from the Effective Date or 1 month from the COD, whichever is later.
- 5.3 The Performance Security shall be returned within 30 days of the COD.
- 5.4 Within 60 days of the Construction Completion Date, the Concessionaire shall submit an unconditional and irrevocable bank guarantee to the Jal Nigam for an amount equal to INR 5,10,00,000 / - (Rupees Five Crores and Ten Lakhs Only), corresponding to 5% of the Bid Project Cost (the **O&M Security**).
- 5.5 The Concessionaire shall furnish the O&M Security in the same format as provided for the Performance Security in the RFP, with necessary modifications. The Concessionaire shall maintain the O&M Security in full force and effect until the expiry of the O&M Period. The O&M Security shall have an initial validity period of 1 year, which must be renewed on a year-on-year basis, before the expiry of the 11th month of the relevant year, until the expiry of the O&M Period.
- 5.6 The Performance Security shall secure the due performance of the Concessionaire's obligations during the Construction Period and the O&M Security shall secure the due performance of the Concessionaire's obligations during the O&M Period. The cost of procuring the Performance Security and the O&M Security shall be borne solely by the Concessionaire.
- 5.7 If the Performance Security is scheduled to expire before the COD, then the Concessionaire shall arrange for an extension of the Performance Security at least 30 days prior to such expiration. If the Concessionaire fails to procure such extension or replacement, the Jal Nigam shall be entitled to drawdown the total amount available under the Performance Security, and retain such amount as cash security until such time that the Concessionaire

submits an extension or replacement of the Performance Security.

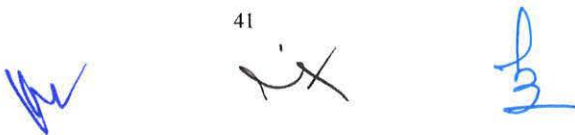
- 5.8 If the O&M Security is not renewed by the expiry of the 11th month of the relevant year of the O&M Period, then the Jal Nigam shall be entitled to drawdown the total amount available under the O&M Security, and retain such amount as cash security until such time that the Concessionaire submits an extension or replacement of the O&M Security.
- 5.9 The Jal Nigam shall be entitled to utilize such retained amount in the same manner as it would utilize the Performance Security or the O&M Security, as the case may be.

Upon receipt of a renewed or replacement Performance Security or within 30 days of the COD, the Jal Nigam shall return the unutilized cash security amount for the Performance Security to the Concessionaire.

Upon receipt of a renewed or replacement O&M Security or within 30 days of the expiry of the O&M Term, the Jal Nigam shall return the unutilized cash security amount for the O&M Security to the Concessionaire.

The interest earned on any retained amounts or cash security shall be the property of the Jal Nigam and the Jal Nigam shall not be required to account to the Concessionaire for any such interest.

- 5.10 The Jal Nigam shall have the right to draw on the Performance Security and claim up to the amount guaranteed upon the Concessionaire's failure to satisfy any Condition Precedent or honour any of its obligations, responsibilities or commitments during the Construction Period, or any amount due and payable by the Concessionaire to the Jal Nigam (including any Delay Liquidated Damages and Termination Compensation), in accordance with this Agreement.
- 5.11 The Jal Nigam shall have the right to draw on the O&M Security and claim up to the amount guaranteed upon the Concessionaire's failure to honour any of its obligations, responsibilities or commitments during the O&M Period, or any amount due and payable by the Concessionaire to the Jal Nigam (including any Availability Liquidated Damages, Performance Liquidated Damages, Termination Compensation and any amounts the Concessionaire is liable to pay under Clause 19.2), in accordance with this Agreement.
- 5.12 The Jal Nigam shall not be required to give any prior notice to the Concessionaire of its intention to make a demand under the Performance Security or the O&M Security, as the case may be. However, the Jal Nigam shall provide the Concessionaire with a copy of any demand notice issued by the Jal Nigam under the Performance Security or the O&M Security, simultaneously with the issuance of the demand notice to the Scheduled Bank that has issued the Performance Security or the O&M Security.
- 5.13 If the Jal Nigam makes a demand under the Performance Security or O&M Security, in part or in full, the Concessionaire shall immediately and in no event later than 15 days of such demand, restore the value of the Performance Security or O&M Security to the amount stated in Clause 5.1 or Clause 5.4.
- 5.14 Within 30 days from the COD or the termination of this Agreement, whichever is earlier, the Performance Security or, as the case may be, the amount retained by the Jal Nigam as cash



security under Clause 5.7, shall be released to the Concessionaire after the expiry of 30 days from the COD or termination of this Agreement, subject to the Jal Nigam's right to receive any amounts from the Concessionaire before or upon COD or termination of this Agreement.

5.15 Upon the expiry of the O&M Period or the termination of this Agreement, whichever is earlier, the O&M Security or, as the case may be, the amount retained by the Jal Nigam as cash security under Clause 5.8, shall be released to the Concessionaire after the expiry of 30 days from the date of expiry or termination of this Agreement, subject to the Jal Nigam's right to receive any amounts from the Concessionaire before or upon such expiry or termination of this Agreement.

5.16 Mobilization Advance Guarantee

- (a) Within 30 days of the Effective Date, the Concessionaire shall submit to the Jal Nigam an unconditional and irrevocable bank guarantee for an amount equal to the Mobilization Advance in the form set out at Schedule 4. The Mobilization Advance Guarantee shall secure the Mobilization Advance paid to the Concessionaire in accordance with Clause 9.3(d). The cost of procuring the Mobilization Advance Guarantee shall be borne solely by the Concessionaire.
- (b) The Mobilization Advance Guarantee shall remain valid until the entire Mobilization Advance secured by such Mobilization Advance Guarantee has been adjusted against the Construction Payments. However, the Concessionaire may, at its discretion, progressively reduce the value of the Mobilization Advance Guarantee by the amount of the Mobilization Advance adjusted against each of the 4 instalments of the Construction Payments, in accordance with Clause 9.3(d). For this purpose, the Concessionaire shall be required to furnish a replacement Mobilization Advance Guarantee of the reduced amount within 15 days of receipt of a Payment Certificate from the Jal Nigam on successful completion of the relevant Payment Milestone. The Jal Nigam shall return the relevant existing Mobilization Advance Guarantee upon receipt of a replacement Mobilization Advance Guarantee from the Concessionaire.
- (c) If the Mobilization Advance Guarantee is scheduled to expire before the entire Mobilization Advance has been adjusted, then the Concessionaire shall arrange for an extension of the Mobilization Advance Guarantee at least 30 days prior to such expiration. If the Concessionaire fails to procure such extension or replacement, the Jal Nigam shall be entitled to drawdown the total amount available under such Mobilization Advance Guarantee and retain such amount as cash security until such time that the Concessionaire submits an extension or replacement of the Mobilization Advance Guarantee.
- (d) The Jal Nigam shall be entitled to utilize such retained amount in the same manner as it would utilize the Mobilization Advance Guarantee. Upon receipt of an extension or replacement Mobilization Advance Guarantee or on adjustment of the entire Mobilization Advance, the Jal Nigam shall return the unutilized cash security amount to the Concessionaire.

The interest earned on any retained amounts or cash security shall be the property of the Jal Nigam and the Jal Nigam shall not be required to account to the

Concessionaire for any such interest.

- (e) The Jal Nigam shall have the right to draw on the Mobilization Advance Guarantee in the event of the inadequate adjustment of the Mobilization Advance in accordance with Clause 9.3(d), prior to the Construction Completion Date.
- (f) The Jal Nigam shall not be required to give any prior notice to the Concessionaire of its intention to make a demand under any Mobilization Advance Guarantee. However, the Jal Nigam shall provide the Concessionaire with a copy of any demand notice issued by the Jal Nigam under a Mobilization Advance Guarantee, simultaneously with the issuance of the demand notice to the Scheduled Bank that has issued the Mobilization Advance Guarantee.

6. PROJECT ENGINEER

- 6.1 NMCG shall appoint a third party engineering firm with requisite technical expertise, knowledge and experience in the design, engineering and construction of STPs as the engineer for the Project (the **Project Engineer**). The Project Engineer shall assist the Jal Nigam in supervising the construction, rehabilitation, operation and maintenance of the Facilities and the Associated Infrastructure and shall support the Jal Nigam to monitor compliance with the KPIs. The detailed scope of work of the Project Engineer is set out in Schedule 5.
- 6.2 All fees, costs, charges and expenses payable to the Project Engineer shall be borne by NMCG.
- 6.3 The Concessionaire may request NMCG to replace the Project Engineer if the Concessionaire believes that the Project Engineer is not performing its duties in accordance with this Agreement or is otherwise impeding the performance of the Concessionaire's obligations under this Agreement.

NMCG may replace the Project Engineer in any of the following circumstances:


- (a) if it has reason to believe or has received a formal complaint from the Concessionaire that the Project Engineer has not discharged its duties in accordance with this Article 6 or Schedule 5; or
 - (b) if the Project Engineer submits its resignation.
- 6.4 In appointing any replacement of the Project Engineer, NMCG shall comply with this Article 6 and Schedule 5.
 - 6.5 The Project Engineer shall be required to act independently, reasonably, fairly and expeditiously to ensure: (a) the timely completion of construction of the Facilities and restoration of the Associated Infrastructure on or before the Scheduled Construction Completion Date; and (b) compliance with the KPIs during the O&M Period.
 - 6.6 During the Construction Period, the Project Engineer shall inspect the Facilities and the Associated Infrastructure at least once a month and prepare an inspection report, setting out the progress of the construction of the Facilities and the rehabilitation of the Associated

Infrastructure, defects or deficiencies, if any, and status of compliance with the Construction Plan, Technical Specifications and Designs and Drawings. The Project Engineer shall send the report to the Jal Nigam and the Concessionaire within 7 days of such inspection, pursuant to which, the Concessionaire shall be required to rectify the defects or deficiencies, if any, identified by the Project Engineer.

- 6.7 During the O&M Period, the Project Engineer shall inspect the Facilities and the Associated Infrastructure at least once a month and prepare an inspection report, setting out the defects or deficiencies, if any, and status of compliance with the KPIs (including specifically, the Influent Standards and the Discharge Standards). The Project Engineer shall send the report to the Jal Nigam and the Concessionaire within 7 days of such inspection, pursuant to which, the Concessionaire shall be required to rectify the defects or deficiencies, if any, identified by the Project Engineer. The Project Engineer shall also have the right to verify the results of the tests undertaken by the Concessionaire at any time during the O&M Period at the Inlet Point and the Outlet Point to determine the standard of the Sewage, the STP By-Products and the Treated Effluent.
- 6.8 Except as specifically provided in this Agreement, the Project Engineer shall have no authority, whether express or implied, to amend, vary or curtail any of the rights or obligations of the Parties.
- 6.9 The Project Engineer shall at all times during the Term have the right to enter upon and access the Site. The Concessionaire shall have the right to accompany the Project Engineer during its inspection of the Facilities and the Associated Infrastructure.
- 6.10 The Project Engineer shall, at all times, have the right to attend any meetings held by the Concessionaire to review the progress of the construction or O&M of the Facilities and the Associated Infrastructure, and to provide its comments/suggestions regarding the progress as well as the manner in which the construction works or O&M services is being undertaken. Neither any comments/suggestions provided by the Project Engineer nor any failure to provide comments/suggestions shall be deemed to be an acceptance of the construction or rehabilitation works or the O&M services or a waiver of the Concessionaire's obligations to implement the Project, in accordance with this Agreement, the Technical Specifications, the Designs and Drawings, the EHS Plan, and all Applicable Laws and Applicable Permits.
- 6.11 The Concessionaire agrees that notwithstanding any review by the Project Engineer of any or all of the construction works or O&M services, the Concessionaire shall bear all risk, responsibility and liability for the quality, adequacy and suitability of the Facilities and the Associated Infrastructure.

7. CONSTRUCTION PERIOD

7.1 Commencement and Duration

 The period for construction of the Facilities and restoration of the Associated Infrastructure shall commence on and from the Effective Date, and shall continue until the Construction Completion Date (the **Construction Period**).

Notwithstanding anything to the contrary in this Agreement, the Concessionaire shall, prior to the Effective Date, be entitled to commence:

- (a) soil or geophysical investigation or testing at the Site; and
- (b) appointment of Subcontractors for the construction works for the Facilities and the Associated Infrastructure, with the prior approval of the Jal Nigam.



7.2 Designs and Drawings

- (a) Phase I Designs and Drawings
 - (i) The Concessionaire shall prepare the Basic Engineering Designs in accordance with the Technical Specifications, Applicable Laws and Applicable Permits. If the Concessionaire proposes to set up the Power Plant, the Concessionaire shall also submit the Basic Engineering Designs for the Power Plant. The Basic Engineering Designs shall be drawn to scale, with accurate dimensions, to minimize construction delays, disputes and cost overruns and to ensure smooth construction of the Facilities. The Facilities and the Associated Infrastructure should be designed in a manner such that the Concessionaire can obtain a consent to operate from the Uttar Pradesh Pollution Control Board for the operation of the Facilities and the Associated Infrastructure. The Basic Engineering Designs should also specify the Proposed Technology for the Varanasi STP.
 - (ii) Within 30 days from the Appointed Date, the Concessionaire shall submit 4 hard copies and 1 soft copy on a compact disc of the draft Basic Engineering Designs to the Jal Nigam for its review and approval.
 - (iii) The Jal Nigam shall forward the Basic Engineering Designs to the Project Engineer and the Indian Institute of Technology (IIT) for their review and comments.
 - (iv) The Jal Nigam shall provide comments if any, on the draft Basic Engineering Designs (including any comments from IIT and the Project Engineer) to the Concessionaire or notify the Concessionaire of its approval of the draft Basic Engineering Designs within 20 days from the date of receipt of the draft Basic Engineering Designs. The Jal Nigam may require the Concessionaire to amend or modify the draft Basic Engineering Designs if the Jal Nigam, IIT or the Project Engineer identifies any deficiencies, inaccuracies or shortcomings in the draft Basic Engineering Designs. If the Concessionaire receives any comments, suggestions or instructions to modify the draft Basic Engineering Designs from the Jal Nigam, then the Concessionaire shall modify the draft Basic Engineering Designs to correct any such shortcomings, inaccuracies or deficiencies and/or address, in writing, the Jal Nigam's/IIT's/the Project Engineer's comments on the draft Basic Engineering Designs and submit the revised Basic Engineering Designs to the Jal Nigam for its approval within 10 days of receipt of comments. The process set out in this Clause 7.2(a)(iv) shall continue until the Basic Engineering Designs are certified by IIT and are approved by the Jal Nigam in accordance with this Clause 7.2(a)(iv).

- (v) Within 30 days from the approval of the Basic Engineering Designs, the Concessionaire shall prepare the balance Phase I Designs and Drawings based on the approved Basic Engineering Designs and submit 4 hard copies and 1 soft copy on a compact disc of the balance Phase I Designs and Drawings to the Jal Nigam for its review and approval. The process set out in Clause 7.2(a)(iii) and Clause 7.2(a)(iv) will apply for approval of the balance Phase I Designs and Drawings.
- (b) Phase II Designs and Drawings
- (i) At least 2 months prior to the commencement of work for the second Payment Milestone, the Concessionaire shall submit 4 hard copies and 1 soft copy on a compact disc of the Phase II Designs and Drawings for the works corresponding to the second Payment Milestone. The process set out in Clause 7.2(a)(iii) and Clause 7.2(a)(iv) will apply for approval of the Phase II Designs and Drawings for the works corresponding to the second Payment Milestone.
- (ii) The process set out in Clause 7.2(a)(iii) above shall apply to the submission and approval of the Phase II Designs and Drawings for the work corresponding to the third Payment Milestone and the fourth Payment Milestone.
- (c) The Concessionaire shall construct the Facilities strictly in accordance with the approved Designs and Drawings. If there are any errors or deficiencies in the Technical Specifications, the Designs and Drawings shall take into account, address or rectify such errors or deficiencies. The Concessionaire shall not deviate from or make any subsequent modification or amendment to the approved Designs and Drawings without the prior written approval of the Jal Nigam. The Concessionaire shall not commence construction of any part of the Facilities prior to approval of the Designs and Drawings in accordance with this Clause 7.2. If the Concessionaire undertakes any construction work for the Facilities prior to the approval of the Designs and Drawings, it shall do so at its own risk and the Jal Nigam shall have the right to reject any such construction work that does not comply with the approved Designs and Drawings.
- (d) Notwithstanding any approval of the Designs and Drawings by the Jal Nigam, the Concessionaire shall bear all risk, responsibility and liability for the suitability, accuracy, adequacy and practicality of the Designs and Drawings. Subject to Clause 3.5 and Clause 7.11(b), the Concessionaire shall not be entitled to any extension of time and/or costs incurred in the preparation of the Designs and Drawings and complying with the requirements of this Clause 7.2.



7.3 **Construction Plan**

- (a) Within 30 days from the Appointed Date, the Concessionaire shall prepare and submit to the Jal Nigam a detailed Construction Plan. The Construction Plan shall set out:
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- (i) the detailed plan for completing the construction of the Facilities and rehabilitation of the Associated Infrastructure by the Scheduled Construction Completion Date;
 - (ii) specific activities and extent of construction and rehabilitation work to be performed by the Concessionaire to achieve each of the 4 Payment Milestones; and
 - (iii) the order in which the Concessionaire proposes to execute the construction of the Facilities and rehabilitation of the Associated Infrastructure.
- (b) The Jal Nigam shall review and provide comments, if any, on the draft Construction Plan to the Concessionaire or notify the Concessionaire of its approval of the draft Construction Plan within 30 days from the date of receipt of the draft Construction Plan from the Concessionaire. The Jal Nigam may require the Concessionaire to amend or modify the draft Construction Plan if the Jal Nigam identifies any deficiencies or shortcomings in the draft Construction Plan. If the Concessionaire receives any comments, suggestions or instructions to modify the draft Construction Plan from the Jal Nigam, then the Concessionaire shall incorporate the suggestions made by the Jal Nigam and modify the draft Construction Plan to address any such comments, shortcomings or deficiencies identified by the Jal Nigam. Thereafter, the Concessionaire shall submit the revised Construction Plan to the Jal Nigam for its approval. The process set out in this Clause 7.3(b) shall continue until the Construction Plan is approved by the Jal Nigam in accordance with this Clause 7.3(b).
- (c) The Concessionaire shall construct the Facilities and rehabilitate the Associated Infrastructure strictly in accordance with the approved Construction Plan. The Concessionaire shall not deviate from or make any subsequent modification or amendment to the approved Construction Plan without the prior written approval of the Jal Nigam. The Concessionaire shall not commence construction of any part of the Facilities or rehabilitation of any part of the Associated Infrastructure, prior to approval of the Construction Plan in accordance with this Clause 7.3.
- (d) Notwithstanding any approval of the Construction Plan by the Jal Nigam, the Concessionaire shall, subject to Clause 7.11(b), be solely liable for completing the construction of the Facilities and rehabilitation of the Associated Infrastructure, by the Scheduled Construction Completion Date.

7.4 **Environment, Health and Safety Plan**

- (a) Within 45 days from the Appointed Date, the Concessionaire shall prepare and submit 4 hard copies and 1 soft copy on a compact disc of a detailed EHS Plan to the Jal Nigam. The EHS Plan shall set out the health, safety and environment policies, guidelines and procedures to be followed by the Concessionaire in undertaking the Project and shall include a comprehensive Site safety assurance plan, developed in accordance with Applicable Laws, Applicable Permits, the Technical Standards, the EHS Standards (including specifically, the IFC Performance Standards) and Good Industry Practices.

- (b) The Jal Nigam shall forward a copy of the draft EHS Plan to the Project Engineer for its review and comments.
- (c) The Jal Nigam shall provide comments, if any, on the draft EHS Plan (including any comments from the Project Engineer) to the Concessionaire or notify the Concessionaire of its approval of the draft EHS Plan within 30 days from the date of receipt of the draft EHS Plan from the Concessionaire. The Jal Nigam may require the Concessionaire to amend or modify the draft EHS Plan if the Jal Nigam identifies any deficiencies or shortcomings in the draft EHS Plan. If the Concessionaire receives any comments, suggestions or instructions to modify the draft EHS Plan from the Jal Nigam, then the Concessionaire shall modify the draft EHS Plan to address any such comments, shortcomings or deficiencies identified by the Jal Nigam. Thereafter, the Concessionaire shall submit the revised EHS Plan to the Jal Nigam for its approval. The process set out in this Clause 7.4(c) shall continue until the EHS Plan is approved by the Jal Nigam in accordance with this Clause 7.4(c).
- (d) The Concessionaire shall and shall ensure that its Subcontractors comply with and conform in all aspects to the EHS Plan, approved in accordance with this Clause 7.4, in executing the Project. Any failure of the Concessionaire or the Subcontractors to comply with the EHS Plan shall constitute a Concessionaire Event of Default. The Concessionaire shall indemnify the Jal Nigam and NMCG against all costs, expenses, penalties and liabilities incurred/suffered by the Jal Nigam and NMCG due to the Concessionaire's or any Subcontractor's failure to comply with the EHS Plan in the course of execution of the Project. The Concessionaire shall not deviate from or make any subsequent modification or amendment to the approved EHS Plan without the prior written approval of the Jal Nigam.
- (e) Neither any approval of the EHS Plan by the Jal Nigam, nor any failure to review and provide comments on the EHS Plan shall excuse any failure by the Concessionaire to adopt proper and recognized safety and environment friendly practices during the execution of the Project. The Concessionaire shall bear all risk, responsibility and liability for the accuracy and adequacy of the final EHS Plan in ensuring compliance with all Applicable Laws, Applicable Permits and Good Industry Practices in the execution of the Project. The Concessionaire shall not be entitled to any extension of time and/or costs incurred in preparation of the EHS Plan and complying with the requirements of this Clause 7.4.

7.5 **Subcontracting**

- (a) The Concessionaire may enter into Subcontracts to perform any part of its scope of work during the Construction Period, with the prior written consent of the Jal Nigam.
- (b) The Concessionaire shall provide a copy of each proposed Subcontract along with details of the relevant Subcontractor, to the Jal Nigam for its approval, which should set out the precise scope of work to be subcontracted to such Subcontractor and should be consistent with the terms of this Agreement.

- (c) Within 15 days of receipt of a draft Subcontract under Clause 7.5(b) above, the Jal Nigam shall notify the Concessionaire of its approval or rejection (along with reasons) of the Subcontractor.
- (d) The approval of any Subcontractor and the corresponding Subcontract by the Jal Nigam shall be subject to the following conditions:
- (i) the Subcontractor appointed by the Concessionaire possesses the requisite skill, expertise and capability to perform the relevant obligations of the Concessionaire during the Construction Period;
 - (ii) the Subcontract is on terms consistent with this Agreement;
 - (iii) the Subcontract contains provisions that provide, at the Jal Nigam's option, for the subcontract to be novated or assigned to the Jal Nigam or its nominee without any further consent or the approval from the Concessionaire or the Subcontractor or entitle the Jal Nigam or its nominee to step into such Subcontract, in substitution of the Concessionaire, if this Agreement is terminated due to a Concessionaire Event of Default. However, the step-in rights of the Jal Nigam shall always be subject to the substitution rights of the Lenders under this Agreement or the Substitution Agreement; and
 - (iv) the Concessionaire shall be responsible for the supervision and monitoring of the performance of any work or services by the Subcontractor.
- (e) If the Jal Nigam does not notify its approval or rejection of any Subcontract to the Concessionaire within 15 days of the receipt of the draft Subcontract, then such Subcontract will be deemed to be approved by the Jal Nigam.
- (f) Within 7 days of the execution of an amendment to any approved Subcontract, the Concessionaire shall submit a copy of such amendment to the Jal Nigam for its records.
- (g) If the Concessionaire proposes to novate an approved Subcontract and/or replace an approved Subcontractor, then such novation or replacement shall be with prior approval of the Jal Nigam and the process set out in this Clause 7.5 shall apply in such case.
- (h) Notwithstanding the approval of any Subcontractor by the Jal Nigam, the Concessionaire shall be and remain liable under this Agreement for all work and services subcontracted under this Agreement and for all acts, omissions or defaults of any Subcontractor. No default under any Subcontract shall excuse the Concessionaire from its obligations or liabilities under this Agreement. All references in this Agreement to any act, default, omission, breach or negligence of the Concessionaire shall be construed to include any such act, default, omission, breach or negligence of the Subcontractors.



7.6 Concessionaire's Construction Obligations

The Concessionaire shall design, finance, construct and complete the Facilities, rehabilitate the Associated Infrastructure and achieve the COD in accordance with Applicable Laws, Applicable Permits, Good Industry Practice, the Technical Specifications, the EHS Plan, the Designs and Drawings, the Construction Plan and other provisions of this Agreement.

For this purpose, during the Construction Period, the Concessionaire shall:

- (a) complete the work corresponding to each Payment Milestone by the Scheduled Payment Milestone Completion Date and complete the construction of the Facilities and rehabilitation of the Associated Infrastructure by the Scheduled Construction Completion Date, in a manner that:
 - (i) is in compliance with the Technical Specifications, the Designs and Drawings, the Construction Plan, the EHS Plan, Applicable Laws, Applicable Permits and Good Industry Practices. For the avoidance of doubt, if there arises any ambiguity or conflict between the Technical Specifications and any Applicable Laws, then the one setting out the more stringent requirements or specifications shall prevail;
 - (ii) the Facilities and Associated Infrastructure are fabricated, erected, installed and completed in accordance with the final Designs and Drawings;
 - (iii) the Facilities and the Associated Infrastructure are free from all defects in design, materials, and workmanship;
 - (iv) the Facilities and Associated Infrastructure are safe, reliable and fit for purpose; and
 - (v) the Varanasi STP shall be capable of treating Sewage up to the Design Capacity.
- (b) maintain and comply with the conditions of all Applicable Permits in undertaking the construction and rehabilitation of the Facilities and the Associated Infrastructure, and make reasonable endeavours to assist the Jal Nigam in obtaining the Applicable Permits from the relevant Government Authorities;
- (c) within 30 days of the Effective Date, and in any event, prior to the commencement of any construction of the Facilities or rehabilitation of the Associated Infrastructure, appoint a Person with sufficient skill and expertise to act as the Concessionaire's Representative. The Concessionaire's Representative shall monitor, coordinate and supervise the completion of the Facilities and the Associated Infrastructure, and liaise with the Jal Nigam's Representative, NMCG's Representative and the Project Engineer during the Construction Period and the O&M Period. At any time during the Term, the Concessionaire may replace the Concessionaire's Representative with prior written notice to the Jal Nigam and NMCG;

- (d) provide all necessary assistance to the Project Engineer and the Jal Nigam in undertaking inspection of the Facilities and the Associated Infrastructure, and in performing its other obligations and duties under this Agreement;
- (e) reasonably consider and act upon the comments/suggestions made by the Project Engineer and the Jal Nigam during any meetings with the Concessionaire;
- (f) rectify any defects and/or deficiencies in the Facilities and the Associated Infrastructure, including any defects and/or deficiencies identified by the Project Engineer or the Jal Nigam;
- (g) take all necessary measures to maintain the safety and security of personnel, material and property at the Site and the Adjoining Properties, in accordance with the approved EHS Plan and all Applicable Laws;
- (h) ensure that all excavated materials, earthworks, waste materials and hazardous substances are stored and/or disposed in accordance with the EHS Plan, Applicable Laws and Applicable Permits;
- (i) submit monthly reports to the Project Engineer (with a copy to the Jal Nigam), no later than 10 days after the end of each month, which should set out the following:
 - (i) extent of progress of construction activities performed by the Concessionaire for the Facilities;
 - (ii) extent of progress of the rehabilitation and/or upgradation activities performed by the Concessionaire for the Associated Infrastructure;
 - (iii) comparison of actual progress against the planned progress of construction works, reasons for delay, if any and steps taken by the Concessionaire to mitigate the delay;
 - (iv) details of any accident or hazardous incident at the Site and the steps taken by the Concessionaire to mitigate the consequences of such accident or hazardous incident; and
 - (v) status of rectification of defects and/or deficiencies discovered by the Project Engineer or the Jal Nigam;
- (j) ensure that an adequate number of suitably skilled and experienced contractors, architects, workmen and other personnel are engaged to undertake the Project. The Concessionaire shall be solely responsible for the work performed by any staff and labour engaged by it to execute the Project and for payment of all applicable labour charges, fees, cess payable under Applicable Laws (including labour welfare legislations) in connection with the skilled and unskilled manpower employed for the Project, including specifically the Building and Other Construction Workers Welfare Cess Act, 1996. The Concessionaire shall and shall ensure that its Subcontractors provide all necessary amenities and welfare facilities for the staff and labour engaged by them at the Site and comply with all

applicable labour laws. The Concessionaire shall indemnify and hold harmless the Jal Nigam and NMCG from and against all claims, liabilities, expenses, costs and losses suffered or incurred by the Jal Nigam or NMCG due to the Concessionaire's or any Subcontractor's failure to comply with any Applicable Laws (including labour welfare legislations);

- (k) arrange for all equipment, machinery, tools and other resources required to undertake the Project and be solely responsible for such equipment, machinery, tools and resources. The Jal Nigam may provide the Concessionaire an indicative list of vendors for procurement of equipment for the Facilities and the Associated Infrastructure, and the Concessionaire may, at its discretion, procure equipment from such vendors;
- (l) take all reasonable measures to ensure that the transportation of any of the Concessionaire's or the Subcontractors' personnel or equipment, to or from the Site, does not interfere with local traffic in the vicinity of the Site;
- (m) maintain accurate and systematic accounts and records of goods and material utilized and other costs and expenses incurred in connection with the construction and restoration works for the Facilities and the Associated Infrastructure, including all invoices, receipts, challans, vouchers, quotations and other records and documents with respect to the Facilities and the Associated Infrastructure in accordance with Applicable Laws;
- (n) obtain and maintain adequate insurances as per this Agreement; and
- (o) prepare and keep up-to-date, "as-built" records of the execution of the construction and restoration work for the Facilities and the Associated Infrastructure, showing the exact as-built locations, sizes and details of the works executed. The "as-built" records shall be kept on the Site and be made available to the Project Engineer and the Jal Nigam for review and verification. The Concessionaire shall provide 4 hard copies and 1 soft copy on a compact disc of the complete set of "as-built" drawings for the Facilities and the Associated Infrastructure to the Jal Nigam as a condition precedent to the issuance of the Construction Completion Certificate.

7.7 Power Plant

- (a) The Concessionaire may, at its sole option and discretion, construct a Power Plant at the Site to produce clean energy to operate the Facilities and the Associated Infrastructure. The Concessionaire shall utilise the energy produced by the Power Plant to operate the Facilities and sell any excess energy to third party consumers during the Term, in accordance with all Applicable Laws.
- (b) If the Concessionaire chooses to construct a Power Plant at the Site, then it shall undertake such construction in accordance with all Applicable Laws and after obtaining all necessary approvals and consents to construct the Power Plant at the Site.
- (c) The Concessionaire shall not be entitled to any additional land, Construction

Payments, or an extension of the Scheduled Construction Completion Date for construction of the Power Plant.

- (d) The Concessionaire shall not be entitled to any additional O&M Payments for operating the Power Plant.
- (e) In case the Concessionaire sets up a biogas Power Plant, the Jal Nigam and NMCG shall not be liable to the Concessionaire in any manner whatsoever if the quality or quantity of Sewage delivered to the Varanasi STP is not adequate or appropriate to produce sufficient biogas to operate the Power Plant.
- (f) The ownership, rights and title to the Power Plant constructed by the Concessionaire shall vest with the Jal Nigam during the entire Term and thereafter.

7.8 **Jal Nigam's rights and obligations**

During the Construction Period, the Jal Nigam shall:

- (a) comply with all its obligations under Applicable Laws (including, specifically the UPWSS Act) and the Jal Nigam Applicable Permits;
- (b) make reasonable endeavours to assist the Concessionaire in obtaining the Applicable Permits from the relevant Government Authorities, provided that the Concessionaire has complied with all the requirements as per Applicable Laws for applying for such Applicable Permits;
- (c) maintain the Supporting Infrastructure to enable the delivery of Sewage at the main pumping station and disposal of the Treated Effluent from the Discharge Point during the Trial Operations;
- (d) within 30 days of the Effective Date, and in any event, prior to the commencement of any construction for the Facilities or rehabilitation of the Associated Infrastructure, appoint a Person with sufficient skill and expertise to act as the Jal Nigam's Representative. The Jal Nigam's Representative shall liaise with the Concessionaire's Representative, NMCG's Representative and the Project Engineer during the Construction Period and the O&M Period. At any time during the Term, the Jal Nigam may replace the Jal Nigam's Representative with prior written notice to the Concessionaire and NMCG;
- (e) cause the Project Engineer to carry out timely inspection of the Facilities and the Associated Infrastructure, and perform its other obligations and duties under this Agreement;
- (f) upon progressive completion of construction and rehabilitation works for the Facilities and the Associated Infrastructure in accordance with the Technical Specifications, Designs and Drawings, Construction Plan and other provisions of this Agreement, as certified by the Project Engineer, issue the Milestone Completion Certificates and the Construction Completion Certificate to the Concessionaire; and



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- (g) ensure that the Concessionaire enjoys peaceful access to the Site and shall not assign, transfer, or otherwise dispose its rights, title, and interest in the Site or create any Encumbrance over any part of the Site, which may adversely impact the exercise of the Concessionaire's rights and duties under this Agreement.

7.9 NMCG's rights and obligations

During the Construction Period, NMCG shall:

- (a) comply with all its obligations under the Applicable Laws (including specifically, the Ganga 2016 Order);
- (b) make the Construction Payments, on satisfactory completion of the relevant Payment Milestone, in accordance with Clause 9.3;
- (c) within 30 days of the Effective Date, and in any event, prior to the commencement of any construction for the Facilities or rehabilitation of the Associated Infrastructure, appoint a Person with sufficient skill and expertise to act as the NMCG's Representative. NMCG's Representative shall liaise with the Concessionaire's Representative, the Jal Nigam's Representative and the Project Engineer during the Construction Period and the O&M Period. At any time during the Term, NMCG may replace the NMCG Representative with prior written notice to the Jal Nigam and the Concessionaire; and
- (d) ensure that the Escrow Account is funded with the Minimum Escrow Balance.

7.10 Utilities

- (a) The Concessionaire shall obtain, install and maintain at its cost, all utilities necessary for undertaking the construction of the Facilities and rehabilitation of the Associated Infrastructure, including all temporary power and water connections, lighting facilities, telephone connections, internet connections, etc. at the Site.
- (b) The Concessionaire shall not be entitled to any extension of time or costs to comply with its obligations in Clause 7.10 (a) above.
- (c) The Jal Nigam shall provide any reasonable assistance required by the Concessionaire to obtain the utilities for the construction and rehabilitation of the Facilities and the Associated Infrastructure.

7.11 Construction Timelines

- (a) The Concessionaire shall comply with the Construction Plan, the Designs and Drawings and the Technical Specifications and complete the construction of the Facilities and the rehabilitation of the Associated Infrastructure on or before the Scheduled Construction Completion Date.



- (b) Subject to Clause 7.11(c) below, the Concessionaire shall be entitled to a day-for-day extension of the relevant Scheduled Payment Milestone Completion Date or as the case may be, the Scheduled Construction Completion Date, if the completion of construction of the Facilities or rehabilitation of the Associated Infrastructure is delayed due to any of the following reasons (each such event, a **Delay Event**):
- (i) occurrence of a Force Majeure Event, provided that the requirements of Article 14 have been complied with;
 - (ii) a Qualifying Change in Law;
 - (iii) undue delay by the relevant Government Authority in granting or renewing any Applicable Permit, despite the Concessionaire having applied for such grant or renewal expeditiously and having complied with the requirements of Applicable Laws in making such application;
 - (iv) undue delay by the relevant Government Authority in providing any utility connection, despite the Concessionaire having applied for such utility connection expeditiously and having complied with the requirements of Applicable Laws in making such application;
 - (v) any delay attributable to unforeseen site conditions in accordance with Clause 4.4;
 - (vi) delay by the Jal Nigam in approval of the Phase II Designs and Drawings in accordance with Clause 7.2;
 - (vii) delay by the Jal Nigam in approval of the O&M Manual in accordance with Clause 8.2;
 - (viii) delay by the Jal Nigam in issuance of a Milestone Completion Certificate in accordance with Clause 7.13(a);
 - (ix) any variation proposed by the Jal Nigam in the Technical Specifications or the Designs and Drawings in accordance with Article 20; or
 - (x) delay caused in complying with any instructions of the Jal Nigam or the Project Engineer, which instructions are not attributable to any default of the Concessionaire.

The Concessionaire shall promptly provide the Jal Nigam (with a copy to the Project Engineer and NMCG) with a notice upon becoming aware of any Delay Event listed at Clause 7.11(b) above. The notice should specify the nature of the Delay Event, the extent of delay suffered or likely to be suffered by the Concessionaire and mitigation measures being taken by the Concessionaire.

The issuance of the notice under this Clause 7.11(b), within 7 days from the date the Concessionaire became aware of the Delay Event, shall be a condition precedent to the Concessionaire's entitlement to an extension under Clause

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7.11(b).

- (c) Without prejudice to the Concessionaire's obligations to notify the Jal Nigam regarding the occurrence of a Delay Event above, the Concessionaire shall: (i) keep and maintain records as reasonably necessary to substantiate and establish claims for extensions under Clause 7.11(b); and (ii) give the Jal Nigam and the Project Engineer access to such records and documents or provide the Jal Nigam and the Project Engineer with copies, if so requested.
- (d) If the Concessionaire claims an extension of time in accordance with Clause 7.11(b) and the Jal Nigam is of the opinion that such delay was caused or materially contributed to by any concurrent or interacting cause or causes of delay not listed in Clause 7.11(b), then the Concessionaire shall not be entitled to any extension of time for the concurrent period of delay.
- (e) If two or more of the Delay Events listed in Clause 7.11(b) occur concurrently, then such concurrent period shall not be counted twice in determining an extension under Clause 7.11(b).
- (f) Except as provided in Clause 7.11(b), the Concessionaire shall not be entitled to any extension of time for any reason whatsoever, including due to:
 - (i) delay caused in complying with any instructions of the Jal Nigam or the Project Engineer which are attributable to any act or omission of the Concessionaire;
 - (ii) failure of any Subcontractor to commence or carry out any work within the prescribed timelines;
 - (iii) unavailability or shortage of equipment, materials, or any other resources;
 - (iv) any delay in approving the drafts of the Designs and Drawings, the Construction Plan, the EHS Plan or any other document submitted by the Concessionaire due to any deficiencies or shortcomings in such drafts of the Designs and Drawings, the Construction Plan, the EHS Plan or other documents, as the case may be; or
 - (v) the Concessionaire's decision to construct the Power Plant at the Site.
- (g) Any Dispute between the Parties with respect to the occurrence, length of subsistence or consequence of any of the Delay Event shall be settled in a final and binding manner in accordance with Article 21 (*Dispute Resolution*).

 7.12 **Delay Liquidated Damages and Bonus**

- (a) Subject to Clause 7.11(b), if the Concessionaire fails to complete the work corresponding to any Payment Milestone by the Scheduled Payment Milestone Completion Date or fails to complete the construction of the Facilities and rehabilitation of the Associated Infrastructure by the Scheduled Construction Completion Date, then the Jal Nigam shall be entitled to liquidated damages for

each day of delay beyond the Scheduled Payment Milestone Completion Date, or, as the case may be, the Scheduled Construction Completion Date, at the rate of 0.1% of the Performance Security for each day of delay up to 6 months from the relevant Scheduled Payment Milestone Completion Date, or, as the case may be, the Scheduled Construction Completion Date (collectively, the **Delay Liquidated Damages**).

The Delay Liquidated Damages will be payable until the work for the relevant Payment Milestone is completed or, as the case may be, the construction of the Facilities and rehabilitation of the Associated Infrastructure is completed, as certified by the Jal Nigam in accordance with Clause 7.13.

If the Concessionaire completes the construction and rehabilitation of the Facilities and the Associated Infrastructure by the Scheduled Construction Completion Date, the aggregate Delay Liquidated Damages recovered by the Jal Nigam under this Clause 7.12(a) for a delay in achieving any Payment Milestone shall be refunded by the Jal Nigam to the Concessionaire, without any interest.

- (b) The Jal Nigam shall be entitled to deduct the Delay Liquidated Damages from the amount payable to the Concessionaire for any Payment Milestone, and if such amounts are insufficient, the Jal Nigam shall have a right to invoke the Performance Security to the extent of the Delay Liquidated Damages.
- (c) The Parties acknowledge that the Delay Liquidated Damages are a genuine pre-estimation of and reasonable compensation for the loss that shall be suffered by the Jal Nigam as a result of the delay in the completion of the Facilities and rehabilitation of the Associated Infrastructure, and not as penalty.
- (d) If, for any reason, the above paragraphs relating to the payment of Delay Liquidated Damages are void, invalid or otherwise inoperative so as to disentitle the Jal Nigam from claiming any Delay Liquidated Damages, then the Jal Nigam will be entitled to claim against the Concessionaire for general damages for delay in completing the works for the relevant Payment Milestone by the Scheduled Payment Milestone Completion Date, or for the delay in completing the construction of the Facilities and rehabilitation of the Associated Infrastructure by the Scheduled Construction Completion Date.
- (e) If the Concessionaire fails to complete the works for a Payment Milestone within 6 months of the Scheduled Payment Milestone Completion Date or if the Concessionaire fails to complete the construction of the Facilities and rehabilitation of the Associated Infrastructure within 6 months from the Scheduled Construction Completion Date, other than on account of any Delay Event (**Grace Period**), then such failure shall be deemed to be a Concessionaire Event of Default in accordance with Clause 16.1.
- (f) The payment or deduction of Delay Liquidated Damages shall not relieve the Concessionaire from its obligations to complete the construction of the Facilities and the restoration of the Associated Infrastructure, or from any of its other duties, obligations or responsibilities under the Agreement. The Concessionaire shall use

and continue to use its best endeavours to avoid or reduce further delay in completing the Facilities and rehabilitating the Associated infrastructure.

(g) Bonus on early completion

If the Construction Completion Date occurs prior to the Scheduled Construction Completion Date, the Concessionaire shall be entitled to a bonus equal to 0.05% of the Performance Security for each day by which the Construction Completion Date precedes the Scheduled Construction Completion Date.

7.13 **Completion of Construction**

(a) Completion of Payment Milestones

(i) Upon completion of the works corresponding to each Payment Milestone, as specified in the Construction Plan, the Concessionaire shall issue a notice to the Jal Nigam, with a copy to the Project Engineer and NMCG, requiring the Jal Nigam to inspect (or cause the Project Engineer to inspect) the completed works covered by the relevant Payment Milestone. The purpose of such inspection shall be to determine whether the works corresponding to the relevant Payment Milestone have been completed in accordance with the requirements of Clause 7.6.

(ii) If the Jal Nigam is satisfied that the works for the relevant Payment Milestone have been completed in accordance with the requirements of Clause 7.6, the Jal Nigam shall issue a Milestone Completion Certificate to the Concessionaire for such completed Payment Milestone, with a copy to NMCG within 7 days from the date of inspection of the works covered by such Payment Milestone.

(iii) If the Jal Nigam is of the view that the works for the relevant Payment Milestone do not satisfy the requirements of Clause 7.6, then the Jal Nigam shall have the right to provide any comments, suggestions and/or instruct the Concessionaire to carry out necessary modifications, to ensure that the works comply with the requirements of Clause 7.6. Upon receipt of such comments, suggestions or instructions from the Jal Nigam, the Concessionaire shall make necessary modifications to the works to remedy any defects or deficiencies and re-issue a notice to the Jal Nigam. The Concessionaire shall bear all costs of remedying the defects and deficiencies in the works and shall not be entitled to any extension of time for remedying such defects or deficiencies. This process shall be repeated until the Jal Nigam is satisfied that the works for the relevant Payment Milestone have been completed in accordance with the requirements of Clause 7.6 and issues a Milestone Completion Certificate in accordance with this Clause 7.13(a).

(iv) If the Jal Nigam fails to:

(A) inspect the completed portion of the works covered by the relevant Payment Milestone, within 7 days from the date of

receipt of a notice from the Concessionaire under Clause 7.13(a)(i) above;

- (B) provide any comments or suggestions or notify the Concessionaire of any defects or deficiencies in the completed portion of the works covered by the relevant Payment Milestone, within 7 days from the date of inspection of such completed portion of the works; or
- (C) issue the Milestone Completion Certificate, within 7 days from the date of inspection of the completed portion of the works covered by the relevant Payment Milestone,

then, such delay shall be treated as a Delay Event, which will entitle the Concessionaire to a day for day extension in the Scheduled Payment Milestone Completion Date or the Scheduled Construction Completion Date, as the case may be, beyond the 7-day period.

- (v) The Jal Nigam may exercise its rights to review and certify the completion of works for any Payment Milestone either itself or through the Project Engineer. If the Jal Nigam instructs the Project Engineer to undertake a review of the works, then the Concessionaire shall co-operate with the Project Engineer to facilitate such review and rectify any defects or deficiencies identified by the Project Engineer in the works. Provided that, in all instances, the Jal Nigam shall finally approve the works and issue the Milestone Completion Certificates.

(b) Testing and Commissioning

- (i) Upon completion of construction of the Facilities and the rehabilitation of the Associated Infrastructure in accordance with the requirements set out in this Agreement, the Concessionaire shall issue a notice to the Jal Nigam, with a copy to NMCG, requiring it to be present at the Site on the date specified in such notice to undertake a final inspection of the completed Facilities and Associated Infrastructure and conduct any tests required to ensure that the Facilities and the Associated Infrastructure comply with the Technical Specifications, the Designs and Drawings, Applicable Laws and Applicable Permits.
- (ii) Within 5 days from the date of receipt of a notice under Clause 7.13(b)(i) above, the Jal Nigam may request the Concessionaire to vary the date of the final inspection and tests and the Concessionaire shall accommodate such request, provided that, such date shall be no later than 7 days from the date specified in the notice received from the Concessionaire under Clause 7.13(b)(i) above.
- (iii) The Concessionaire shall, on the date specified in the notice issued under Clause 7.13(b)(i) or on such other date as may be agreed with the Jal Nigam, carry out the tests in accordance with the instructions and under

the supervision of the Jal Nigam, to demonstrate that the Facilities and the Associated Infrastructure comply with the requirements of Clause 7.6.

- (iv) If the Jal Nigam is not satisfied with the results of the tests or inspection, then the Concessionaire shall remedy any defects or deficiencies in the Facilities and/or the Associated Infrastructure, identified by the Jal Nigam or revealed through the tests and the Facilities and the Associated Infrastructure shall be tested again upon rectification of such defects or deficiencies. This process shall be repeated until such time that the Jal Nigam is satisfied that the Facilities and the Associated Infrastructure have been completed in accordance with Clause 7.6 and are safe and fit for purpose. The Concessionaire shall bear all costs of remedying the defects and deficiencies and retesting the Facilities and/or the Associated Infrastructure and shall not be entitled to any extension of time for remedying such defects or deficiencies or for retesting the Facilities and/or the Associated Infrastructure.
- (v) If the Jal Nigam is satisfied with the results of the tests and inspection of the Facilities and the Associated Infrastructure, the Jal Nigam shall issue the Milestone Completion Certificate in respect of the last Payment Milestone to the Concessionaire, with a copy to NMCG, within 7 days from the date of inspection and testing of the completed Facilities and Associated Infrastructure. The issue of the Milestone Completion Certificate for the last Payment Milestone shall certify that the Facilities and the Associated Infrastructure have been completed in accordance with this Agreement, the Technical Specifications, the Designs and Drawings, Applicable Laws and Applicable Permits and the Facilities and the Associated Infrastructure are safe and fit for purpose.
- (vi) If the Jal Nigam fails to:
 - (A) inspect or witness the testing of the Facilities and the Associated Infrastructure on the date specified in the notice issued under Clause 7.13(b)(i) or such other date as may be agreed with the Concessionaire;
 - (B) notify the Concessionaire of any defects or deficiencies in the Facilities or the Associated Infrastructure within 7 days from the date of inspection and testing of the Facilities and the Associated Infrastructure; or
 - (C) issue the Milestone Completion Certificate for the last Payment Milestone within 7 days from the date of inspection and testing of the Facilities and the Associated Infrastructure,

then, such delay shall be treated as a Delay Event, which will entitle the Concessionaire to a day for day extension in the Scheduled Payment Milestone Completion Date and the Scheduled Construction Completion Date.

(c) Issue of Construction Completion Certificate

- (i) Within 7 days from the date of issuance of the Milestone Completion Certificate for the last Payment Milestone, the Jal Nigam shall issue the Construction Completion Certificate to the Concessionaire, with a copy to NMCG, subject to the following conditions having been fulfilled by the Concessionaire:
- (A) the submission of 4 hard copies and 1 soft copy on a compact disc of complete sets of the "as-built" drawings of the Facilities and the Associated Infrastructure;
 - (B) the Concessionaire having obtained all Applicable Permits necessary for commencement of the O&M services (including specifically the consent to operate from the Uttar Pradesh Pollution Control Board for the operation of the Facilities and the Associated Infrastructure);
 - (C) the Concessionaire having obtained adequate insurance for the O&M Period in accordance with Clause 11.2;
 - (D) the Concessionaire having engaged sufficient number of adequately skilled O&M personnel to perform the services during the O&M Period; and
 - (E) the O&M Manual having been approved by the Jal Nigam; and
 - (F) the Concessionaire having cleared the Site and removed all debris, hazardous materials, surplus construction materials, equipment, temporary works, work sheds, labour camps and all other temporary installations on the Site.
- (ii) If the Jal Nigam fails to issue the Construction Completion Certificate to the Concessionaire within 7 days from the date of satisfaction of the conditions set out in Clause 7.13(c)(i)(A) to (F) above and fails to notify the Concessionaire of any reasons for the failure to issue the Construction Completion Certificate, then, the Construction Completion Certificate shall be deemed to have been issued to the Concessionaire upon the expiry of the 7 days period.
- (iii) The date of the issuance or deemed issuance of the Construction Completion Certificate shall be the Construction Completion Date.

7.14 Trial Operations

- (a) Subject to Clause 7.14(c) below, within 1 day of the issuance or deemed issuance of the Construction Completion Certificate to the Concessionaire, the Concessionaire shall commence the Trial Operations of the Facilities and the Associated Infrastructure in accordance with the Trial Operation Procedures to determine whether the Facilities and the Associated Infrastructure meet the KPIs

on a continuous basis and are fit and ready to be placed into commercial operations for treatment and disposal of Sewage in accordance with this Agreement.

- (b) The Jal Nigam shall ensure that adequate quantity of Sewage is delivered to the Facilities and the Associated Infrastructure during the Trial Operations to enable the Concessionaire to demonstrate that the Facilities and the Associated Infrastructure meet the Technical Specifications and the KPIs.
- (c) If the Concessionaire fails to commence or continue the Trial Operations, due to the inadequate quantity or inferior quality of the Sewage delivered to the Facilities and the Associated Infrastructure, then the Concessionaire shall promptly notify the Jal Nigam. If in the opinion of the Jal Nigam, the quantity or quality of Sewage is not adequate to undertake Trial Operations, then the Jal Nigam shall extend the time period for the Trial Operations. In such case, the Scheduled COD will also be extended on a day-for-day basis, provided that the Scheduled COD shall not be extended beyond the date which is 6 months from the Construction Completion Date.
- (d) During the Trial Operations, the Jal Nigam shall or shall cause the Project Engineer to monitor the performance of the Facilities and the Associated Infrastructure on a regular basis and shall have the right to test the compliance of the incoming Sewage with the Influent Standards and test the compliance of the STP By-Products and the Treated Effluent with the Discharge Standards every 7 days to ensure that the Facilities meet the KPIs. If the Jal Nigam, or, as the case may be, the Project Engineer is of the view that: (i) the Trial Operations are not being conducted in accordance with the Trial Operations Procedure; or (ii) there are any defects or deficiencies in the Facilities and/or the Associated Infrastructure, the Jal Nigam shall instruct the Concessionaire to follow the Trial Operation Procedures and/or rectify the defects and deficiencies to ensure compliance with the KPIs.

It is clarified that no Availability Liquidated Damages or Performance Liquidated Damages are payable by the Concessionaire during the Trial Operations period for a failure to achieve the KPIs. However, for the Trial Operations to be successfully concluded, the Concessionaire must demonstrate that the Facilities and the Associated Infrastructure consistently and continuously meet the KPIs during the last 20 days of the 3 months Trial Operations period, as may be extended in accordance with Clause 7.14(c) above. If the Facilities and the Associated Infrastructure fail to achieve the KPIs on a continuous basis during the last 20 days of the initial 3 months Trial Operations period (as extended in accordance with Clause 7.14(c)), then the Trial Operations period shall be extended by another 20 days. Subject to Clause 7.14(i), the Trial Operations shall continue until the Concessionaire can demonstrate that the Facilities and the Associated Infrastructure consistently achieve the KPIs for 20 consecutive days.

- (e) If the Concessionaire has been able to consistently achieve the KPIs for 20 consecutive days (as supported by daily reports) the Concessionaire shall issue a notice to the Jal Nigam requiring the Jal Nigam to undertake a final inspection of the Facilities and the Associated Infrastructure. The Jal Nigam shall have the right

to undertake such final inspection within 5 days of a notice being issued by the Concessionaire.

- (f) If, upon final inspection, the Jal Nigam is satisfied that the Facilities and the Associated Infrastructure meet the Technical Specifications, and are capable of safe and reliable operations, then, the Jal Nigam shall issue the Trial Operations Completion Certificate to the Concessionaire within 7 days of the Jal Nigam undertaking a final inspection of the Facilities and the Associated Infrastructure pursuant to Clause 7.14(e) above.
- (g) If, upon final inspection, the Jal Nigam believes the Facilities and the Associated Infrastructure do not comply with the Technical Specifications and/or the KPIs, other than due to: (i) volume of Sewage being inadequate to conduct the Trial Operations; or (ii) the quality or characteristics of the Sewage being beyond the Influent Standards, then the Jal Nigam shall reject the Facilities and terminate this Agreement. Upon termination of this Agreement, in accordance with this Clause 7.14(g), the consequences set out in Article 17 shall follow.
- (h) If the Jal Nigam: (i) does not undertake a final inspection of the Facilities and the Associated Infrastructure within 5 days of receipt of a notice from the Concessionaire under Clause 7.14(e); or (ii) fails to notify the Concessionaire of any defects in the Facilities or Associated Infrastructure within 7 days of undertaking a final inspection; or (iii) fails to issue a Trial Operations Completion Certificate within 7 days from the date of the final inspection, then the Trial Operations shall be deemed to have been successfully completed and the Trial Operations Completion Certificate will be deemed to have been issued to the Concessionaire upon the expiry of the 5 days period (in case of (i)) and upon the expiry of the 7 day period (in case of (ii) and (iii)).
- (i) If the Trial Operations are not successfully completed and/or the Concessionaire fails to issue a notice to the Jal Nigam under Clause 7.14(e) above on or prior to the Scheduled COD, as may be extended in accordance with Clause 7.14(c), then such failure shall be treated as a Concessionaire Event of Default and the consequences set out at Article 17 shall follow.
- (j) Notwithstanding anything contained in Clause 7.14(h), if the Concessionaire fails to successfully complete the Trial Operations on or prior to the Scheduled COD, as may be extended in accordance with Clause 7.14(c), due to the: (i) volume of Sewage being inadequate to conduct the Trial Operations; or (ii) quality or characteristics of the Sewage being beyond the Influent Standards, then such failure will be treated as a Jal Nigam Event of Default, and the consequences set out at Article 17 shall follow.
- (k) The Concessionaire will not be entitled to any O&M Payments or any other payment for conducting the Trial Operations, which shall be carried out solely at the cost and risk of the Concessionaire.

7.15 Commercial Operations Date

- (a) Within 7 days from the date of issuance or deemed issuance of the Trial Operations Completion Certificate, the Jal Nigam shall issue the COD Certificate, with a copy to NMCG, subject to the following conditions having been fulfilled by the Concessionaire:
 - (i) the Concessionaire having submitted to the Jal Nigam the Scheduled Maintenance Programme for the first year post COD; and
 - (ii) the Concessionaire having submitted the O&M Security to the Jal Nigam.
- (b) If the Jal Nigam fails to issue the COD Certificate to the Concessionaire within 7 days from the date of satisfaction of the conditions set out in Clause 7.15 (a) above and fails to notify the Concessionaire of any reasons for the failure to issue the COD Certificate, then, the COD Certificate shall be deemed to have been issued to the Concessionaire upon the expiry of the 7 day period.
- (c) The date on which the COD Certificate is issued or deemed to have been issued to the Concessionaire shall be the Commercial Operations Date of the Facilities and the Associated Infrastructure.

8. OPERATIONS AND MAINTENANCE PERIOD

8.1 Commencement and Duration

The period for the operation and maintenance of the Facilities and the Associated Infrastructure shall commence on and from the COD, and shall continue until the expiry of 15 years from the COD (the **O&M Period**), unless terminated earlier in accordance with Article 16.

8.2 O&M Manual

- (a) The Concessionaire shall prepare a detailed O&M Manual for the Facilities and Associated Infrastructure based on the Proposed Technology and in accordance with the Technical Specifications, EHS Plan, Applicable Laws and Applicable Permits. The O&M Manual shall specify the operation procedures (separately for each component of the Facilities and the Associated Infrastructure) and maintenance procedures. If there any errors or deficiencies in the Technical Specifications, the O&M Manual shall take in account, address or rectify such errors or deficiencies.
- (b) At least 30 days prior to the Scheduled Construction Completion Date, the Concessionaire shall submit 4 hard copies and 1 soft copy on a compact disc of the draft O&M Manual to the Jal Nigam for its review and approval.
- (c) The Jal Nigam shall review and provide comments, if any, on the draft O&M Manual to the Concessionaire or notify the Concessionaire of its approval of the draft O&M Manual within 20 days from the date of receipt of the draft O&M Manual from the Concessionaire. The Jal Nigam may require the Concessionaire to

amend or modify the draft O&M Manual if the Jal Nigam identifies any deficiencies, inaccuracies or shortcomings in the draft O&M Manual. If the Concessionaire receives any comments, suggestions or instructions to modify the draft O&M Manual from the Jal Nigam, then the Concessionaire shall modify the draft O&M Manual to correct any shortcomings, inaccuracies or deficiencies identified by the Jal Nigam and/or address, in writing, the Jal Nigam's comments on the draft O&M Manual and submit the revised O&M Manual to the Jal Nigam for its approval. The process set out in this Clause 8.2(c) shall continue until the O&M Manual is approved by the Jal Nigam in accordance with this Clause 8.2(c).

- (d) The Concessionaire shall revise the O&M Manual as and when the Concessionaire thinks it necessary to do so and in such case the provisions of Clause 8.2(c) will apply as is to the approval of the revised manual.
- (e) The Concessionaire shall undertake the O&M of the Facilities and the Associated Infrastructure strictly in accordance with the approved O&M Manual. The Concessionaire shall not deviate from or make any amendment to the approved O&M Manual without the prior written approval of the Jal Nigam. The Concessionaire shall not commence operation of the Facilities or the Associated Infrastructure prior to approval of the O&M Manual in accordance with this Clause 8.2.
- (f) Notwithstanding any approval of the O&M Manual by the Jal Nigam, the Concessionaire shall bear all risk, responsibility and liability for the suitability, accuracy, adequacy and practicality of the O&M Manual. The Concessionaire shall not be entitled to any extension of time and/or costs incurred in the preparation of or updating the O&M Manual and complying with the requirements of this Clause 8.2.
- (g) The Concessionaire shall submit a consolidated O&M Manual for the Facilities and the Associated Infrastructure.

8.3 Subcontracting

- (a) The Concessionaire may enter into Subcontracts to perform any part of its scope of work during the O&M Period, with the prior written consent of the Jal Nigam.
- (b) The Concessionaire shall provide a copy of each proposed Subcontract, along with details of the relevant Subcontractor, to the Jal Nigam for its approval, which should set out the precise scope of work to be subcontracted to such Subcontractor and should be consistent with the terms of this Agreement.
- (c) Within 15 days of receipt of a draft Subcontract under Clause 8.3(b) above, the Jal Nigam shall notify the Concessionaire of its approval or rejection (along with reasons) of the Subcontractor.
- (d) The approval of any Subcontractor and the corresponding Subcontract by the Jal Nigam shall be subject to the following conditions:
 - (i) the Subcontractor appointed by the Concessionaire possesses the requisite

skill, expertise and capability to perform the relevant obligations of the Concessionaire during the O&M Period;

- (ii) the Subcontract is on terms consistent with this Agreement;
 - (iii) the Subcontract contains provisions that provide, at the Jal Nigam's option, for the Subcontract to be novated or assigned to the Jal Nigam or its nominee without any further consent or the approval from the Concessionaire or the Subcontractor or entitle the Jal Nigam or its nominee to step into such Subcontract, in substitution of the Concessionaire, if this Agreement is terminated due to a Concessionaire Event of Default. However, the step-in rights of the Jal Nigam shall always be subject to the substitution rights of the Lenders under this Agreement or the Substitution Agreement; and
 - (iv) the Concessionaire shall be responsible for the supervision and monitoring of the performance of any work or services by the Subcontractors.
- (e) If the Jal Nigam does not notify its approval or rejection of any Subcontract to the Concessionaire within 15 days of the receipt of the draft Subcontract, then such Subcontract will be deemed to be approved by the Jal Nigam.
- (f) Within 7 days of the execution of an amendment to any approved Subcontract, the Concessionaire shall submit a copy of such amendment to the Jal Nigam for its records.
- (g) If the Concessionaire proposes to novate an approved Subcontract and/or replace an approved Subcontractor, then such novation or replacement shall be with prior approval of the Jal Nigam and the process set out in this Clause 8.3 shall apply in such case.
- (h) Notwithstanding the approval of any Subcontractor by the Jal Nigam, the Concessionaire shall be and remain liable under this Agreement for all work and services subcontracted under this Agreement and for all acts, omissions or defaults of any Subcontractor. No default under any Subcontract shall excuse the Concessionaire from its obligations or liabilities under this Agreement. All references in this Agreement to any act, default, omission, breach or negligence of the Concessionaire shall be construed to include any such act, default, omission, breach or negligence of the Subcontractors.

8.4 Concessionaire's rights and obligations

- Ch*
- (a) The Concessionaire shall operate and maintain the Facilities and the Associated Infrastructure in a manner that:
 - (i) is in compliance with the Technical Specifications, Applicable Laws, Applicable Permits and Good Industry Practice;
 - (ii) results in the Facilities and the Associated Infrastructure achieving the KPIs;
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- (iii) ensures that the Varanasi STP is capable of treating Sewage up to the Design Capacity on a daily basis;
 - (iv) ensures efficient treatment of Sewage and handling and disposal of STP By-Products and the Treated Effluent;
 - (v) is safe and reliable, subject to normal wear and tear of the Facilities and the Associated Infrastructure;
 - (vi) is in compliance with the technology license agreement executed by the Concessionaire for the technology, processes, know-how and systems used or incorporated into the Facilities and/or the Associated Infrastructure;
 - (vii) maintains the safety and security of personnel, material and property at the Site, in accordance with the approved EHS Plan, Applicable Laws and Applicable Permits; and
 - (viii) ensures that all waste materials and hazardous substances are stored and/or disposed in accordance with the EHS Plan, Applicable Laws and Applicable Permits.
- (b) The Concessionaire shall provide adequate power backup at the Site (including through installation of DG Sets) to ensure continuous supply of power (even during any interruption(s) in the supply of power from the grid) for the uninterrupted operations of the Facilities and the Associated Infrastructure during the O&M Period.
- (c) The Concessionaire shall provide all necessary assistance to the Project Engineer and the Jal Nigam in undertaking inspection and monitoring of the operation and maintenance of the Facilities and the Associated Infrastructure.
- (d) The Concessionaire shall reasonably consider and act upon the comments/suggestions made by the Project Engineer and the Jal Nigam during any meetings of the Concessionaire with its Subcontractors.
- (e) The Concessionaire shall provide the Jal Nigam and the Project Engineer with reasonable access to the Site during office hours to monitor and inspect the Facilities and the Associated Infrastructure.
- (f) The Concessionaire shall arrange for all equipment, machinery, tools and other resources required to undertake the O&M of the Facilities and the Associated Infrastructure and shall take all reasonable measures to ensure that the transportation of any of the Concessionaire's or the Subcontractors' personnel or equipment, to or from the Site, does not interfere with local traffic in the vicinity of the Site.
- (g) The Concessionaire shall develop and implement a safety and surveillance programme for the Facilities and the Associated Infrastructure and for handling and disposal of the STP By-Products and the Treated Effluent, and adopt

appropriate measures and safeguards for security of the environment, life, and property at the Site.

8.5 **Jal Nigam's rights and obligations**

During the O&M Period, the Jal Nigam shall:

- (a) comply with all its obligations under Applicable Laws (including, specifically the UPWSS Act) and the Jal Nigam Applicable Permits;
- (b) monitor and review the operations and performance of the Facilities and the Associated Infrastructure, including disposal of the STP By-Products and the Treated Effluent. This includes the right to access the Facilities, and review the records and reports that the Concessionaire is required to maintain, during normal working hours;
- (c) review the Scheduled Maintenance Programme and all other plans and documents submitted by the Concessionaire in an expeditious manner, in accordance with this Agreement; and
- (d) ensure that the Concessionaire continues to enjoy peaceful access to the Site and shall not assign, transfer, or otherwise dispose of its rights, title, and interest in the Site or create any Encumbrance over any part of the Site, which may adversely impact the exercise of the Concessionaire's rights and duties under this Agreement.

8.6 **NMCG's rights and obligations**

During the O&M Period, NMCG shall:

- (a) comply with all its obligations under the Applicable Laws (including specifically, the Ganga 2016 Order);
- (b) make the O&M Payments in accordance with Clause 9.4; and
- (c) ensure that the Escrow Account is funded with the Minimum Escrow Balance.

8.7 **Utilities**

- (a) The Jal Nigam shall apply for and obtain the power connection (at the battery limit of the Site) for the operation of the Facilities and the Associated Infrastructure, in its name, at least 30 days prior to the Scheduled Construction Completion Date. The Concessionaire shall provide all necessary assistance to the Jal Nigam in procuring the power connection, including by providing all documents and information necessary to complete the application process.
- (b) The Concessionaire shall install and maintain at its cost, all utilities (other than power) necessary for the O&M of the Facilities and the Associated Infrastructure, including water, telephone connections, internet connections, etc. at the Site. Specifically, to procure water for the O&M of the Facilities and the Associated Infrastructure, the Concessionaire may dig borewells at the Site after obtaining all

Applicable Permits (including any no-objection certificates from the Central Ground Water Authority or the relevant state authority).

- (c) The Concessionaire shall not be entitled to any additional costs to comply with its obligations in this Clause 8.7.
- (d) The Jal Nigam shall provide any reasonable assistance required by the Concessionaire to obtain the utilities for the O&M of the Facilities and the Associated Infrastructure.

8.8 Monitoring and Reporting

(a) Online Monitoring and Meters

- (i) The Concessionaire shall install and maintain an online monitoring system as part of the Facilities, in accordance with the Technical Specifications and Applicable Laws (including specifically, the EPA) to monitor the volume, specifications and characteristics of the incoming Sewage and the Treated Effluent. The online monitoring device should be capable of measuring and analyzing the flow rate and characteristics of the Sewage at the Inlet Point and of the Treated Effluent at the Outlet Point. Such monitoring shall be conducted in accordance with Applicable Laws and Good Industry Practices
- (ii) As part of the online monitoring system, the Concessionaire shall also install flow measurement meters in accordance with Applicable Laws and Technical Specifications, at the rising main, the Inlet Point, the Outlet Point, weir at Assi Nala and at any other point set out in the Technical Specifications or required as per Applicable Laws, to measure the flow of sewage over the weir and the volume and concentration of Sewage delivered to the Facilities, and the Treated Effluent discharged from the Facilities.
- (iii) The Concessionaire shall record and transmit all data collected from the online monitoring system and the meter reading of the grade, volume and characteristics of the incoming Sewage and the Treated Effluent. The Concessionaire shall furnish a summary report to the Jal Nigam (with a copy to the Project Engineer) on a daily basis, which shall indicate the periods during which: (A) the volume of the Sewage received at the Varanasi STP and the volume of the Treated Effluent discharged from the Varanasi STP during each hour of the relevant day; and (B) the periods during which the volume of Sewage received at the Varanasi STP exceeded the Design Capacity; (C) the quality of the incoming Sewage was beyond the Influent Standards; and (D) the quality of the Treated Effluent was beyond the Discharge Standards.
- (iv) The Concessionaire shall also be required to upload the periodic reports from the online monitoring on the Central Pollution Control Board's website.

- (v) The Concessionaire shall maintain the online monitoring system and meters at its own cost and expense for the entire O&M Period.
- (vi) The Concessionaire shall also install meters and gauges at the DG Sets to measure the total number of energy units (in kWh) consumed from the DG Sets in each month of the O&M Period.
- (vii) If the Concessionaire sets up a Power Plant, then the Concessionaire shall install meters at the Power Plant to measure the total number of energy units (in kWh) generated from the Power Plant in each month of the O&M Period.
- (viii) The meters shall be calibrated once every year during the O&M Period in accordance with Good Industry Practices and the meters shall be jointly tested by the Jal Nigam and the Concessionaire to ensure the accuracy of the meters installed by the Concessionaire.

(b) Records and Reporting Requirements

- (i) The Concessionaire shall maintain:
 - (A) records of the volume and characteristics of the Sewage received at, and the STP By-Products and the Treated Effluent discharged from the Varanasi STP; and
 - (B) books of accounts recording all payments received from NMCG and other revenues derived/collected by it from the Facilities or resulting from its use.
- (ii) The Concessionaire shall provide to the Jal Nigam 2 copies of its audited financial statements along with a report from its statutory auditors, within 90 days of the close of each Financial Year.
- (iii) The Concessionaire shall deliver to the Jal Nigam, with a copy to the Project Engineer, the following during the O&M Period within the specified timelines:
 - (A) reports relating to any activity, problem, incident or circumstance that threatens or may threaten public health, safety, the environment or the safety and security of the Facilities or the Associated Infrastructure, and any action taken to mitigate the effect of such incident or problem, as soon as reasonably practicable but no later than 12 hours after the occurrence of such event or circumstance;
 - (B) reports on any critical breakdowns or failures in the Facilities or the Associated Infrastructure, within 12 hours of such occurrence;
 - (C) reports on accidents or other incidents in relation to the O&M personnel or any third party, along with statements on actions

taken to minimise recurrence, within 2 days of such occurrence;

- (D) daily reports with the data collected from the monitoring and metering system, the online monitoring system and the tests conducted by the Concessionaire in accordance with Clause 8.10 on the characteristics and volume of Sewage treated at the Facilities, the STP By-Products and the Treated Effluent discharged from the Facilities, at the end of each day (i.e., on or before 1500 hours every day);
- (E) monthly progress reports relating to the performance of O&M services (including on compliance with the KPIs, details of disposal or sale, as the case may be, of the STP By-Products and the Treated Effluent, and details of any Emergency during the relevant month), on or before the 7th day of the following month. The monthly progress report must be certified by the Project Engineer before it is submitted to the Jal Nigam;
- (F) copies of any reports, notices or responses submitted for compliance/non-compliance with Applicable Laws or Applicable Permits, within 2 days of making such submissions to the relevant Government Authority; and
- (G) reports on any material litigation, including any winding-up proceedings or notice to commence winding-up proceedings or material disputes to which the Concessionaire is a party, appointment of a receiver or administrator in relation to the business or assets of the Concessionaire and any adverse orders or judgments passed by any Government Authorities that affects or is likely to affect the performance of the O&M services, as soon as reasonably possible after the occurrence of any such event.

8.9 Design Capacity Utilization

- (a) During each day of the O&M Period, the Concessionaire shall ensure that the Varanasi STP can accept, treat, and process Sewage up to the Design Capacity.
- (b) The Concessionaire shall notify the Jal Nigam (with a copy to the Project Engineer) as soon as it becomes aware that the volume of Sewage received at the main pumping station is more than the Design Capacity.
- (c) In such circumstances, if the Concessionaire is unable to accept and treat the excess Sewage (i.e., over and above the Design Capacity) at the Varanasi STP, then such failure shall be treated as a Forced Unavailability for which the Concessionaire shall not be liable, subject to the Concessionaire having notified the Jal Nigam in accordance with Clause 8.9(b) above. The Jal Nigam reserves the right to require the Project Engineer to verify the capacity utilization at the Varanasi STP, at any time during the O&M Period.

8.10 Testing

- (a) The Sewage and the Treated Effluent will be tested at the Inlet Point and the Outlet Point, respectively in accordance with this Clause 8.10 and the Technical Specifications.
- (b) The Concessionaire shall test the characteristics of the incoming Sewage at the Inlet Point to determine if the incoming Sewage meets the Influent Standards. The Concessionaire will be required to carry out such tests at the Inlet Point at the intervals specified in the Technical Specifications or at such other time interval as may be instructed by the Jal Nigam.
- (c) The Concessionaire shall test the characteristic of the Treated Effluent at the Outlet Point to determine if the Treated Effluent meets the Discharge Standards. The Concessionaire will be required to carry out such tests at the Outlet Point at the intervals specified in the Technical Specifications or such other time interval as may be instructed by the Jal Nigam.
- (d) The Concessionaire shall test the characteristics of the Digested Sludge after digestion of the raw Sewage at the Varanasi STP to assess the volatile suspended solids (VSS) value of the Digested Sludge, in accordance with the Technical Specifications.
- (e) The Concessionaire shall maintain proper records of the tests conducted at the Inlet Point, the Outlet Point or at any other point at the Varanasi STP (for the Digested Sludge) and the test results shall be verified by the Project Engineer. Separately, the Project Engineer shall also have the right to take random samples of the incoming Sewage, the Digested Sludge and the Treated Effluent at any time during the O&M Period to test compliance with the Influent Standards and the Discharge Standards.
- (f) The Concessionaire shall prepare daily reports compiling the test reports for each day, which shall be submitted to the Jal Nigam, after being duly certified by the Project Engineer.

8.11 Maintenance and Repair of the Facilities and the Associated Infrastructure

- (a) During the O&M Period, the Concessionaire shall undertake the maintenance of the Facilities and the Associated Infrastructure and repair any damage to the Facilities and the Associated Infrastructure either by itself, or through an approved Subcontractor, such that the Facilities and the Associated Infrastructure shall be:
 - (i) in good working condition (subject only to wear and tear and Force Majeure) and achieve their full useful economic life in accordance with the Designs and Drawings;
 - (ii) maintained in compliance with the Technical Specifications, O&M Manual, Scheduled Maintenance Programme, Applicable Laws, Applicable Permits, Good Industry Practice and the recommendations of

the technology providers; and

- (iii) capable of meeting the KPIs.
- (b) For the first year of the O&M Period, the Concessionaire shall submit its scheduled maintenance programme, specifying the Scheduled Maintenance periods and the impact of such Scheduled Maintenance periods on the Availability (**Scheduled Maintenance Programme**) to the Jal Nigam at least 1 month before the Scheduled COD and for every subsequent year of the O&M Period, the Concessionaire shall submit the Scheduled Maintenance Programme, at least 1 month prior to the beginning of the relevant year. The Scheduled Maintenance Programme for the first year will cover the period from the COD until the end of the calendar year in which the COD occurs.
- (c) Within 15 days of receipt of the Scheduled Maintenance Programme, the Jal Nigam shall notify the Concessionaire of its approval of such schedule.

If the Jal Nigam does not accept any one or more of the requested Scheduled Maintenance periods or its impact on the Availability, the Jal Nigam shall advise the Concessionaire within 15 days of the receipt of the Scheduled Maintenance Programme on when any Scheduled Maintenance can be rescheduled or how its impact on the Availability may be minimised. The rescheduled time shall be as close as reasonably practicable to the requested time, and shall be of equal duration as the requested period. If the Jal Nigam fails to object to any Scheduled Maintenance within the specified time period or fails to advise the Concessionaire of a substitute time, the Concessionaire may schedule the Scheduled Maintenance for such duration and at such time as initially requested.

- (d) Notwithstanding the finalization of the Scheduled Maintenance Programme pursuant to this Clause 8.11, the Jal Nigam may require the Concessionaire to reschedule a Scheduled Maintenance in the Scheduled Maintenance Programme, provided that:
 - (i) the Jal Nigam has given the Concessionaire at least 30 days' prior written notice of such re-scheduling;
 - (ii) the Jal Nigam shall not require such Scheduled Maintenance to be rescheduled for a period of shorter or longer duration;
 - (iii) the Jal Nigam shall not require that a single Scheduled Maintenance period be split into two or more periods; and
 - (iv) the Jal Nigam shall not require that a Scheduled Maintenance be brought forward any earlier than 15 days from the date of such notice without the consent of the Concessionaire.
- (e) Notwithstanding the finalization of the Scheduled Maintenance Programme pursuant to this Clause 8.11, the Concessionaire may request a rescheduling of any Scheduled Maintenance upon 60 days' prior written notice to the Jal Nigam. The Jal Nigam shall respond to such request within 10 days and shall not

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unreasonably withhold its permission for such re-scheduling.

- (f) Within 5 days of any re-scheduling of a Scheduled Maintenance in accordance with Clause 8.11(d) or Clause 8.11(e) above, the Concessionaire shall provide to the Jal Nigam, the amended Scheduled Maintenance Programme, which shall then be the "**Scheduled Maintenance Programme**".
- (g) During the O&M Period, the Concessionaire shall, at its own cost, replace any component or part of the Facilities that is damaged or worn out or in the Concessionaire's judgement becomes no longer practicable to repair as a result of normal wear and tear.
- (h) If at any time during the O&M Period, the Facilities are damaged by a Minor Casualty, the Concessionaire shall, with reasonable diligence, proceed to process the claim with insurance providers and repair, replace, and restore the damaged portion of the Facilities to the same condition that it was in before the occurrence of such Minor Casualty. To the extent available, insurance proceeds shall be applied to such repair, replacement or restoration.
- (i) If at any time during the O&M Period, the Facilities are damaged by a Total Casualty, then this Agreement shall be terminable at the option of the Concessionaire. If the Concessionaire elects to terminate the Agreement, then the consequences set out at Clause 14.7 will follow. If, however, the Concessionaire elects not to terminate the Agreement, then the Concessionaire shall repair, replace and restore the damaged Facilities to the same condition that it was in before the occurrence of such Total Casualty. To the extent available, insurance proceeds shall be applied to such repair, replacement or restoration.

8.12 **Key Performance Indicators**

(a) Availability

- (i) The Concessionaire shall ensure that the Availability of the Facilities and the Associated Infrastructure on every day during the O&M Period shall be 100% (the **Guaranteed Availability**). Provided that during the period of a Scheduled Maintenance that is undertaken as per the approved Scheduled Maintenance Programme or as notified and approved in accordance with Clause 8.11 for the Facilities and the Associated Infrastructure, the Concessionaire shall ensure that the Guaranteed Availability of the Facilities and the Associated Infrastructure is at least 95%.

The '**Availability**' of the Facilities and the Associated Infrastructure will be determined as a ratio of the number of hours in a day during which the Facilities and the Associated Infrastructure are available to convey, accept and treat the Sewage up to its Design Capacity, to the total number of hours in a day, and the term 'Available' shall be construed accordingly.

- (ii) In computing the Availability, the Concessionaire agrees that the Facilities and the Associated Infrastructure will be deemed to be

Available at all times, other than during the period of:

- (A) an Unscheduled Outage;
- (B) a Power Outage;
- (C) suspension of the O&M services for reasons attributable to the Concessionaire (in accordance with Clause 15.1 and 15.2); or
- (D) an Emergency attributable to the Concessionaire,

during which the Facilities and the Associated Infrastructure will be deemed to be not Available.

It is clarified that the Facilities shall be deemed to be not Available even if the Varanasi STP is available to accept and treat the Sewage but the Associated Infrastructure is not available to convey the Sewage to the Varanasi STP.

- (iii) Notwithstanding anything to the contrary contained in this Agreement, during the period of a Forced Unavailability or a Force Majeure, the Facilities and the Associated Infrastructure will be deemed to be Available.
- (iv) If the Availability on any given day is less than the Guaranteed Availability, the Jal Nigam shall issue a notice to the Concessionaire requiring the Concessionaire to cure the default causing the reduction in Availability in 3 days. Any failure to cure the default and achieve the Guaranteed Availability within 3 days of receipt of the notice from the Jal Nigam shall constitute a Concessionaire Event of Default.
- (v) ***Availability Liquidated Damages***

Without prejudice to Clause 8.12(a)(iv), if the Availability on any given day is less than the Guaranteed Availability, then the Concessionaire shall pay the liquidated damages to the Jal Nigam set out in Schedule 6, (the "**Availability Liquidated Damages**").

The aggregate Availability Liquidated Damages payable by the Concessionaire in any quarter of the O&M Period will be deducted from the O&M Payments due to the Concessionaire for such quarter. If the Availability Liquidated Damages for a quarter exceed the O&M Payments for such quarter, then the excess amounts shall, at the discretion of the Jal Nigam, either be adjusted against the O&M Payments for the subsequent quarter or recovered from the O&M Security.

(b) Influent Standards and Discharge Standards

- (i) The Concessionaire is required to receive, treat, and dispose all Sewage delivered to the Varanasi STP. If, however the Sewage is beyond the

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Influent Standards (as set out in Schedule 10 (KPIs), then the Concessionaire shall be required to treat such Sewage but will not be liable for any Performance Liquidated Damages (*defined below*) if the Treated Effluent and/or the Digested Sludge fails to meet the Discharge Standards.

- (ii) Subject to Clause 8.12(b)(i) above, the Concessionaire shall ensure that the Treated Effluent and Digested Sludge comply with the Discharge Standards set out in the Technical Specifications.
- (iii) Subject to Clause 8.12(b)(iv) below, if the Treated Effluent or the Digested Sludge does not comply with the Discharge Standards, then the process set out below shall follow:
 - (A) In the first instance of non-compliance of the Treated Effluent or the Digested Sludge with the Discharge Standards (**First Breach**), the Jal Nigam shall issue a notice to the Concessionaire on the first day of such non-compliance (**First Breach Notice**) requiring the Concessionaire to cure the First Breach within 20 days from the date of the First Breach Notice. If the First Breach is cured within 2 days of the First Breach Notice, then the Concessionaire shall not be liable to pay any Performance Liquidated Damages. If, however, the First Breach continues beyond 2 days of the First Breach Notice, then, the Concessionaire shall be liable to pay the Performance Liquidated Damages specified in Schedule 6, from the 3rd day of the First Breach.
 - (B) If: (I) the First Breach continues for 20 days from the date of the First Breach Notice; or (II) another instance of non-compliance with the Discharge Standards occurs within 6 months of the First Breach, then such breach shall constitute the **Second Breach**. Upon occurrence of the Second Breach, the Jal Nigam shall issue a notice to the Concessionaire on the first day of the Second Breach (**Second Breach Notice**) requiring the Concessionaire to cure the Second Breach within 20 days from the date of the Second Breach Notice. If the Second Breach continues beyond 2 days of the Second Breach Notice, then, the Concessionaire shall be liable to pay twice the amount of the Performance Liquidated Damages specified in Schedule 6, from the 1st day of the Second Breach. In case of (I) above, it is clarified that the Concessionaire will be liable to pay Performance Liquidated Damages at the rate specified in Schedule 6, for the first 2 days of a continuing breach from the date of the Second Breach Notice and twice the specified Performance Liquidated Damages from the 3rd day of a continuing Second Breach.
 - (C) If: (I) the Second Breach continues for 20 days from the date of the Second Breach Notice; or (II) another instance of non-compliance with the Discharge Standards occurs within 6 months

of the Second Breach, then such breach shall constitute the **Third Breach**. Upon occurrence of the Third Breach, the Jal Nigam shall issue a notice to the Concessionaire on the first day of the Third Breach (**Third Breach Notice**) requiring the Concessionaire to cure the Third Breach within 20 days from the date of the Third Breach Notice. If the Third Breach continues beyond 2 days of the Third Breach Notice, then: (X) the Concessionaire shall be liable to pay thrice the amount of the Performance Liquidated Damages specified in Schedule 6, from the 1st day of the Third Breach; and (Y) the Capex Annuity for the relevant quarter(s) will be reduced by an amount equal to the Capex Annuity for the relevant quarter/90 for each day that the Third Breach continues beyond the 1st day of the Third Breach. In case of (I) above, it is clarified that the Concessionaire will be liable to pay twice the Performance Liquidated Damages specified in Schedule 6, for the first 2 days of a continuing breach from the date of the Third Breach Notice and thrice the specified Performance Liquidated Damages from the 3rd day of the Third Breach, in addition to the reduction in the Capex Annuity.

(D) If: (I) the Third Breach is not cured within 20 days from the Third Breach Notice; or (II) a failure to comply with the Discharge Standards results in occurrence of a Third Breach more than 3 times in a continuous 12 month period, it will be treated as a Concessionaire Event of Default and the consequences set out at Article 17 shall apply.

(E) The Parties acknowledge that the Performance Liquidated Damages (including any escalation contemplated in this Clause 8.12(b)(iii)) are a genuine pre-estimation of and reasonable compensation for the environmental damage that may be caused by the Concessionaire's continuing failure to comply with the Discharge Standards, and not as penalty. The payment of Performance Liquidated Damages will not absolve the Concessionaire from any other liability under Applicable Law, for causing any environmental pollution or health hazard due to its failure to comply with the Discharge Standards and/or Applicable Law.

(iv) If the Treated Effluent and/or the Digested Sludge does not meet the Discharge Standards on account of: (A) the characteristics of the Sewage being beyond the permissible Influent Standards; or (B) the volume of the Sewage being more than the Design Capacity, then, the Concessionaire shall not be liable to pay any Performance Liquidated Damages for a failure to meet the Discharge Standards.

(v) The Performance Liquidated Damages payable by the Concessionaire in any quarter of the O&M Period will be deducted from the O&M Payments due to the Concessionaire for such quarter. If the Performance Liquidated Damages for a quarter exceed the O&M Payments for such quarter, then

the excess amounts shall, at the discretion of the Jal Nigam, either be adjusted against the O&M Payments for the subsequent quarter or recovered from the O&M Security.

- (vi) Within 7 days from the end of each month, the Concessionaire shall be required to provide the monthly progress report (prepared in accordance with Clause 8.8(b)(iii)(E) above) on compliance of the Facilities and the Associated Infrastructure with the KPIs, which should indicate the periods during which the Facilities did not meet the Guaranteed Availability or the Treated Effluent and/or the Digested Sludge did not meet the Discharge Standards and the reasons for such failure. The Project Engineer shall be required to certify each such monthly report before it is provided to the Jal Nigam. Such certified report on compliance with KPIs shall be referred to as the **KPI Adherence Report**, and shall form the basis for O&M Payments being made to the Concessionaire during the O&M Period.

8.13 Disposal of STP By-Products and the Treated Effluent

The Concessionaire shall be required to store, handle and dispose the STP By-Products and the Treated Effluent in the manner set out in this Clause 8.13 during the O&M Period:

- (a) Waste Disposal Site
 - (i) Within 30 days from the Effective Date, the Jal Nigam shall inform the Concessionaire of the Waste Disposal Site at which the Concessionaire shall be required to dispose the STP By-Products, resulting from the treatment of the Sewage at the Varanasi STP, and any other waste materials resulting from the construction and/or rehabilitation of the Associated Infrastructure during the Construction Period (including silt).
 - (ii) The Jal Nigam may shift the Waste Disposal Site from time to time during the O&M Period provided that, the Waste Disposal Site will always be within a radius of 10 km from the boundary of the STP Site and any shifting of the Waste Disposal Site will be with at least 30 days' prior written notice to the Concessionaire.
 - (iii) If, at any time during the O&M Period, the Jal Nigam shifts the Waste Disposal Site to a location beyond a radius of 10 km from the boundary of the STP Site, then, the Jal Nigam shall compensate the Concessionaire for any additional transportation costs incurred by the Concessionaire in transporting the STP By-Products to such Waste Disposal Site.
 - (iv) Any approval for disposal of the STP By-Products at the Waste Disposal Site will be obtained by the Jal Nigam at its cost. Further, all costs and charges in connection with the setting up and maintaining the Waste Disposal Site (including any tipping fee for the disposal of the STP By-Products) will be borne by the Jal Nigam. The Concessionaire shall only be responsible for transporting the STP By-Products to the Waste Disposal Site and bearing the costs for transportation and unloading of the

STP By-Products at the Waste Disposal Site.

(b) Disposal of Residual Grit and Screenings

- (i) The Concessionaire shall, at its cost and expense, be required to transfer the Residual Grit and the Screenings to the Waste Disposal Site and shall make adequate transportation arrangements for this purpose.
- (ii) The Concessionaire shall ensure that the Residual Grit and the Screenings are neither disposed at any place on or about the Site, other than the Waste Disposal Site, nor discharged into the river Ganga. The disposal of the Residual Grit and the Screenings at the Waste Disposal Site must be strictly in accordance with all Applicable Laws. The Concessionaire shall indemnify the Jal Nigam against any costs or liabilities that may arise due to the Concessionaire's failure to comply with this Clause 8.13(b) and all Applicable Laws in disposal of the Residual Grit and the Screenings.

(c) Disposal of Digested Sludge

- (i) As part of the Facilities, the Concessionaire shall be required to set up a sludge handling facility at the Site, where the Concessionaire can dry the Digested Sludge during the O&M Period.
- (ii) The Concessionaire shall, subject to compliance with Applicable Laws and Applicable Permits, be free to sell the Digested Sludge, at such price and to such Persons as it may deem fit or dispose the Digested Sludge at the Waste Disposal Site. Provided that if the Concessionaire sells the Digested Sludge to any third party, the Concessionaire shall be required to share 50% of the revenues from such sale with the Jal Nigam.
- (iii) The Concessionaire shall maintain proper records of sale of any Digested Sludge generated from the Facilities (including the revenues earned by the Concessionaire from such sale) and make them available to the Jal Nigam for its review.
- (iv) The Concessionaire shall ensure that the Digested Sludge is neither disposed at any place on or about the Site, except the Waste Disposal Site, nor discharged into the river Ganga. The Concessionaire shall indemnify the Jal Nigam against any costs or liabilities that may arise due to the Concessionaire's failure to comply with this Clause 8.13(c) and all Applicable Laws in disposal of the Digested Sludge.

(d) Disposal of Treated Effluent

- (i) As part of the Facilities, the Concessionaire shall be required to set up an Effluent Disposal Pipeline for transportation of the Treated Effluent from the Outlet Point to the Discharge Point.
- (ii) The Concessionaire shall, subject to compliance with Applicable Laws and Applicable Permits, be free to dispose the Treated Effluent in the

following manner:

- (A) transfer the Treated Effluent through the Effluent Disposal Pipeline to the Discharge Point for discharge into the river Ganga; or
 - (B) sell the Treated Effluent at such price and to such Persons as it may deem fit. Provided that if the Concessionaire sells the Treated Effluent to any third party, the Concessionaire shall be required to share 50% of the revenues from such sale with the Jal Nigam.
- (iii) The Concessionaire shall maintain proper records of sale of any Treated Effluent generated from the Facilities (including the revenues earned by the Concessionaire from such sale) and make them available to the Jal Nigam for its review.
- (iv) The Concessionaire shall indemnify the Jal Nigam against any costs or liabilities that may arise due to the Concessionaire's failure to comply with this Clause 8.13(d) and all Applicable Laws in disposal of the Treated Effluent.
- (e) Rights and interest in the STP By-Products and the Treated Effluent

All rights and interest in the STP By-Products and the Treated Effluent discharged from the Varanasi STP shall vest with the Concessionaire at all times during the O&M Period, unless transferred by the Concessionaire to a third party buyer/offtaker in accordance with this Agreement.

8.14 Remedial Measures

If after the COD, the Concessionaire ceases to operate the Facilities and the Associated Infrastructure for a period of 48 consecutive hours other than due to a Forced Unavailability, Scheduled Maintenance, or a suspension pursuant to Clause 15.1 or Clause 15.2, which is not attributable to the Concessionaire, or a Force Majeure Event, without the prior written consent of the Jal Nigam, then the Jal Nigam shall be entitled to step-in and undertake O&M of the Facilities and the Associated Infrastructure until the Concessionaire demonstrates to the satisfaction of the Jal Nigam that it can and will resume normal operation and maintenance of the Facilities and the Associated Infrastructure. The exercise of the Jal Nigam's rights under this Clause 8.14 shall be at the cost, risk and expense of the Concessionaire. The Concessionaire shall not be entitled to receive any O&M Charges for the duration that the Jal Nigam steps-in to operate and maintain the Facilities and the Associated Infrastructure.

8.15 O&M Personnel

- (a) The Concessionaire shall engage (either directly or through an approved Subcontractor) adequate number of suitably skilled and qualified personnel to undertake the O&M of the Facilities and the Associated Infrastructure in accordance with the requirements set out in this Article 8.

- (b) The Concessionaire shall be solely responsible for discharging all obligations in connection with the employment of the O&M personnel, including the payment of wages, salaries, Taxes, and retrenchment compensation and providing all amenities and benefits required under applicable labour laws.
- (c) Subject to compliance with the Applicable Laws, the Concessionaire shall have full freedom to determine its internal human resources (HR) policies, including, the wages, benefits and salary structure of its employees, the conditions of service, the shifts of work, its hire and fire policy (whether for misconduct or other cause), and payment of severance or retrenchment compensation.
- (d) The Jal Nigam is not and shall not be treated as the "principal employer" of or be deemed to have any contractual or other relationship with the O&M personnel. The Concessionaire shall hold harmless and indemnify the Jal Nigam against all losses, claims, costs and damages that the Jal Nigam may suffer due to the Concessionaire's or any of its Subcontractor's failure to comply with applicable labour laws.

9. PAYMENT AND INVOICING

9.1 In consideration of the works and services required to be performed by the Concessionaire for designing, financing, constructing, rehabilitating operating and maintaining the Facilities and the Associated Infrastructure in accordance with this Agreement, the Concessionaire shall be entitled to receive the Construction Payments and the O&M Payments from NMCG in accordance with this Article 9.

9.2 The Concessionaire shall be deemed to have satisfied itself regarding the adequacy, accuracy and sufficiency of the Construction Payments and the O&M Payments. Except for any adjustment in accordance with Clause 8.13(a) and Clause 13.2, or any permitted Variation, the Construction Payments and the O&M Payments are the total consideration payable to the Concessionaire for undertaking the Project.

9.3 Construction Payments

- (a) NMCG shall deposit an amount equivalent to the first 2 Payment Milestones in the Escrow Account in accordance with Clause 9.5 and the Escrow Agreement, prior to the Effective Date. From the Effective Date and during the Construction Period, NMCG shall ensure that the Escrow Account is funded with an amount equivalent to the next 2 Payment Milestones.
- (b) 10% of the Bid Project Cost shall be given to the Concessionaire as a Mobilization Advance in accordance with Clause 9.3(d), which will be adjusted against the Construction Payments to be paid by NMCG to the Concessionaire in 4 instalments, in accordance with Clause 9.3(e). The Construction Payments will be paid to the Concessionaire, upon completion of the work corresponding to the Payment Milestones and certification of completion of such Payment Milestones by the Jal Nigam in accordance with Clause 7.13.



(c) Adjustment in Construction Payments

- (i) The Construction Payments shall be adjusted during the Construction Period to reflect the variation in the Construction Price Index occurring after the Reference Index Date immediately preceding the Bid Due Date.
- (ii) All Invoices to be submitted by the Concessionaire to the Jal Nigam for any instalment of the Construction Payments shall be the product of the relevant percentage of the Bid Project Cost and the Price Index Multiple applicable on the date of the Invoice.

(d) Mobilization Advance

- (i) 10% of the Bid Project Cost shall be payable to the Concessionaire as the Mobilization Advance, within 30 days from the Effective Date, subject to the Concessionaire having submitted a Mobilization Advance Guarantee in accordance with Clause 5.16. The Concessionaire is liable to simple interest at the rate of 8% on the Mobilization Advance, which amount shall be deducted along with the Mobilization Advance from the Construction Payments.
- (ii) The Mobilization Advance (along with interest) shall be deducted in equal instalments from the 4 instalments of the Construction Payments to be made to the Concessionaire upon progressive completion of the Payment Milestones.

(e) Milestone Construction Payments

- (i) Subject to this Clause 9.3(e), the Construction Payments will be paid by NMCG to the Concessionaire in the following 4 equal instalments (**Payment Milestones**) (after adjusting the Mobilization Advance and the interest payable on the Mobilization Advance):
 - (A) 1st instalment of 10% of the Bid Project Cost, as adjusted for the Price Index Multiple applicable on the date of the relevant Invoice, upon the expiry of 5 months from the Effective Date or issuance of the first Milestone Completion Certificate, whichever is earlier;
 - (B) 2nd instalment of 10% of the Bid Project Cost, as adjusted for the Price Index Multiple applicable on the date of the relevant Invoice, upon the expiry of 10 months from the Effective Date or issuance of the second Milestone Completion Certificate, whichever is earlier;
 - (C) 3rd instalment of 10% of the Bid Project Cost, as adjusted for the Price Index Multiple applicable on the date of the relevant Invoice, upon the expiry of 15 months from the Effective Date or issuance of the third Milestone Completion Certificate, whichever is earlier; and

- (D) 4th instalment of 10% of the Bid Project Cost, as adjusted for the Price Index Multiple applicable on the date of the relevant Invoice, upon the expiry of 21 months from the Effective Date or issuance of the Construction Completion Certificate, whichever is earlier.
- (ii) Within 7 days of issuance of the Milestone Completion Certificate for a Payment Milestone, the Concessionaire shall submit an Invoice to the Jal Nigam for the amount of the Construction Payment linked to such Payment Milestone. Any Invoice raised by the Concessionaire for the Construction Payments shall be accompanied by a copy of the relevant Milestone Completion Certificate issued by the Jal Nigam.
- (iii) Within 10 days of receipt of an Invoice from the Concessionaire pursuant to Clause 9.3(e)(ii) above, the Jal Nigam shall verify and certify the amounts due and payable to the Concessionaire, and either:
- (A) approve the Invoice and issue a certificate to the Escrow Bank (with a copy to NMCG and the Concessionaire), conveying its approval for the release of the amount specified in the Invoice, less any necessary deductions or adjustments in accordance with this Agreement and/or Applicable Laws (including for payments to be made by the Concessionaire under applicable labour laws); or
- (B) issue a notice to the Concessionaire disputing the Invoice and directing the Concessionaire to issue a revised Invoice, after rectifying the errors or discrepancies identified by the Jal Nigam.
- The Concessionaire shall submit a revised Invoice to the Jal Nigam after rectifying the errors or discrepancies identified by the Jal Nigam and this process will be repeated until the Jal Nigam approves the Invoice and issues a certificate to the Escrow Bank (with a copy to NMCG and the Concessionaire), conveying its approval for release of the amount specified in the Invoice.
- (iv) Any dispute between the Parties in relation to a disputed Invoice will be settled in accordance with Article 21 (*Dispute Resolution*).
- (v) A certificate issued by the Jal Nigam in accordance with Clause 9.3(e)(iii) shall be referred to as a **Payment Certificate**.
- (vi) If, within 10 days from the date of receipt of an Invoice, the Jal Nigam does not dispute an Invoice, then the Invoice shall be deemed to have been accepted by the Jal Nigam and the Concessionaire shall have the right to issue instructions to the Escrow Bank (with a copy to the Jal Nigam and NMCG) to release the amounts specified in the Invoice, upon the expiry of the 10-day period.

- (vii) Immediately upon receipt of a Payment Certificate from the Jal Nigam in accordance with Clause 9.3(e)(iii) or upon receipt of instructions from the Concessionaire in accordance with Clause 9.3(e)(vi), the Escrow Bank shall release the amount specified in the Payment Certificate or if no Payment Certificate has been issued, then the amount specified in the relevant Invoice, in accordance with the Escrow Agreement.
- (viii) Notwithstanding anything to the contrary in this Agreement, the Jal Nigam shall have no obligation to issue a Payment Certificate unless:
 - (A) the Performance Security remains valid and in effect;
 - (B) the insurances to be obtained by the Concessionaire in accordance with Clause 11.2 are valid and in effect;
 - (C) the Concessionaire Applicable Permits for construction and rehabilitation of the Facilities and the Associated Infrastructure are in full force and effect, unless the withdrawal or cancellation of any Applicable Permit is not attributable to the Concessionaire's failure to comply with Applicable Laws;
 - (D) the Concessionaire has complied with the EHS Plan in undertaking the construction of the Facilities and the Associated Infrastructure; and
 - (E) there is no subsisting Concessionaire Event of Default.

9.4 O&M Payments

- (a) During the O&M Period, NMCG shall be required to make the O&M Payments to the Concessionaire comprising the Capex Annuity, the interest on the reducing balance of 60% of the Completion Cost, the O&M Charges and the Power Charges, in accordance with this Clause 9.4.
- (b) Calculation of Completion Cost
 - (i) The Completion Cost will be the aggregate of (A) – (D) below:
 - (A) 25% of the Bid Project Cost adjusted for the Price Index Multiple as applicable on the Reference Index Date preceding the date of the Invoice for the first Payment Milestone;
 - (B) 25% of the Bid Project Cost adjusted for the Price Index Multiple as applicable on the Reference Index Date preceding the date of the Invoice for the second Payment Milestone;
 - (C) 25% of the Bid Project Cost adjusted for the Price Index Multiple as applicable on the Reference Index Date preceding the date of the Invoice for the third Payment Milestone; and

- (D) 25% of the Bid Project Cost adjusted for the Price Index Multiple as applicable on the Reference Index Date preceding the date of the Invoice for the fourth Payment Milestone.
- (ii) 60% of the Completion Cost will be paid in quarterly instalments during the O&M Period as Capex Annuity.
- (c) On and from the COD and during the O&M Period, NMCG shall deposit the O&M Payments in the Escrow Account such that the Escrow Account is funded at all times with the Capex Annuity (along with interest), the O&M Charges and the estimated Power Charges for the next 2 years.
- (d) Adjustment in O&M Charges
- (i) The O&M Charges shall be adjusted during the O&M Period to reflect the variation in the O&M Price Index occurring after the Reference Index Date immediately preceding the Bid Due Date.
- (ii) All Invoices to be submitted by the Concessionaire to the Jal Nigam for the quarterly O&M Charges shall be the product of the applicable O&M Charges for the relevant quarter and the Price Index Multiple applicable on the date of the Invoice.
- (e) Capex Annuity
- (i) The Capex Annuity shall be payable in 60 equal quarterly instalments during the O&M Period.
- (ii) Interest shall be payable on the reducing balance of 60% of the Completion Cost, at the rate of the SBI MCLR plus 3% per annum. Such interest shall be due and payable quarterly along with each instalment of the Capex Annuity. The Parties agree that such interest shall be calculated on the basis of the number of days for which the relevant rate of the SBI MCLR was applicable during the period of calculation.

*By way of illustration, assuming that the balance Completion Cost to be paid to the Concessionaire on the date of payment of the 1st Capex Annuity instalment is INR 50,00,00,000 (Rupees fifty crores), the applicable SBI MCLR for the first 50 days is 8% and thereafter it is revised to 7.5% and remains unchanged till the date of payment of the 2nd Capex Annuity, the interest would be calculated as $((50*11\%*50)/365)+((50*10.5\%*40)/365)$. For the avoidance of doubt, the interest shall be calculated on simple interest basis and the interest shall not be compounded for the purpose of payment.*

- (f) O&M Charges
- (i) The O&M Charges for the first quarter after COD will be calculated on the basis of the O&M Charges quoted by the Selected Bidder in the Financial Proposal for the first month from the COD, which amount shall

be adjusted for the Price Index Multiple applicable on the Reference Index Date preceding the date of the first Invoice for the O&M Payments.

- (ii) For each subsequent quarter of the O&M Period, the O&M Charges will be adjusted for the Price Index Multiple applicable on the Reference Index Date preceding the date of the relevant Invoice for the O&M Payments.

(g) Power Charges

- (i) The Power Charges for the Facilities and the Associated Infrastructure shall initially be borne by the Concessionaire, which shall be reimbursed by NMCG to the Concessionaire as follows:

- (A) Power Charges for the Facilities shall be reimbursed at actuals subject to a cap of the Power Charges based on the Guaranteed Energy Consumption; and

- (B) Power Charges for the Associated Infrastructure shall be reimbursed at actuals.

- (ii) The Power Charges for any given quarter of the O&M Period will be calculated as follows:

- (A) For the units of energy consumed from the grid (as evidenced by a copy of the bill issued by the distribution licensee), the Power Charges will be calculated by multiplying the number of units consumed in such quarter (subject to the Guaranteed Energy Consumption for the energy consumed by the Facilities) with the Power Unit Rate.

If the Concessionaire procures power from outside Uttar Pradesh, then, the Power Unit Rate will be the prevalent power unit rate in Uttar Pradesh or the tariff at which the Concessionaire procures power from outside Uttar Pradesh, whichever is lower.

- (B) If there is any interruption in the supply of power from the grid, and the Concessionaire uses backup power supply from the DG Sets, then,

- (I) the Concessionaire's Representative and the Jal Nigam shall jointly take readings from the meters installed at the DG Sets to determine the number of units of energy consumed from the DG Sets for O&M of the Facilities and the Associated Infrastructure;

- (II) the number of units of energy consumed from the DG Sets (determined as per (I) above) for the Facilities shall be adjusted such that the aggregate of the total number of units consumed from the grid for the Facilities and the total number of units consumed from the DG Sets for the

Facilities shall not exceed the Guaranteed Energy Consumption (**Adjusted DG Set Units**);

- (III) the quantity of diesel consumed to generate the units of energy consumed from the DG Sets for the Associated Infrastructure (determined as per (I) above) and the Adjusted DG Set Units for the Facilities in the relevant quarter shall be calculated by the Jal Nigam based on the rated specific fuel consumption of the DG Sets specified by the manufacturers of the DG Sets; and
 - (IV) the Power Charges for the units of energy consumed from the DG Sets for the Associated Infrastructure (determined as per (I) above) and the Adjusted DG Set Units will be calculated by multiplying the quantity of diesel consumed (determined as per (III) above) with the Fuel Price.
- (C) The Concessionaire shall be liable to pay liquidated damages to the Jal Nigam for any units of energy consumed beyond the Guaranteed Energy Consumption (whether from the grid or from the DG Sets) for the Facilities (**Power Consumption Liquidated Damages**), which will be calculated as follows:
- (I) For excess power consumption up to 5% of the Guaranteed Energy Consumption:

Power Consumption Liquidated Damages: (Number of power units consumed in the relevant quarter – Guaranteed Energy Consumption for such quarter) * [Power Unit Rate] * 0.25
 - (II) For excess power consumption between 5% and 10% of the Guaranteed Energy Consumption:

Power Consumption Liquidated Damages: (Number of power units consumed in the relevant quarter – Guaranteed Energy Consumption for such quarter) * [Power Unit Rate] * 0.5
 - (III) For excess power consumption above 10% of the Guaranteed Energy Consumption:

Power Consumption Liquidated Damages: (Number of power units consumed in the relevant quarter – Guaranteed Energy Consumption for such quarter) * [Power Unit Rate]
- (D) The Power Consumption Liquidated Damages payable by the Concessionaire in any quarter of the O&M Period will be

deducted from the O&M Charges payable to the Concessionaire for such quarter. If the Power Consumption Liquidated Damages for a quarter exceed the O&M Charges for such quarter, then the excess amounts shall, at the discretion of the Jal Nigam, either be adjusted against the O&M Charges for the subsequent quarter or recovered from the O&M Security.

- (h) The O&M Payments shall be paid by NMCG to the Concessionaire on a quarterly basis. The Concessionaire shall submit an Invoice to the Jal Nigam for each quarter on or before the 7th day of the first month of the following quarter, which should set out: (i) the Capex Annuity due to the Concessionaire in such quarter along with interest in accordance with Clause 9.4(e)(ii) above; (ii) the O&M Charges due to the Concessionaire in such quarter; (iii) the Power Charges incurred by the Concessionaire during such quarter for power drawn from the grid or the DG Sets, subject to the cap of the Power Charges based on the Guaranteed Energy Consumption; and (iv) the Power Charges incurred by the Concessionaire during such quarter for power drawn from the grid or the DG Sets for the Associated Infrastructure. Any Invoice raised by the Concessionaire for O&M Payments shall be accompanied with a copy of the: (A) KPI Adherence Report for each month of the relevant quarter, duly certified by the Project Engineer; and (B) copy of the bill(s) issued by the state distribution utility for the Power Charges, and if relevant, copy of the joint meter reading for consumption of power from the DG Sets.

If the Invoice is not accompanied with the supporting documents specified at (A) and (B) above, the Jal Nigam shall not be required to process such Invoice.

- (i) Within 10 days of receipt of an Invoice from the Concessionaire pursuant to Clause 9.4(h) above, the Jal Nigam shall verify and certify the amounts due and payable to the Concessionaire, and either:
- (A) approve the Invoice and issue a certificate to the Escrow Bank (with a copy to NMCG and the Concessionaire), conveying its approval for the release of the amount specified in the Invoice, less any necessary deductions or adjustments in accordance with this Agreement and/or Applicable Laws (including any statutory dues); or
 - (B) issue a notice to the Concessionaire disputing the Invoice and directing the Concessionaire to issue a revised Invoice, after rectifying the errors or discrepancies identified by the Jal Nigam.

The Concessionaire shall submit a revised Invoice to the Jal Nigam after rectifying the errors or discrepancies identified by the Jal Nigam and this process will be repeated until the Jal Nigam approves the Invoice and issues a certificate to the Escrow Bank (with a copy to NMCG and the Concessionaire), conveying its approval for release of the amount specified in the Invoice.

- (j) Any dispute between the Parties in relation to a disputed Invoice will be settled in accordance with Article 21 (*Dispute Resolution*).

- (k) A certificate issued by the Jal Nigam in accordance with Clause 9.4(i) shall be referred to as a **Payment Certificate**.
- (l) If, within 10 days from the date of receipt of an Invoice, the Jal Nigam does not dispute an Invoice, then the Invoice shall be deemed to have been accepted by the Jal Nigam and the Concessionaire shall have the right to issue instructions to the Escrow Bank (with a copy to the Jal Nigam and NMCG) to release the amounts specified in the Invoice, upon the expiry of the 10-day period.
- (m) Immediately upon receipt of a Payment Certificate in accordance with Clause 9.4(i)(A) or upon receipt of instructions from the Concessionaire in accordance with Clause 9.4(l), the Escrow Bank shall release the amount specified in the Payment Certificate or if no Payment Certificate has been issued, then the amount specified in the relevant Invoice, in accordance with the Escrow Agreement.
- (n) Notwithstanding anything to the contrary in this Agreement, the Jal Nigam shall have no obligation to issue a Payment Certificate unless:
 - (i) the O&M Security remains valid and in effect;
 - (ii) the insurances to be obtained by the Concessionaire in accordance with Clause 11.2 are valid and in effect;
 - (iii) the Concessionaire Applicable Permits for O&M of the Facilities and the Associated Infrastructure are in full force and effect, unless the withdrawal or cancellation of any Applicable Permit is not attributable to the Concessionaire's failure to comply with Applicable Laws;
 - (iv) the Concessionaire has complied with the EHS Plan in undertaking the O&M of the Facilities and the Associated Infrastructure; and
 - (v) there is no subsisting Concessionaire Event of Default.

9.5 Escrow Account

- (a) Prior to the Effective Date, the Concessionaire, NMCG, the Jal Nigam and the Escrow Bank shall enter into the Escrow Agreement and NMCG shall open the Escrow Account with the Escrow Bank in accordance with the Escrow Agreement, which shall be operational until the expiry of the Term. The Escrow Agreement shall set out the terms of appointment of the Escrow Bank, NMCG's obligation to deposit the Construction Payments and the O&M Payments in accordance with this agreement with the Escrow Bank and terms of withdrawal of amounts from the Escrow Account.
- (b) Minimum Escrow Balance
 - (i) NMCG shall deposit an amount equivalent to the first 2 Payment Milestones prior to the Effective Date. From the Effective Date and during the Construction Period, NMCG shall ensure that the Escrow

Account is funded with an amount equivalent to the next 2 Payment Milestones; and

- (ii) On and from the COD and during the O&M Period, NMCG shall deposit the O&M Payments in the Escrow Account such that the Escrow Account is funded at all times with the Capex Annuity (along with interest), the O&M Charges and the estimated Power Charges for the next 2 years,

(the **Minimum Escrow Balance**).

If at any time during the Construction Period or the O&M Period, the balance in the Escrow Account falls below the Minimum Escrow Balance, NMCG shall promptly, and in any event, no later than 90 days, fund the Escrow Account such that the Minimum Escrow Balance is maintained. A failure to maintain the Minimum Escrow Balance for 90 days would be treated as a NMCG Event of Default and the consequences set out in Article 17 would follow.

It is clarified that any interest earned on the amounts deposited by NMCG in the Escrow Account will be counted towards the Minimum Escrow Balance.

- (c) The Concessionaire shall be entitled to withdraw amounts from the Escrow Account in accordance with the provisions of this Agreement and the Escrow Agreement.

9.6 **Taxes and Royalties**

- (a) The Construction Payments and the O&M Payments are inclusive of all Taxes other than service tax, which will be paid separately, at actuals.
- (b) The Jal Nigam may deduct from the Construction Payments, the O&M Payments and any other amounts due to the Concessionaire, any income tax or withholding tax that is required to be deducted at source.
- (c) The Concessionaire shall be responsible for payment of all applicable Taxes, including all procedural compliances related to the payment of Taxes pursuant to this Agreement, and shall be solely responsible for any proceedings initiated by any Government Authority, in respect of any non-payment or short-payment of Taxes.
- (d) The Concessionaire shall be responsible for payment of all applicable royalties on any fine and coarse aggregate, core sand, fine sand, grit and any other minerals extracted and/or used by the Concessionaire or any Subcontractor during the Construction Period and furnish proof of payment of such royalties to the Jal Nigam along with the Invoices for the Construction Payments.
- (e) Upon a request from the Concessionaire, NMCG/Jal Nigam will provide all relevant certificates and information to enable the Concessionaire to obtain any Tax exemptions available in relation to the Project. It is clarified that the Jal Nigam shall not be responsible in any manner for ensuring that any applicable Tax exemptions are available to the Concessionaire.

- (f) The Concessionaire shall indemnify NMCG and the Jal Nigam from and against any cost or liability that may arise due to the Concessionaire's failure to pay all applicable Taxes, in connection with the Project.
- (g) Any Taxes payable in relation to the Site shall be borne by the Jal Nigam.

9.7 Default Interest

Upon any Party's failure to make a payment due and payable by it on the due date for such payment, the defaulting Party shall be liable to pay default interest on all such outstanding amounts at the prevailing SBI MCLR + 3% per annum or part thereof. This is without prejudice to any Party's right to terminate this Agreement in accordance with Article 16 or any other right or remedy available to it under this Agreement or Applicable Laws.

9.8 Right of Set-Off

The Concessionaire shall not be entitled to retain or set off any amount due to NMCG or the Jal Nigam by it, but NMCG or the Jal Nigam may retain or set off any amount owed to it by the Concessionaire under this Agreement, which has fallen due and payable against any amount due to the Concessionaire under this Agreement. NMCG shall notify the Concessionaire at the time it exercises its right to set-off and shall provide the Concessionaire its reasons for exercising such right to set-off.

10. FINANCING ARRANGEMENTS AND SECURITY

10.1 Financing and Bankability Support

- (a) The Parties acknowledge that for the purposes of implementing the Project, the Concessionaire may require Financial Assistance from the Lenders. To this end, the Jal Nigam shall co-operate with the Concessionaire to achieve Financial Close, including by signing any relevant documents and providing such consents and waivers as may be reasonably required by the Lenders.
- (b) In case of a Concessionaire Event of Default, the Jal Nigam and NMCG acknowledge that the Lenders will have a right to substitute the Concessionaire in accordance with Clause 16.2 and the Substitution Agreement. The Jal Nigam will suspend its right to step-in or terminate this Agreement until the expiry of the period available to the Lenders to exercise their substitution rights under Clause 16.2.

10.2 Security Creation

- (a) The Concessionaire shall be entitled to create Security over all of its rights, title and interests in and to the Concession Agreement and the Escrow Agreement in favour of the Lenders for the purpose of obtaining Financial Assistance for the Project, provided that the creation of such Security will not result in any financial liability to the Jal Nigam or NMCG.



- (b) The Concessionaire shall be entitled to include the Lenders as co-insured and/or additional loss payees in any of the insurances taken by the Concessionaire in accordance with Clause 11.2 and/or grant Security over the proceeds of such insurance.
- (c) Except for any Security created by operation of law and any Security created pursuant to this Clause 10.2, the Concessionaire shall not be entitled to create any other Security over the Concession Agreement, the Escrow Agreement or insurance policies taken by it in favour of any third Persons, without the prior written consent of the Jal Nigam, which consent the Jal Nigam may deny in its sole discretion.
- (d) The Concessionaire shall not be entitled to create any Security over the Site or any part thereof, or any of the Facilities or the Associated Infrastructure or the Power Plant, if any, whether in favour of the Lenders or any third Persons.

11. INSURANCE AND INDEMNITIES

11.1 Indemnity and Limitation of Liability

- (a) Subject to Clause 11.1(b) below, the Concessionaire shall be responsible for, release, hold harmless and indemnify the Jal Nigam, NMCG, the Jal Nigam Related Parties and the NMCG Related Parties on demand from and against, all suits, actions, claims, demands, losses, damages, fines, penalties, costs or expenses (including costs of legal fees) or liability for:
 - (i) death or personal injury of any person;
 - (ii) loss of or damage to property;
 - (iii) non-compliance with Applicable Laws or Applicable Permits (including specifically, environmental laws and environmental consents);
 - (iv) any damage caused to the environment by the Concessionaire (including specifically, due to the Concessionaire's failure to meet the Discharge Standards); and
 - (v) any third party losses or claims;

which may arise out of, or in consequence of the performance or non-performance of the Concessionaire's obligations under this Agreement.

- (b) The Concessionaire shall not be responsible or be obliged to indemnify the Jal Nigam or NMCG for any injury, loss, damage, cost and expense caused by the negligence or Wilful Misconduct of the Jal Nigam, NMCG, the Jal Nigam Related Parties or the NMCG Related Parties or by a breach by the Jal Nigam or NMCG of their respective obligations under this Agreement.

- (c) The Jal Nigam and NMCG 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 them in respect of, resulting from, related to or arising out of any matter for which they are entitled to be indemnified under this Agreement, and the reasonable costs and expenses (including legal fees) thereof, shall be subject to the indemnification obligations of the Concessionaire.

If, however, the Concessionaire acknowledges in writing its obligations to indemnify the Jal Nigam and/or NMCG in respect of loss to the full extent provided by this Agreement, the Concessionaire shall be entitled, at its option, to assume and control the defence of such claim, action, suit or proceeding at its expense and through a counsel of its choice if it gives prompt notice of its intention to do so to the Jal Nigam and NMCG and reimburses the Jal Nigam and/or NMCG for the costs and expenses incurred by the Jal Nigam and/or NMCG prior to the assumption by the Concessionaire of such defence. A Party shall not settle or compromise any such claim, action, suit or proceeding without the prior written consent of the other Parties, which consent shall not be unreasonably withheld or delayed. Notwithstanding the foregoing, the Jal Nigam and/or NMCG shall have the right to employ its own counsel and such counsel may participate in such action, but the fees and expenses of such counsel, as and when incurred, shall be at the expense of the Jal Nigam or NMCG, as the case may be.

- (d) The Jal Nigam shall be responsible for, release, hold harmless and indemnify the Concessionaire and the Concessionaire Related Parties on demand from and against, all suits, actions, claims, demands, losses, damages, fines, penalties, costs or any other liability incurred or suffered by the Concessionaire under Applicable Laws, or pursuant to the law of torts, principles of absolute liability or strict liability or polluter pays principle, as a result of any environmental pollution or health hazard caused by the quality of raw Sewage which is delivered at the Facilities or the Associated Infrastructure.

(e) Limitation of liability

- (i) Notwithstanding anything to the contrary contained in this Contract, the maximum overall liability of any Party under this Agreement shall not exceed INR 120,00,00,000 (Rupees one hundred and twenty crores).
- (ii) Provided that the limitation of liability set out in Clause 11.1(e) above shall not apply to the following:
- (A) breach of Applicable Law and Applicable Permits;
 - (B) breach of any third party Intellectual Property Rights;
 - (C) fraud and Wilful Misconduct;
 - (D) gross negligence;
 - (E) damages to or loss of third party property;

- (F) damage caused to the environment;
- (G) misrepresentation by the Concessionaire; and
- (H) health hazard, bodily injury or loss of life.

(iii) The Parties agree and acknowledge that the provisions of this Clause 11.1(e) in respect of limitation and exclusion of liabilities is an agreed allocation of risk between the Parties, the sufficiency of which the Parties hereby agree and acknowledge.

(f) The provisions of this Clause 11.1 shall survive the termination of this Agreement.

11.2 Insurance

(a) The Concessionaire shall, obtain and maintain the policies of insurance set out below in the minimum coverage amounts and during the specified periods. In addition, the Concessionaire shall obtain any additional coverage required by Applicable Laws and/or deemed necessary by the Concessionaire, the Lenders or the Jal Nigam in accordance with this Clause 11.2.

Insurances during the Construction Period

During the Construction Period, the Concessionaire shall obtain and maintain such insurances for such maximum sums as may be required under the Financing Documents and Applicable Laws, and such insurances as may be necessary or prudent in accordance with Good Industry Practices.

Insurances during the O&M Period

During the O&M Period, the Concessionaire shall obtain and maintain insurance policies including but not limited to the following:

- (i) loss, damage or destruction of the Facilities, at replacement value;
- (ii) comprehensive third party liability insurance including injury to or death of personnel of the Jal Nigam or NMCG or others caused by the Project;
- (iii) the Concessionaire's general liability arising out of the Project;
- (iv) liability to third parties for goods or property damage;
- (v) workmen's compensation insurance; and
- (vi) any other insurance that may be necessary to protect the Concessionaire and its employees, including for all Force Majeure Events that are insurable at commercially reasonable premiums and not otherwise covered in items (i) to (v) above.

- (b) The level of insurance to be maintained by the Concessionaire after repayment of the Lenders' dues in full shall be determined on the same principles as applicable for determining the level of insurance prior to such repayment of the Lenders' dues, in accordance with the Financing Documents.
- (c) The Concessionaire shall, within 30 days of the Effective Date, provide a notice to the Jal Nigam, setting out information in respect of the insurances that it proposes to effect and maintain. Within 15 days of receipt of such notice, the Jal Nigam may require the Concessionaire to effect and maintain such other insurances as it may deem necessary, and in the event of any difference or disagreement relating to any such insurance, the provisions of Article 21 (*Dispute Resolution*) shall apply.
- (d) The Concessionaire shall purchase insurance from reputable Indian and/or international companies licensed to operate in India, at competitive terms, and shall maintain the insurances on terms consistent with Good Industry Practices. Within 15 days of obtaining any insurance cover, the Concessionaire shall furnish to the Jal Nigam, notarised true copies of the certificate(s) of insurance, copies of insurance policies and premia payment receipts in respect of such insurance.
- (e) Each insurance policy shall contain the following endorsements:
 - (i) the Jal Nigam shall be additional insured under all policies maintained by the Concessionaire in relation to the Site and the Project, against loss or damage;
 - (ii) the insurers shall waive all rights of subrogation against the Jal Nigam and NMCG;
 - (iii) the insurance policy may not be cancelled or materially changed by the insurer without giving 45 days' prior written notice, except in the case of non-payment, in which case it will be 10 days' prior written notice, to the Jal Nigam; and
 - (iv) the Jal Nigam shall not be responsible for payment of any insurance premium.
- (f) Any changes in the insurances which impact the Site or the Project will need the prior written consent of the Jal Nigam, which consent shall not be unreasonably withheld.
- (g) The Concessionaire shall apply proceeds from all insurance claims, except life and injury, for any necessary repair, reconstruction, reinstatement, replacement, improvement, delivery or installation of the Facilities or the Associated Infrastructure, and the balance remaining, if any, shall be applied in accordance with the provisions contained in this behalf in the Financing Documents.
- (h) If the Concessionaire fails to procure or maintain any insurance required pursuant to this Clause 11.2 which is required to be obtained for the Site or the Project, the

Jal Nigam shall have the right to procure and maintain such insurance in accordance with the requirements of this Clause 11.2 and charge the full cost thereof to the Concessionaire.

12. CHANGE IN OWNERSHIP

12.1 Ownership Information

The Selected Bidder shall inform the Jal Nigam that it has caused the Concessionaire to be incorporated as a special purpose company to implement the Project and undertake other obligations of the Concessionaire under and in accordance with this Agreement. The shareholding pattern of the Members in the Concessionaire is as follows:

S. No.	Name of the shareholder	No. of shares held	Nature of the shares [Equity/Preference]	Value of the shares held [in Rs.]	Shareholding [in %]
1.	Essel Infraprojects Ltd.	7,399	Equity	73,990	73.99
2.	Research and Production Company "ECOS" LLC	2,600	Equity	26,000	26
3.	Essel Infraprojects Ltd. jointly with Yatin Yogesh Sangani	1	Equity	10	0.01

The Concessionaire represents and warrants to the Jal Nigam and NMCG that no arrangements are in place that have resulted or may result in a breach of the change in ownership restrictions set out in Clause 12.2 below.

12.2 Change in Ownership Restrictions

- (a) The Concessionaire shall ensure that Members of the Selected Bidder, being the shareholders of the Concessionaire, comply with the following ownership restrictions:
- (i) the Lead Member shall hold at least 26% of the total Capital and voting rights of the Concessionaire until 3 years after the COD; and
 - (ii) any Member of the Consortium, other than the Lead Member, whose Technical Capacity or Financial Capacity is being assessed, shall hold at least 26% of the total Capital and voting rights of the Concessionaire until 3 years after the COD.

After the expiry of 3 years from the COD, the Lead Member and other Members can exit the Concessionaire, subject to: (A) the Member who demonstrated the O&M experience for the purposes of qualification continuing to be part of the Concessionaire; or (B) the entity acquiring the shareholding of the Lead Member/

any other Member in the Concessionaire meeting the O&M qualification criteria set out in the RFP; or (C) the Concessionaire appointing an O&M contractor who complies with the O&M qualification criteria set out in the RFP.

- (b) The Concessionaire shall ensure that the change in ownership restrictions set out in Clause 12.2(a) are incorporated in the articles of association of the Concessionaire.
- (c) If, any Associate, whose credentials were taken into consideration for determining Technical Capacity, ceases or will cease to be an Associate of the Member, then, the Concessionaire shall seek the approval of the Jal Nigam for such occurrence along with all relevant details. While the Jal Nigam shall not unreasonably withhold or delay such approval, the decision of the Jal Nigam will be final in this regard. If Jal Nigam is of the view that such occurrence is likely to affect the Technical Capacity of the Concessionaire to undertake the Project, then the Jal Nigam may treat such occurrence as a Concessionaire Event of Default, in which case the consequences set out in Article 17 shall follow.
- (d) If, at any time after the expiry of 3 years from the COD, any Member is proposed to be replaced by an entity that meets the O&M qualification criteria set out in the RFP or the Concessionaire proposes to appoint an O&M contractor to meet the change in ownership condition set out in Clause 12.2(a), then the Concessionaire shall submit a proposal to the Jal Nigam with details of the proposed shareholder/O&M contractor, for its approval. The proposal should demonstrate to the satisfaction of the Jal Nigam that the Concessionaire or the proposed O&M contractor meets the O&M qualification criteria specified in the RFP.

Within 15 days of receipt of a proposal from the Concessionaire, the Jal Nigam shall notify the Concessionaire of its approval or rejection (along with reasons) of the proposed shareholder/O&M contractor.

The approval of the proposed shareholder/O&M contractor by the Jal Nigam shall be at Jal Nigam's sole discretion.

If the Jal Nigam does not notify its approval or rejection of the proposed shareholder/O&M contractor within 60 days of the receipt of the proposal from the Concessionaire, then such proposed shareholder/O&M contractor will be deemed to be approved by the Jal Nigam.

13. CHANGE IN LAW

13.1 Change in Law

The Concessionaire may claim the benefit of and/or relief for a Change in Law event subject to and in accordance with this Article 13.



13.2 Consequences of Change in Law

- (a) The Concessionaire shall not be allowed any relief and/or compensation for any Change in Law which is not a: (i) Qualifying Change in Law; or (ii) Fundamental Change in Law.
- (b) If a Qualifying Change in Law occurs, then the Concessionaire shall notify the Jal Nigam and NMCG of such Qualifying Change in Law along with details of:
 - (i) any necessary change in the Construction Plan, the O&M Manual or the Technical Specifications on the basis of which construction works and O&M services are required to be undertaken for the Facilities and the Associated Infrastructure;
 - (ii) any changes that are required to the terms of this Agreement to deal with such Qualifying Change in Law;
 - (iii) any extension of the Scheduled Payment Milestone Completion Date or the Scheduled Construction Completion Date, to account for the delay, if any, resulting from the Qualifying Change in Law; and/or
 - (iv) any increase in Costs that will result from the Qualifying Change in Law.
- (c) As soon as practicable and in any event, within 30 days from the receipt of any notice from the Concessionaire under Clause 13.2(b) above, the Parties shall agree on the consequences of the Qualifying Change in Law, as specified in the notice, and any way in which the Concessionaire can mitigate the effect of the Qualifying Change in Law, including:
 - (i) providing evidence that the Concessionaire has used reasonable endeavours (including, where practicable, the use of competitive quotes) to minimise any increase in Costs or oblige the Subcontractors to minimise any increase in Costs;
 - (ii) providing evidence as to how the Qualifying Change in Law has affected prices of materials used for construction or O&M of STPs which are similar to the Facilities; and
 - (iii) demonstrating to the Jal Nigam and NMCG that the Qualifying Change in Law is the direct cause of the increase in Costs or delay and the estimated increase in Costs, or extension of time could not reasonably be expected to be mitigated or recovered by the Concessionaire.
- (d) If the Parties fail to agree on the consequences of the Qualifying Change in Law within 30 days from the receipt of any notice from the Concessionaire under Clause 13.2(b) above, the dispute will be finally settled in accordance with the dispute resolution procedure set out in Article 21.
- (e) If the Concessionaire has complied with Clause 13.2 (c) above and the Parties mutually agree or it is determined in accordance with Article 21 that the

Concessionaire is required to incur additional Costs due to a Qualifying Change in Law, then:

- (i) the Concessionaire shall be required to bear all Costs resulting from any one or more Qualifying Change in Law events, up to an aggregate amount equivalent to 0.5% of the Bid Project Cost (**Threshold Limit**); and
- (ii) for any additional Costs resulting from the Qualifying Change in Law, which is in excess of the Threshold Limit, the Concessionaire shall be entitled to be compensated for such additional Costs, in excess of the Threshold Limit, by way of,
 - (A) a lump-sum payment of an amount equivalent to the additional Costs incurred by the Concessionaire, over and above the Threshold Limit; or
 - (B) an appropriate adjustment in the O&M Charges.
- (f) If the Concessionaire has complied with Clause 13.2(c) above and the Parties mutually agree or it is determined in accordance with Article 21 that the Concessionaire will suffer any delay as a result of the occurrence of a Qualifying Change in Law, then the Concessionaire shall be entitled to an extension of time in accordance with Clause 7.11(b).
- (g) The quantum of relief (whether extension of time or compensation) that the Concessionaire shall be entitled to under this Clause 13.2 shall be as agreed by the Parties or as determined in accordance with Article 21, provided always that:
 - (i) the Concessionaire shall bear any increased Cost to the extent of the Threshold Limit; and
 - (ii) the Concessionaire shall only be entitled to relief that is reasonable for such Qualifying Change in Law.
- (h) Notwithstanding anything to the contrary in this Agreement, the Concessionaire shall not be entitled to any schedule relief and/or compensation or adjustment in the Bid Project Cost or the O&M Charges due to a Qualifying Change in Law, if such Qualifying Change in Law becomes applicable as a result of a delay in the execution of the Project, which is not attributable to a Delay Event.
- (i) If a Fundamental Change in Law occurs, then,
 - (i) the affected Party may notify the other Parties of the effects of such Fundamental Change in Law on the validity and enforceability of this Agreement or on the rights of the Concessionaire under this Agreement; and
 - (ii) any Party may propose amendments to the Concession Agreement, which would make the Concession Agreement compliant with Applicable Laws, while enabling the Parties to achieve their commercial objectives.

If the Parties are unable to agree on necessary amendments to the terms of this Agreement within 30 days of receipt of a notice from the affected Party or the Fundamental Change in Law event is such that it cannot be mitigated with amendments to the terms of this Agreement, the Fundamental Change in Law event shall be treated as a Direct Political Force Majeure Event in accordance with Article 14.

14. FORCE MAJEURE

14.1 Force Majeure Events

- (a) A **Force Majeure Event** means any act, event or circumstance or a combination of acts, events or circumstances or the consequence(s) thereof occurring after the date of this Agreement, which is/are:
- (i) beyond the reasonable control of the Affected Party;
 - (ii) such that the Affected Party is unable to overcome or prevent despite exercise of due care and diligence;
 - (iii) which does/do not result from the negligence of such Affected Party or the failure of such Affected Party to perform its obligations hereunder; and
 - (iv) such that it/they has/have a Material Adverse Effect.
- (b) A Force Majeure Event means the following events and circumstances to the extent that they satisfy the conditions set out in Clause 14.1(a):
- (i) Non-Political Force Majeure Events
 - (A) acts of God including storm, tempest, cyclone, hurricane, tsunami, flood, whirlwind, lightning, earthquake, washout, landslide, soil erosion, volcanic eruption, or extreme adverse weather or environmental conditions or actions of the elements;
 - (B) fire or explosion caused by reasons not attributable to the Concessionaire or any Concessionaire Related Parties;
 - (C) chemical or radioactive contamination or ionising radiation;
 - (D) epidemic, plague or quarantine;
 - (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; and
 - (F) accidents of navigation, air crash, shipwreck, train wreck or other similar failures of transportation of equipment and/or material

necessary for construction or O&M of the Facilities or the Associated Infrastructure.

Non-Political Force Majeure Event shall not include the following conditions, except to the extent resulting from a Non-Political Force Majeure Event:

- (A) heavy rainfall;
- (B) quantum of the Sewage being more than the Design Capacity;
- (C) characteristics of the Sewage being beyond the Influent Standards;
- (D) unavailability, late delivery or changes in cost of plant, machinery, equipment, materials or spare parts required for undertaking the Project;
- (E) a delay in the performance of any Subcontractor;
- (F) non-performance resulting from normal wear and tear; or
- (G) non-performance caused by the non-performing Party's (I) negligent or intentional acts, errors or omissions, (II) failure to comply with the Applicable Laws or Applicable Permits, or (III) breach of, or default under, this Agreement, as the case may be.

(ii) Indirect Political Force Majeure Events

- (A) hostilities (whether declared as war or not), riot, civil disturbance, revolution, rebellion, insurrection, act of terrorism, in each case involving the GoI or the GoUP or occurring in Uttar Pradesh;
- (B) invasion, armed conflict, coup d'etat, act of foreign enemy, blockade, embargo, revolution, insurgency, nuclear blast/explosion, politically motivated sabotage, religious strife or civil commotion, in each case involving the GoI or the GoUP or occurring in Uttar Pradesh;
- (C) strikes, lockout, boycotts or other industrial disputes which are not directly attributable to the actions of the Affected Party;
- (D) any orders issued by the relevant Government Authority, which require the Concessionaire to suspend the construction or O&M of the Facilities and the Associated Infrastructure provided that, such orders are not attributable to the Concessionaire's breach or violation of any Applicable Laws or Applicable Permits; and
- (E) delay or failure by relevant Government Authorities in renewing or granting any Applicable Permit, despite the Concessionaire

having applied for such Applicable Permit expeditiously and complied with the requirements of Applicable Laws in making such application or the unlawful revocation of any Applicable Permit.

- (iii) Direct Political Force Majeure Events
 - (A) occurrence of a Fundamental Change in Law in accordance with Clause 13.2(i);
 - (B) compulsory acquisition in national interest or expropriation of the Site; and
 - (C) any order, notification or judgement issued or passed by any Government Authority which restricts the Concessionaire from constructing, rehabilitating or operating the Facilities and/or the Associated Infrastructure as contemplated in this Agreement on the Site, unless such restriction is, in any manner, attributable to the Concessionaire.
- (c) Without prejudice to the provisions of Clauses 14.1(a) or 14.1(b) above,
 - (i) any act, event or circumstance which primarily affects any of the Concessionaire Related Parties associated with the Project shall constitute a Force Majeure Event if and to the extent that it is of a kind or character that, if it had directly affected the Concessionaire, it would have come within the definition of Force Majeure Event under this Clause 14.1; and
 - (ii) any act, event or circumstance which primarily affects any of the Jal Nigam Related Parties or the NMCG Related Parties shall constitute a Force Majeure Event if and to the extent that it is of a kind or character that, if it had directly affected the Jal Nigam or NMCG, it would have come within the definition of Force Majeure Event under this Clause 14.1.
- (d) If the Parties are unable to agree in good faith on the occurrence or existence of a Force Majeure Event, such dispute shall be finally settled in accordance with the dispute resolution procedure set out in Article 21, provided however that the burden of proof as to the occurrence or existence of such Force Majeure Event shall be upon the Affected Party.

14.2 Notice of Force Majeure Events

- (a) The Affected Party shall give notice to the other Party in writing of the occurrence of any Force Majeure Event (the **FM Notice**), as soon as the same arises or as soon as reasonably practicable and in any event within 3 days after the Affected Party knew of its occurrence, the adverse effect it has or is likely to have on the performance of its obligations under this Agreement, the actions being taken and an estimate of the time period required to overcome the Force Majeure Event and/or its nature and effects (if it is possible to estimate the same).

- (b) If, following the issue of the FM Notice, the Affected Party receives or becomes aware of any further information relating to the Force Majeure Event, it shall submit such further information to the other Party as soon as reasonably practicable.
- (c) Any party claiming to have been affected by a Force Majeure Event shall not be entitled to any relief unless it has complied with all the provisions of this Clause 14.2.

14.3 **Excuse of Performance**

The Affected Party, to the extent rendered unable to perform its obligations or part of the obligation thereof under this Agreement as a consequence of the Force Majeure Event, shall be excused from performance of the affected obligations, provided that the period shall not exceed 120 days for a Non-Political Force Majeure Event, 90 days for an Indirect Political Force Majeure Event and 60 days for a Direct Political Force Majeure Event from the date of issuance of the FM Notice.

The Parties may mutually agree to extend the period of excuse from performance due to a Force Majeure Event.

Provided that the excuse from performance shall be of no greater scope and of no longer duration than is reasonably warranted by the Force Majeure Event.

14.4 **No Liability for Other Losses**

Save and except as expressly provided in this Agreement, no Party shall be liable in any manner whatsoever to the other Parties in respect of any loss relating to or arising out of the occurrence or existence of any Force Majeure Event or the exercise by it of any right pursuant to this Article 14.

14.5 **Resumption of Performance**

The Affected Party shall, in consultation with the other Parties, make all reasonable efforts to limit or mitigate the effects of a Force Majeure Event on the performance of its obligations under this Agreement. The Affected Party shall also make efforts to resume performance of its obligations under this Agreement as soon as possible and upon resumption, shall notify the other Parties of the same in writing. The other Parties shall afford all reasonable assistance to the Affected Party in this regard.

14.6 **Allocation of costs during a Force Majeure Event**

- (a) Upon occurrence of a Force Majeure Event prior to the COD, the Parties shall bear their respective Costs and no Party shall be required to pay any Costs to the other Parties.
- (b) Upon occurrence of a Force Majeure Event post the COD, the Concessionaire shall be entitled to continue receiving the Capex Annuity (along with interest) and the O&M Charges during the subsistence of the Force Majeure Event.

14.7 **Termination due to Force Majeure Event**

(a) **Termination due to a Non-Political Force Majeure Event**

If a Non-Political Force Majeure Event continues for a period of period of 120 days after the notification of a Non-Political Force Majeure Event or any extended period agreed in pursuance of Clause 14.3, any Party shall, after the expiry of the period of 120-day period or any other mutually extended period, be entitled to forthwith terminate this Agreement in its sole discretion by issuing a notice to that effect to the other Parties.

Notwithstanding anything contained in this Clause 14.7:

- (i) if the Facilities are affected by a Total Casualty, then the Concessionaire may terminate this Agreement without having to wait for the expiry of the 120 days' period stipulated for a Non-Political Force Majeure Event; and
- (ii) if the Facilities are affected by a Minor Casualty, then the Concessionaire shall be required to repair and restore the Facilities to the same condition as previously existed and the Concessionaire shall not be entitled to terminate this Agreement on the grounds of a continuing Non-Political Force Majeure Event.

(b) **Termination due to an Indirect Political Force Majeure Event**

If an Indirect Political Force Majeure Event continues for a period of period of 90 days after the notification of an Indirect Political Force Majeure Event or any extended period agreed in pursuance of Clause 14.3, any Party shall, after the expiry of the period of 90 days' period or any other mutually extended period, be entitled to forthwith terminate this Agreement in its sole discretion by issuing a notice to that effect to the other Parties.

(c) **Termination due to a Direct Political Force Majeure Event**

If a Direct Political Force Majeure Event continues for a period of period of 60 days after the notification of a Direct Political Force Majeure Event or any extended period agreed in pursuance of Clause 14.3, any Party shall, after the expiry of the period of 60 days' period or any other mutually extended period, be entitled to forthwith terminate this Agreement in its sole discretion by issuing a notice to that effect to the other Parties.

All the other consequences of termination that are set out at Article 17 shall apply in case of termination of this Agreement due to a Force Majeure Event.

15. SUSPENSION

15.1 Suspension by the Concessionaire

(a) Suspension of construction or O&M of the Facilities and/or the Associated Infrastructure

- (i) At any time during the Term, the Concessionaire may suspend, whether partially or wholly, the construction or O&M of the Facilities and/or the Associated Infrastructure, as the case may be, in case of an Emergency.
- (ii) The Concessionaire acknowledges that suspension of the construction and/or rehabilitation of the Facilities and/or the Associated Infrastructure during the Construction Period pursuant to Clause 15.1(a)(i) shall not entitle the Concessionaire to an extension of time if such event is attributable to the Concessionaire.
- (iii) In case of suspension of the performance of the O&M services pursuant to Clause 15.1(a)(i) for reasons attributable to the Concessionaire, the Concessionaire shall be entitled to continue to receive the Capex Annuity along with interest, but not the O&M Charges, for the period during which it suspends the performance of the O&M services pursuant to Clause 15.1(a)(i).
- (iv) In case of suspension of the performance of the O&M services pursuant to Clause 15.1(a)(i) for reasons not attributable to the Concessionaire, the Concessionaire shall be entitled to continue to receive the Capex Annuity along with interest, and the O&M Charges, for the period during which it suspends the performance of the O&M services pursuant to Clause 15.1(a)(i).
- (v) Upon the occurrence of an Emergency, the Concessionaire shall as soon as reasonably possible, and in no event later than 3 days after such occurrence, notify the Jal Nigam of such occurrence.
- (vi) If, upon notification, the Jal Nigam does not concur with the Concessionaire on the nature of such occurrence, then the Concessionaire shall be required to immediately re-commence the construction or O&M of the Facilities and the Associated Infrastructure, as the case may be. Upon re-commencement of the construction or O&M services, the Concessionaire may initiate a Dispute regarding its claim for the occurrence of such an event or circumstance, and such Dispute shall be finally settled in accordance with the dispute resolution procedure set out in Article 21, provided however that the burden of proof as to the occurrence or existence of such an event shall be upon the Concessionaire.

(b) Mitigation, Resumption and Termination

- (i) The Concessionaire shall make best endeavours to:

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- (A) mitigate the effects (including incremental costs and delays) of the events or circumstances resulting in suspension pursuant to Clause 15.1(a)(i) above. Notwithstanding anything to the contrary contained in this Agreement, if the Jal Nigam, in its sole assessment, is not satisfied with the steps being taken by the Concessionaire to mitigate the effects of the Emergency, the Jal Nigam shall have the right to step-in to this Agreement and undertake necessary measures to mitigate the effect of the Emergency at the cost and risk of the Concessionaire; and
 - (B) resume the construction or O&M services of the Facilities and/or the Associated Infrastructure within 24 hours of the ceasing of any of the events or circumstances resulting in suspension pursuant to Clause 15.1(a)(i) or such longer period as may be approved by the Jal Nigam, and notify the Jal Nigam of the resumption of the works or services.
- (ii) Without prejudice to Clause 15.1(b)(i):
- (A) if suspension of the construction or O&M of the Facilities and/or the Associated Infrastructure pursuant to Clause 15.1(a)(i) continues for a period of 60 days, and such event is attributable to the Concessionaire, then such suspension shall amount to a Concessionaire Event of Default in accordance with Clause 16.1; and
 - (B) if suspension of the construction or O&M of the Facilities and/or the Associated Infrastructure pursuant to Clause 15.1(a)(i) continues for a period of 60 days, and such event is not attributable to the Concessionaire, then such event will be treated as a Force Majeure Event and the consequences set out in Article 14 shall apply.

15.2 Suspension by the Jal Nigam

- (a) Suspension of construction and/or the O&M of the Facilities and the Associated Infrastructure
 - (i) At any time during the Term, the Jal Nigam may suspend, whether partially or wholly, the construction or O&M of the Facilities and the Associated Infrastructure, in any of the following events or circumstances:
 - (A) upon the occurrence of an Emergency; or
 - (B) if the Concessionaire fails to comply with Applicable Laws, Applicable Permits, the EHS Plan, the O&M Manual or otherwise fails to perform its obligations in accordance with this Agreement (including the Technical Specifications).

- (ii) The Concessionaire acknowledges that suspension of the construction of the Facilities and/or the Associated Infrastructure during the Construction Period pursuant to Clause 15.2(a)(i) shall not entitle the Concessionaire to an extension of time if such event is attributable to the Concessionaire.
 - (iii) In case of suspension of the performance of the O&M services pursuant to Clause 15.2(a)(i) for reasons attributable to the Concessionaire, the Concessionaire shall be entitled to continue to receive the Capex Annuity along with interest, less the Liquidated Damages payable by the Concessionaire for failure to operate the Facilities and the Associated Infrastructure pursuant to Clause 15.2(a)(i). The Concessionaire shall not be entitled to the O&M Charges for the period during which it suspends the performance of the O&M services pursuant to Clause 15.2(a)(i).
 - (iv) In case of suspension of the performance of the O&M services pursuant to Clause 15.2(a)(i) for reasons not attributable to the Concessionaire, the Concessionaire shall be entitled to continue to receive the Capex Annuity along with interest, and the O&M Charges, for the period during which it suspends the performance of the O&M services pursuant to Clause 15.2(a)(i).
- (b) Mitigation, Resumption and Termination
- (i) The Concessionaire shall make best endeavours to:
 - (A) mitigate the effects (including incremental costs and delays) of the events or circumstances resulting in suspension pursuant to Clause 15.2(a) above. Notwithstanding anything to the contrary contained in this Agreement, if the Jal Nigam, in its sole assessment, is not satisfied with the steps being taken by the Concessionaire to mitigate the effects of the Emergency, the Jal Nigam shall have the right to step-in to this Agreement and undertake necessary measures to mitigate the effect of the Emergency at the cost and risk of the Concessionaire; and
 - (B) resume the construction or O&M services of the Facilities and/or the Associated Infrastructure within 24 hours of the ceasing of any of the events or circumstances resulting in suspension pursuant to Clause 15.2(a) or such longer period as may be agreed between the Parties, and notify the Jal Nigam of the resumption of the works or services.
 - (ii) Without prejudice to Clause 15.2(b)(i):
 - (A) if suspension of the construction or O&M of the Facilities and/or the Associated Infrastructure pursuant to Clause 15.2(a)(i)(A) and the Emergency is attributable to the Concessionaire, or a suspension pursuant to Clause 15.2(a)(i)(B), continues for a period of 60 days then such suspension shall amount to a Concessionaire Event of Default in accordance with Clause 16.1;

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- (B) if suspension of the construction or O&M of the Facilities and/or the Associated Infrastructure pursuant to Clause 15.2(a)(i)(A) continues for a period of 60 days, and the Emergency is not attributable to the Concessionaire, then such event will be treated as a Force Majeure Event and the consequences set out in Article 14 shall apply.

16. EVENTS OF DEFAULT

16.1 Concessionaire Events of Default

A **Concessionaire Event of Default** means any of the following events arising out of any acts or omissions of the Concessionaire and which have not occurred solely as a consequence of a Jal Nigam Event of Default, an NMCG Event of Default, a Qualifying Change in Law, a Fundamental Change in Law or any other Force Majeure Event, and where the Concessionaire has failed to remedy the defects within any specified time period (to the extent any time period is provided):

- (a) failure of the Concessionaire to complete the construction of the Facilities or the rehabilitation of the Associated Infrastructure by the expiry of the Grace Period;
- (b) failure of the Concessionaire to pay the Delay Liquidated Damages within the timelines specified in this Agreement;
- (c) failure of the Concessionaire to achieve successful completion of Trial Operations in accordance with Clause 7.14;
- (d) failure of the Concessionaire to remedy any reduction in Availability within 3 days of receipt of a notice from the Jal Nigam in accordance with Clause 8.12(a)(iv);
- (e) failure of the Concessionaire to cure a Third Breach within 20 days from the Third Breach Notice or a failure to comply with the Discharge Standards results in occurrence of a Third Breach more than 3 times in a continuous 12 month period, in accordance with Clause 8.12(b)(iii)(D);
- (f) failure of the Concessionaire to achieve the KPIs for 2 consecutive days, 32 times in a continuous 12 month period;
- (g) failure of the Concessionaire to achieve the KPIs for 1 day, 64 times in a continuous 12 month period;
- (h) suspension of the construction or O&M of the Facilities and/or the Associated Infrastructure pursuant to Clause 15.1(a)(i) (to the extent such Emergency is attributable to the Concessionaire) for a continuous period of 60 days;
- (i) suspension of construction or O&M of the Facilities or the Associated Infrastructure pursuant to Clause 15.2(a)(i)(A) (to the extent the Emergency is attributable to the Concessionaire) or a suspension pursuant to Clause


15.2(a)(i)(B), for a continuous period of 60 days;

- (j) a breach by the Concessionaire of its obligations under this Agreement which has a Material Adverse Effect on the ability of the Concessionaire to construct, rehabilitate and/or operate and maintain the Facilities or the Associated Infrastructure and such breach, if capable of being remedied, is not remedied within 30 days of issuance of written notice from the Jal Nigam specifying such breach and requiring the Concessionaire to remedy the same;
- (k) any representation made or warranties given by the Concessionaire under this Agreement being found to be false or misleading in any material respect;
- (l) failure of the Concessionaire to submit and maintain a valid Performance Security in accordance with Clause 5.1 or a valid O&M Security in accordance with Clause 5.4;
- (m) failure of the Concessionaire to maintain a valid Mobilization Advance Guarantee in accordance with Clause 5.16;
- (n) breach by the Concessionaire of its obligations under Article 4 (*Site and Asset Ownership*), 10.2 (*Security Creation*) or 23.12 (*Assignment*);
- (o) breach of the Concessionaire's obligations under Article 12 (*Change in Ownership*);
- (p) failure of the Concessionaire to obtain, renew and maintain any Concessionaire Applicable Permit;
- (q) failure of the Concessionaire to comply with any Applicable Law (including specifically the EPA);
- (r) failure of the Concessionaire to obtain and maintain insurance cover in accordance with Clause 11.2;
- (s) failure of the Concessionaire or the Subcontractors to comply with the EHS Plan in accordance with Clause 7.4;
- (t) the Concessionaire entering into liquidation or similar state or if any order is made for the compulsory winding up or dissolution of the Concessionaire or if the Concessionaire becomes unable to pay its debts or the appointment of a receiver or administrator in respect of the Concessionaire, its business and assets or any restructuring, re-organisation, amalgamation, arrangement or compromise affecting the Concessionaire's ability to fulfil its obligations under this Agreement or that otherwise has or may have a Material Adverse Effect; or
- (u) the breach of the Concessionaire's obligations under or the occurrence of an 'event of default' or analogous event under the Financing Documents or the Escrow Agreement, or termination of the Financing Documents, or the Escrow Agreement (for reasons attributable to the Concessionaire).

16.2 Notice of Intent to Terminate upon occurrence of a Concessionaire Event of Default

- (a) Without prejudice to the other provisions of this Agreement, upon the occurrence of a Concessionaire Event of Default, the Jal Nigam may initiate termination by delivering a Notice of Intent to Terminate to the Concessionaire, with a copy to NMCG. The Notice of Intent to Terminate shall specify with reasonable detail the grounds on which termination is sought.
- (b) If, within 60 days from the date of the Notice of Intent to Terminate, the Concessionaire rectifies or remedies the Event of Default to the satisfaction of the Jal Nigam or the Jal Nigam is satisfied with the steps taken or proposed to be taken by the Concessionaire or the Event of Default has ceased to exist, the Jal Nigam shall withdraw the Notice of Intent to Terminate, in writing.
- (c) If, within 60 days from the date of the Notice of Intent to Terminate, the Concessionaire does not rectify or remedy the Event of Default to the satisfaction of the Jal Nigam or the Jal Nigam is not satisfied with the steps taken or proposed to be taken by the Concessionaire to remedy the Event of Default, the Jal Nigam shall issue a notice to the Lenders to exercise their substitution rights.
- (d) If, within 60 days from the date of receipt of the Notice of Intent to Terminate pursuant to Clause 16.2(c) or such longer period as may be mutually agreed between the Jal Nigam and the Lenders, the Lenders have notified their intent to substitute the defaulting Concessionaire, then:
 - (i) the Jal Nigam shall withdraw the Notice of Intent to Terminate, in writing, with a copy to the Lenders; and
 - (ii) the process set out in the Substitution Agreement for nomination and approval of a substitute concessionaire will apply.
- (e) If, within 60 days from the date of receipt of the Notice of Intent to Terminate pursuant to Clause 16.2(c) or such longer period as may be mutually agreed between the Jal Nigam and the Lenders, the Lenders have not notified their intent to substitute the defaulting Concessionaire, then, the Jal Nigam shall terminate the Agreement and the consequences set out in Article 17 shall apply.
- (f) Notwithstanding anything contained in this Clause 16.2, during the subsistence of a Concessionaire Event of Default, the Parties shall continue to perform such of their respective obligations under this Agreement, which are capable of being performed in accordance with this Agreement.

16.3 Jal Nigam's Events of Default

 A **Jal Nigam Event of Default** means any of the following events, unless such an event has occurred as a consequence of a Concessionaire Event of Default, or a Force Majeure Event and where the Jal Nigam has failed to remedy the defects within any specified time period (to the extent any time period is provided):

- (a) a breach by the Jal Nigam of Clause 23.12(b) (*Assignment*);

- (b) a breach by the Jal Nigam of its obligations under this Agreement which has a Material Adverse Effect on the ability of the Concessionaire to construct or operate and maintain the Facilities or the Associated Infrastructure and such breach, if capable of being remedied, is not remedied within 30 days of a notice being given by the Concessionaire;
- (c) failure to achieve successful completion of Trial Operations due to the reasons set out in Clause 7.14(i) by the Scheduled COD;
- (d) a breach by the Jal Nigam of its obligations under Clause 7.8(g) or Clause 8.5(d), in relation to its rights, title and interest in the Site; or
- (e) any representation made or warranties given by the Jal Nigam under this Agreement being found to be false or misleading in any material respect.

16.4 NMCG's Events of Default

An **NMCG Event of Default** means any of the following events, unless such an event has occurred as a consequence of a Concessionaire Event of Default, or a Force Majeure Event and where NMCG has failed to remedy the defects within any specified time period (to the extent any time period is provided):

- (a) a failure by NMCG to pay any undisputed amounts due and payable for 90 consecutive days, notwithstanding service of a formal written demand by the Concessionaire;
- (b) a failure by NMCG to maintain the Minimum Escrow Balance for a period of 90 days;
- (c) a breach by NMCG of Clause 23.12(b) (*Assignment*); or
- (d) any representation made or warranties given by NMCG under this Agreement being found to be false or misleading in any material respect.

16.5 Notice of Intent to Terminate upon occurrence of a Jal Nigam Event of Default or an NMCG Event of Default

- (a) Without prejudice to the other provisions of this Agreement, upon the occurrence of a Jal Nigam Event of Default or an NMCG Event of Default, the Concessionaire may initiate termination of this Agreement by delivering a Notice of Intent to Terminate, which shall specify with reasonable detail the grounds on which termination is sought.
- (b) If, within 60 days from the date of the Notice of Intent to Terminate, the Jal Nigam or NMCG, as the case may be, rectifies or remedies the Jal Nigam Event of Default or the NMCG Event of Default, to the satisfaction of the Concessionaire or the Concessionaire is satisfied with steps taken or proposed to be taken by the Jal Nigam or NMCG or the Jal Nigam Event of Default or the

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NMCG Event of Default, as the case may be, has ceased to exist, the Concessionaire shall withdraw the Notice of Intent to Terminate.

- (c) If, within 60 days from the date of the Notice of Intent to Terminate, the Jal Nigam Event of Default or the NMCG Event of Default has not been remedied or the Jal Nigam or NMCG, as the case may be, has not taken steps or proposed to take steps to remedy the Jal Nigam Event of Default or the NMCG Event of Default to the satisfaction of the Concessionaire, then the Concessionaire shall terminate the Agreement and the consequences set out in Article 17 shall follow.
- (d) During the subsistence of a Jal Nigam Event of Default or an NMCG Event of Default, the Parties shall continue to perform such of their respective obligations under this Agreement, which are capable of being performed in accordance with this Agreement.

17. CONSEQUENCES OF TERMINATION

17.1 Consequences of termination of the Agreement post the Effective Date but prior to the Construction Completion Date

In case of termination of the Agreement prior to the Construction Completion Date:

- (a) the Concessionaire shall cease all work in relation to construction and rehabilitation of the Facilities and the Associated Infrastructure, and the Power Plant, if any;
- (b) the Concessionaire shall take all necessary steps to safeguard and protect the Facilities, the Associated Infrastructure and the Power Plant (at whatever stage of completion) and all other equipment, materials and goods on the Site;
- (c) the Jal Nigam shall require the Project Engineer to assess the Cost of the construction and rehabilitation works undertaken by the Concessionaire in relation to the Facilities and the Associated Infrastructure as on the date of the Notice of Intent to Terminate and based on such assessment, NMCG shall pay the Termination Compensation in accordance with Article 18;
- (d) in case of termination of this Agreement due to a Jal Nigam Event of Default or an NMCG Event of Default, the Jal Nigam shall return the Performance Security and the Mobilization Advance Guarantee within 30 days from the date of the Notice of Intent to Terminate; and
- (e) the Concessionaire shall hand over the Site, the Facilities and the Associated Infrastructure, and the Power Plant, if any, to the Jal Nigam or its nominee in accordance with the Hand-back Requirements set out in Clause 19.3, to the extent applicable.

17.2 Consequences of termination of the Agreement post the Construction Completion Date but prior to the COD

In case of termination of the Agreement post the Construction Completion Date but prior

to the COD:

- (a) the Concessionaire shall cease the Trial Operations of the Facilities, the Associated Infrastructure, and the Power Plant, if any;
- (b) the Concessionaire shall take all necessary steps to safeguard and protect the Facilities, the Associated Infrastructure, the Power Plant, if any, and all other equipment, materials and goods on the Site; and
- (c) the Concessionaire shall handover the Site, the Facilities the Associated Infrastructure and the Power Plant, if any, to the Jal Nigam or its nominee in accordance with the Hand-back Requirements set out in Clause 19.3.

17.3 Consequences of termination of the Agreement after the COD

In case of termination of the Agreement after the COD, the following consequences shall apply:

- (a) the Concessionaire shall cease all work in relation to O&M of the Facilities, the Associated Infrastructure, and the Power Plant, if any;
- (b) the Concessionaire shall take all necessary steps to safeguard and protect the Facilities, the Associated Infrastructure, the Power Plant, if any, and all other equipment, materials and goods on the Site;
- (c) in case of termination of this Agreement due to a Jal Nigam Event of Default or an NMCG Event of Default, the Jal Nigam shall return the O&M Security within 30 days from the date of the Notice of Intent to Terminate; and
- (d) the Concessionaire shall hand over the Site, the Facilities, the Associated Infrastructure and the Power Plant, if any, to Jal Nigam or its nominee in accordance with the Hand-back Requirements set out in Clause 19.3.

17.4 Consequences of termination due to a Force Majeure Event

In case of termination of the Agreement due to a Force Majeure Event, the following consequences shall apply:

- (a) the Concessionaire shall hand over the Site, the Facilities, the Associated Infrastructure and the Power Plant, if any, to the Jal Nigam on an "as is where is" basis and to the extent relevant, in accordance with the Hand-back Requirements set out in Clause 19.3;
- (b) the Jal Nigam shall be required to return the Mobilization Advance Guarantee, the Performance Security or the O&M Security, as the case may be, to the Concessionaire within 30 days from the date of the notice of termination under Clause 14.7; and
- (c) in case of termination due to an Indirect Political Force Majeure Event or a Direct Political Force Majeure Event, the Jal Nigam shall (or shall require the

Project Engineer) to assess the Cost of the construction and rehabilitation work undertaken by the Concessionaire in relation to the Facilities and the Associated Infrastructure as on the date of the notice of termination under Clause 14.7 and based on such assessment, pay the Termination Compensation in accordance with Clause 18.4.

17.5 **Accrued Rights and Liabilities**

- (a) Notwithstanding anything to the contrary contained in this Agreement, any termination of this Agreement shall be without prejudice to the accrued rights of a Party, including its right to claim and recover damages and other rights and remedies which it may have in law or contract. All accrued rights and obligations of a Party under this Agreement, including without limitation, all rights and obligations with respect to Termination Compensation, shall survive the termination of this Agreement, to the extent such survival is necessary for giving effect to such rights and obligations.
- (b) Nothing in Article 16 or this Article 17 shall prevent or restrict a Party to seek injunctive relief or a decree of specific performance or other discretionary remedies of the court.

18. **TERMINATION COMPENSATION**

18.1 **Termination Compensation for Termination post the Effective Date but prior to the Construction Completion Date**

- (a) For a Jal Nigam Event of Default or an NMCG Event of Default

If the Agreement is terminated prior to the Construction Completion Date for a Jal Nigam Event of Default or an NMCG Event of Default, NMCG shall be liable to pay to the Concessionaire the aggregate of:

- (i) Construction Payments due to the Concessionaire for Payment Milestones completed and certified by the Jal Nigam as on the date of the Notice of Intent to Terminate;
- (ii) Debt Due as on the date of Notice of Intent to Terminate;
- (iii) Equity infused in the Concessionaire as on the date of Notice of Intent to Terminate along with interest on the Equity at the rate of the prevailing SBI MCLR + 3%;

LESS

- (iv) any unadjusted Mobilization Advance (and interest);
- (v) any amounts due and payable by the Concessionaire under this Agreement (including Liquidated Damages and any amount payable under Clause 19.2).

(b) For a Concessionaire Event of Default

If the Agreement is terminated prior to the Construction Completion Date for a Concessionaire Event of Default, NMCG shall pay to the Concessionaire, the aggregate of:

- (i) Construction Payments due to the Concessionaire for Payment Milestones completed and certified by the Jal Nigam as on the date of the Notice of Intent to Terminate;
- (ii) 85% of Debt Due;

LESS

- (iii) any unadjusted Mobilization Advance (and interest);
- (iv) any amounts due and payable by the Concessionaire under this Agreement (including Liquidated Damages and any amount payable under Clause 19.2).

18.2 Termination Compensation for Termination post the Construction Completion Date but prior to the COD

(a) For a Jal Nigam Event of Default or an NMCG Event of Default

If the Agreement is terminated post the Construction Completion Date but prior to the COD for a Jal Nigam Event of Default or an NMCG Event of Default, NMCG shall be liable to pay to the Concessionaire the aggregate of:

- (i) Construction Payments, if not already paid as on the date of the Notice of Intent to Terminate;
- (ii) Debt Due;
- (iii) Equity infused in the Concessionaire as on the date of Notice of Intent to Terminate along with interest on the Equity at the rate of the prevailing SBI MCLR + 3%;

LESS

- (iv) any amounts due and payable by the Concessionaire under this Agreement (including Liquidated Damages and any amount payable under Clause 19.2).

(b) For a Concessionaire Event of Default

If the Agreement is terminated post the Construction Completion Date but prior to the COD for a Concessionaire Event of Default, NMCG shall pay to the Concessionaire, the aggregate of:



- (i) Construction Payments, if not already paid as on the date of the Notice of Intent to Terminate;
- (ii) 85% of Debt Due;

LESS

- (iii) any amounts due and payable by the Concessionaire under this Agreement (including Liquidated Damages and any amount payable under Clause 19.2).

18.3 Termination Compensation for Termination post the COD

(a) For a Jal Nigam Event of Default or an NMCG Event of Default

If the Agreement is terminated post the COD for a Jal Nigam Event of Default or an NMCG Event of Default, NMCG shall be liable to pay to the Concessionaire the aggregate of:

- (i) Construction Payments that remain outstanding on the date of the Notice of Intent to Terminate;
- (ii) O&M Payments due to the Concessionaire as on the date of the Notice of Intent to Terminate;
- (iii) Capex Annuity for the unexpired portion of the O&M Period;

LESS

- (iv) any amounts due and payable by the Concessionaire under this Agreement (including Liquidated Damages and any amount payable under Clause 19.2).

(b) For a Concessionaire Event of Default

If the Agreement is terminated post the COD for a Concessionaire Event of Default, NMCG shall pay to the Concessionaire, the aggregate of:

- (i) Construction Payments that remain outstanding on the date of the Notice of Intent to Terminate;
- (ii) O&M Payments due to the Concessionaire as on the date of the Notice of Intent to Terminate;
- (iii) 85% of the Capex Annuity for the unexpired portion of the O&M Period;

LESS

- (iv) any amounts due and payable by the Concessionaire under this Agreement (including Liquidated Damages and any amount payable under Clause

19.2).

18.4 Termination Compensation for Termination due to a Force Majeure Event

(a) Non-Political Force Majeure Event

In the event of a termination of this Agreement as a result of a Non-Political Force Majeure Event in accordance with Clause 14.7(a), the Parties agree that the Concessionaire shall be entitled to retain all proceeds received under any insurance policies maintained by it in relation to the Site and the Project (subject to the Lenders' rights in respect of such insurance proceeds) and the Concessionaire shall not be entitled to any Termination Compensation (other than payment of any outstanding Construction Payments and/or O&M Payments due as on the date of the notice of termination under Clause 14.7).

(b) Indirect Political Force Majeure

(i) If the Agreement is terminated due to an Indirect Political Force Majeure Event, prior to the COD, NMCG shall be liable to pay to the Concessionaire:

(A) Construction Payments due to the Concessionaire for Payment Milestones completed and certified by the Jal Nigam as on the date of the notice of termination under Clause 14.7;

(B) Debt Due;

LESS

(C) any insurance proceeds received and retained by the Concessionaire.

(ii) If the Agreement is terminated due to an Indirect Political Force Majeure Event post the COD, NMCG shall be liable to pay to the Concessionaire:

(A) Construction Payments that remain outstanding on the date of the notice of termination under Clause 14.7;

(B) O&M Payments due to the Concessionaire as on the date of the notice of termination under Clause 14.7;

(C) Debt Due;

LESS

(D) any insurance proceeds received and retained by the Concessionaire.

(c) Direct Political Force Majeure

(i) If the Agreement is terminated due to a Direct Political Force Majeure Event, prior to the COD, NMCG shall be liable to pay to the Concessionaire:

- (A) Construction Payments due to the Concessionaire for Payment Milestones completed and certified by the Jal Nigam as on the date of the notice of termination under Clause 14.7;
- (B) Debt Due;
- (C) Equity infused in the Concessionaire as on the date of the notice of termination under Clause 14.7 along with interest on the Equity at the rate of the prevailing SBI MCLR + 3%;

LESS

- (D) any unadjusted Mobilization Advance (and interest);
- (E) any insurance proceeds received and retained by the Concessionaire; and
- (F) any amounts due and payable by the Concessionaire under this Agreement (including Liquidated Damages and any amount payable under Clause 19.2).

(ii) If the Agreement is terminated due to a Direct Political Force Majeure Event post the COD, NMCG shall be liable to pay to the Concessionaire:

- (A) Construction Payments that remain outstanding on the date of the notice of termination under Clause 14.7;
- (B) O&M Payments due to the Concessionaire as on the date of the notice of termination under Clause 14.7;
- (C) Capex Annuity for the unexpired portion of the O&M Period;

LESS

- (D) any insurance proceeds received and retained by the Concessionaire; and
- (E) any amounts due and payable by the Concessionaire under this Agreement (including Liquidated Damages and any amount payable under Clause 19.2).

18.5 All Termination Compensation required to be paid by NMCG to the Concessionaire shall be paid within 60 days of handover of the Site, the Facilities, the Associated Infrastructure and

the Power Plant, if any, to the Jal Nigam in accordance with Article 19.

18.6 Full and Final Settlement

Notwithstanding anything to the contrary elsewhere in this Agreement, any Termination Compensation determined pursuant to this Article 18 shall, once paid, be in full and final settlement of any claim, demand and/or proceedings of the Concessionaire against NMCG and the Jal Nigam, in relation to termination of this Agreement and the Concessionaire shall be excluded from all other rights and remedies in respect of such termination.

18.7 The provisions of this Article 18 shall survive the termination of this Agreement.

19. TRANSFER ON TERMINATION

19.1 Transfer of the Site, Facilities, and Associated Infrastructure

Upon the expiry or early termination of this Agreement, the Concessionaire shall hand over the Site, the Facilities, the Associated Infrastructure and the Power Plant, if any, to the Jal Nigam or any other entity nominated by the Jal Nigam in accordance with this Article 19.

19.2 Inspection of the Site, the Facilities and Associated Infrastructure

- (a) No later than 30 days from the end of the 14th year of the O&M Period or 30 days from the date of termination of the Agreement, as the case may be, the Jal Nigam shall or shall cause the Project Engineer to carry out a survey of the Site, the Facilities, the Associated Infrastructure, and the Power Plant, if any, to assess whether they have been maintained by the Concessionaire in accordance with its obligations under this Agreement, and are in working condition in line with the design life stipulated in the Technical Specifications.
- (b) The Jal Nigam shall notify the Concessionaire at least 7 days prior to the date on which it wishes to carry out the survey of the Site, the Facilities, the Associated Infrastructure, and the Power Plant, if any.
- (c) If the survey carried out by the Jal Nigam or the Project Engineer shows that the Concessionaire has not or is not complying with its obligations under this Agreement, then the Jal Nigam shall notify the Concessionaire of the rectification and/or maintenance work which is required to ensure that the condition of the Site, the Facilities, the Associated Infrastructure, and the Power Plant, if any is restored to the Hand-back Conditions.
- (d) The Concessionaire shall carry out such rectification and/or maintenance work to achieve the Hand-back Conditions within 30 days from the receipt of a notice from the Jal Nigam in accordance with Clause 19.2(c) above, at its own cost and risk. Upon completion of the rectification and/or maintenance work, the Concessionaire shall request the Jal Nigam to carry out a final survey and inspection of the Site, the Facilities, the Associated Infrastructure, and the Power Plant, if any. The Jal Nigam shall carry out the final survey within 7 days of receipt of a notice from the Concessionaire pursuant to this Clause 19.2(d).

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If the Jal Nigam is satisfied with the results of the final survey, then the Jal Nigam shall notify the Concessionaire within 7 days of carrying out the final survey that the Site, the Facilities, the Associated Infrastructure, and the Power Plant, if any, comply with the Hand-back Conditions. If the Jal Nigam is not satisfied with the results of the final survey, then the Jal Nigam shall or shall cause the Project Engineer to estimate the cost of restoring the Site, the Facilities, the Associated Infrastructure and/or the Power Plant, if any, to the Hand-back Conditions and recover such cost from the Concessionaire.

19.3 Hand-back Requirements

On the expiry or early termination of this Agreement, the Concessionaire shall:

- (a) hand over to the Jal Nigam or any entity nominated by the Jal Nigam, the Site, the Facilities, the Associated Infrastructure, and the Power Plant, if any;
- (b) to the extent that such rights and interests are not already vested in the Jal Nigam, transfer all its rights and interest in the assets comprising the Facilities, the Associated Infrastructure, and the Power Plant, if any and execute such deeds and documents as may be necessary for this purpose and complete all related legal or other formalities;
- (c) hand over all documents relating to the Site, the Facilities, the Associated Infrastructure, and the Power Plant, if any, including as-built records, Designs and Drawings, online monitoring and metering data, operating logs, manuals, reports, plans and records;
- (d) transfer to the Jal Nigam or its nominee (free of cost) the license to use the Proposed Technology and other know-how relating to the Facilities, the Associated Infrastructure, and the Power Plant, if any;
- (e) transfer or cause to be transferred to the Jal Nigam or its nominee any Subcontract that the Jal Nigam or its nominee has chosen to take over and terminate all other Subcontracts;
- (f) transfer to the Jal Nigam or its nominee all Concessionaire Applicable Permits which the Jal Nigam or its nominee may require and which can be legally transferred; and
- (g) remove from the Site all employees and workmen, and assets, equipment and materials that are not required to be taken over by the Jal Nigam or its nominee.

19.4 The provisions of this Article 19 shall survive the termination of this Agreement.

20. VARIATION

20.1 Both the Jal Nigam and the Concessionaire may, at any time during the Term, propose a Variation to the Scope of Work, Technical Specifications, and/or the Designs and Drawings.

20.2 **Jal Nigam Proposed Variation**

- (a) The Jal Nigam may propose a Variation in the Scope of Work, Technical Specifications or the approved Designs and Drawings. Provided that, the Jal Nigam shall not propose a Variation, which: (i) is not technically feasible; or (ii) is not in compliance with any Applicable Law or Applicable Permit.
- (b) Within 15 days of receipt of a request for Variation from the Jal Nigam, the Concessionaire shall submit a proposal to the Jal Nigam (with a copy to the Project Engineer) setting out in sufficient detail the implications of the proposed Variation, including any implications on the Construction Plan, the Scheduled Milestone Completion Date, the Scheduled Construction Completion Date and Scope of Work and additional Costs incurred in undertaking the Variation or any reduction in Costs resulting from the Variation. It is clarified that the additional Costs incurred in undertaking the Variation or any reduction in Costs resulting from the Variation will be determined on the basis of the Jal Nigam's schedule of rates for similar works.
- (c) Notwithstanding anything to the contrary in this Clause 20.2, the Concessionaire shall have the right to reject a Variation proposed by the Jal Nigam if, in the Concessionaire's view, the proposed variation will result in: (i) the Concessionaire incurring additional Costs, of more than 25% of the Bid Project Cost; (ii) reduction in the Bid Project Cost by more than 25%; or (iii) a delay of more than 120 days in a Scheduled Milestone Completion Date or the Scheduled Construction Completion Date.
- (d) Based on its review of the proposal submitted by the Concessionaire, the Jal Nigam may, at its sole discretion: (i) accept the proposal and the corresponding adjustment to the Construction Plan and/or the additional Costs or reduction in the Bid Project Cost for undertaking the Variation; (ii) provide its comments on the proposal seeking amendments and/or justification for the implications put forth by the Concessionaire; or (iii) reject the proposal submitted by the Concessionaire and withdraw the proposed Variation, within 15 days from the date of receipt of the Concessionaire's proposal under Clause 20.2(b) above.
- (e) To the extent the Jal Nigam seeks amendments and/or justification in the proposal submitted by the Concessionaire, the Concessionaire shall incorporate or address, in writing, the Jal Nigam's comments and submit a revised proposal.
- (f) On approval of the proposal or the revised proposal, as the case may be, the Jal Nigam shall issue a Variation Order and Concessionaire shall proceed with the Variation in accordance with the Variation Order.
- (g) If the Parties are unable to agree on the implications of a Variation proposed by the Jal Nigam, which in Jal Nigam's view is necessary or desirable for the Project, the Jal Nigam shall have the right to require the Concessionaire to carry out the proposed variation at the cost determined in accordance with the Jal Nigam's schedule of rates for similar works. Where Jal Nigam's schedule of rates do not provide schedule of rates for similar works, then the cost of the works covered by the proposed Variation will be covered by the Project Engineer. Any dispute on the terms of the

Variation will be resolved in accordance with Article 21.

- (h) On implementation of a Variation Order, the Concessionaire shall be entitled to the agreed adjustment to the Construction Plan, Scheduled Milestone Completion Date, Scheduled Construction Completion Date and/or payment of additional amounts, if any, set out in the Variation Order.

20.3 **Concessionaire Proposed Variation**

- (a) The Concessionaire may propose a Variation if: (i) it considers such Variation necessary or desirable to improve the efficiency, quality, reliability, durability, maintainability or safety of the Facilities and/or the Associated Infrastructure; or (ii) in its view, it is required to undertake additional work for rehabilitating the Associated Infrastructure due to the condition of the Associated Infrastructure being inferior to that set out in Schedule 1 (*Scope of Work*) and Schedule 11 (*Technical Specifications*).
- (b) To propose a Variation, the Concessionaire shall submit a proposal to the Jal Nigam (with a copy to the Project Engineer), with a statement setting out:
 - (i) the need for a Variation;
 - (ii) the additional work required; and
 - (iii) adjustment to the Construction Plan, Scheduled Milestone Completion Date and Scheduled Construction Completion Date;
- (c) Based on its review of the proposal submitted by the Concessionaire, if the Jal Nigam is of the view that the proposed Variation is justified, then it will determine the cost of the proposed Variation using the Jal Nigam's schedule of rates for similar works and where the Jal Nigam's schedule of rates do not provide schedule of rates for similar works, then the cost of the works covered by the proposed Variation will be covered by the Project Engineer. Thereafter, the Jal Nigam shall notify the Concessionaire of the additional cost determined by the Jal Nigam for the proposed Variation and any other comments that the Jal Nigam may have on the implications of the proposed Variation. To the extent the Jal Nigam seeks amendments and/or justification in the proposal submitted by the Concessionaire, the Concessionaire shall incorporate or address, in writing, the Jal Nigam's comments.
- (d) On the Concessionaire's acceptance of the costs determined by the Jal Nigam for the proposed Variation and any other amendments sought by the Jal Nigam to the Concessionaire's proposal, the Jal Nigam shall issue a Variation Order and Concessionaire shall proceed with the Variation in accordance with the Variation Order.
- (e) On implementation of a Variation Order, the Concessionaire shall be entitled to the agreed adjustment in the Construction Plan and/or additional costs, as set out in the Variation Order.

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- 20.4 Notwithstanding anything to the contrary in this Article 20, the Concessionaire shall be bound to implement any Variation that is necessitated by a Change in Law and any consequent adjustment in the Construction Plan and additional Costs shall be determined in accordance with Article 13.
- 20.5 Notwithstanding the above, a Variation made necessary due to any act, omission or default of the Concessionaire or any Subcontractor in the performance of the Concessionaire's obligations under this Agreement shall not entitle the Concessionaire to any adjustment in the Construction Plan or any other compensation or relief.
- 20.6 No Variation shall invalidate this Agreement.

21. DISPUTE RESOLUTION

21.1 Amicable Settlement

In the event of any dispute, controversy or difference between the Parties arising out of or relating to this Agreement (including a dispute relating to the validity or existence of this Agreement and any non-contractual obligations arising out of or in connection with this Agreement) (a **Dispute**), the representatives of the Parties shall, within 15 days of service of a written notice from one Party to the other Parties (the **Dispute Notice**) hold a meeting (the **Dispute Meeting**) in an effort to resolve the Dispute in good faith. In the absence of any agreement to the contrary, the Dispute Meeting shall be held at the office of the Jal Nigam in Lucknow.

21.2 Dispute Resolution by Arbitration

(a) Arbitration Procedure

If a Dispute is not resolved within 30 days after the service of a Dispute Notice, whether or not a Dispute Meeting has been held, any Party to the Dispute shall be entitled to refer the Dispute to arbitration to be finally resolved in the manner set out in this Clause 21.2 by issuing a notice to the other Parties (**Notice of Arbitration**). This Agreement and the rights and obligations of the Parties shall remain in full force and effect pending the award in such arbitration proceeding.

(b) Appointment of Arbitrator

If a Dispute is referred to arbitration by a Party, such Dispute shall be resolved by a sole arbitrator to be appointed by mutual agreement of the Parties. If the Parties fail to appoint an arbitrator within 30 days after service of the Notice of Arbitration, such arbitrator shall be appointed in accordance with the Arbitration Act.

(c) Venue, Language and Rules of Arbitration

The venue of the arbitration shall be New Delhi and the language of the arbitration shall be English. The arbitration shall be conducted in accordance with the Arbitration Act.

(d) Award and Apportionment of costs

- (i) The arbitration award of the arbitrator shall be final and binding on the Parties and shall be enforceable in accordance with its terms. The arbitrator shall state reasons for its findings in writing.
- (ii) The costs of arbitration and the manner of bearing such costs shall be determined by the arbitrator.

(e) Law Governing the Arbitration

The arbitration shall be governed by the laws of India.

21.3 **Survival**

The provisions of this Article 21 shall survive the termination of this Agreement.

22. **REPRESENTATIONS AND WARRANTIES**

22.1 **Mutual Representations and Warranties**

Each Party represents and warrants to the other Parties that:

- (a) it has full power and authority to execute, deliver and perform its obligations under this Agreement, the Substitution Agreement, the Escrow Agreement and any other agreements required in relation to the Project;
- (b) it has taken all necessary action to authorise the execution, delivery and performance of this Agreement, the Substitution Agreement and the Escrow Agreement; and
- (c) there are no actions, suits or proceedings pending or to its best knowledge, threatened against or affecting it before any court, administrative body or arbitral tribunal which might materially and adversely affect its ability to meet or perform any of its obligations under this Agreement, the Substitution Agreement or the Escrow Agreement.

22.2 **Concessionaire's Representations and Warranties**

The Concessionaire represents and warrants to the Jal Nigam and NMCG that:

- (a) it is duly organized, validly existing and of good standing under the laws of India;
- (b) it has the financial standing and capacity to design, finance, construct, complete, operate and maintain the Facilities and the Associated Infrastructure in accordance with this Agreement;
- (c) this Agreement constitutes its legal, valid and binding obligation, enforceable against it in accordance with its terms, 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 India, and hereby expressly and irrevocably waives any immunity in any jurisdiction in respect of this Agreement or matters arising thereunder including any obligation, liability or responsibility hereunder;
- (e) the information furnished in the Bid of the Selected Bidder, and as updated on or before the date of this Agreement is true and accurate in all respects as on the Appointed Date;
- (f) the execution, delivery and performance of this Agreement will not conflict with, result in the breach of, constitute a default under any of the terms of its memorandum and articles of association/charter documents or any Applicable Laws or Applicable Permits or any covenant, contract, agreement, arrangement, understanding, decree or order to which it is a party or by which it or any of its properties or assets is bound or affected;
- (g) 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 the GoI or the GoUP 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;
- (h) it has complied with all Applicable Laws and Applicable Permits 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; and
- (i) no representation or warranty by it contained in this Agreement or in any other document furnished by it to the Jal Nigam, NMCG, the GoI or the GoUP in relation to Applicable Permits contains any untrue or misleading statement of material fact or omits to state a material fact necessary to make such representation or warranty.

22.3 Jal Nigam's Representations and Warranties

The Jal Nigam represents and warrants to the Concessionaire and NMCG that:

- (a) it is duly organized, validly existing and in good standing under the laws of India;
- (b) it has the financial standing and legal capacity to execute this Agreement and perform its obligations under this Agreement;
- (c) it has taken all necessary approvals to execute this Agreement (including any approval required under the UPWSS Act) and perform its obligations under this Agreement;



- (d) this Agreement constitutes legal, valid and binding obligations 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 the GoI or the GoUP, which may result in any Material Adverse Effect on its ability to perform its obligations under this Agreement;
- (f) it has complied with all Applicable Laws and Applicable Permits in all material respects;
- (g) the Site is not subject to any mortgage, lien, charge or any other Encumbrance;
- (h) it does not have any liability for any Taxes, or any interest or penalty in respect thereof, of any nature, that may constitute a lien against the Site; and
- (i) all information provided by it in the RFP and this Agreement (including the Technical Specifications) in connection with the Project is, to the best of its knowledge and belief, true and accurate in all material respects.

22.4 NMCG's Representations and Warranties

NMCG represents and warrants to the Concessionaire and the Jal Nigam that:

- (a) it is duly organized, validly existing and in good standing under the laws of India;
- (b) it has the financial standing and legal capacity to execute this Agreement and perform its obligations under this Agreement;
- (c) it has taken all necessary approvals to execute this Agreement and perform its obligations under this Agreement;
- (d) this Agreement constitutes legal, valid and binding obligations 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 the GoI or the GoUP, which may result in any Material Adverse Effect on its ability to perform its obligations under this Agreement; and
- (f) it has complied with all Applicable Laws and Applicable Permits in all material respects.

22.5 Acknowledgement

- (a) The Parties acknowledge and confirm that the Parties have relied upon and have entered into this Agreement on the basis of the representations, warranties and undertakings made by the Parties hereunder.

- (b) If any occurrence or circumstance comes to the attention of a Party that renders any of its aforesaid representations or warranties untrue or incorrect, such Party shall immediately notify the other Parties. Such notification shall not have the effect of remedying any breach of the representation or warranty that has been found to be untrue or incorrect nor shall it adversely affect or waive any obligation of a Party under this Agreement.
- (c) The Jal Nigam, the Jal Nigam Related Parties, NMCG and the NMCG Related Parties or any of their agents or employees shall not be liable to the Concessionaire in contract, tort, including negligence or breach of statutory duty, statute or otherwise as a result of:
 - (i) any inaccuracy, omission, unfitness for any purpose or inadequacy of any kind whatsoever in the information relating to the Project disclosed by the Jal Nigam or NMCG to the Concessionaire; or
 - (ii) any failure to make available to the Concessionaire any materials, documents, plans or other information relating to the Project.

23. MISCELLANEOUS

23.1 Survival

- (a) Any cause or action which may have occurred in favour of any Party or any right which is vested in any Party under this Agreement as a result of any act, omission, deed, matter or thing done or omitted to be done by any Party before the expiry of the Term by efflux of time or otherwise in accordance with this Agreement, shall survive the expiry of the Agreement.
- (b) The provisions of this Agreement, to the fullest extent necessary to give effect thereto, survive the Term or the termination of this Agreement and the obligations of Parties to be performed or discharged following the termination of this Agreement, shall accordingly be performed or discharged by the Parties.

23.2 Entire Agreement

The Parties hereto acknowledge, confirm and undertake that this Agreement and the RFP constitutes the entire understanding between the Parties regarding the development of the Project and supersedes all previous written or oral representations and/or arrangements regarding the Project.

23.3 Non-exhaustive Remedies

- (a) Save and except as provided in this Agreement, the remedies available to the Concessionaire under this Agreement are not exhaustive and the Concessionaire and third parties shall be entitled to all other rights and remedies and to take all actions in law and in equity in addition to the remedies provided for herein.
- (b) Save and except as provided in this Agreement, the exercise of any rights by any Party under this Agreement shall not preclude such Party from availing of any

other rights or remedies that may be available to it under this Agreement or any other agreement in relation to the Project. All remedies available to the Parties shall be cumulative and the exercise or failure thereof of one or more remedies by any Party shall not limit or preclude the exercise of or constitute a waiver of any other remedies by such Party.

23.4 Notices

- (a) Any notice or request in reference to this Agreement shall be written in English language and shall be sent by email, registered post, courier or facsimile and shall be directed to the other Parties at the address mentioned below:

Jal Nigam: General Manager
Address: Ganga Pollution Prevention Unit, STP Campus,
Bhagwanpur, Lanka, Varanasi-221005
Tel: +919473942688
Fax: +91 (0542) 2368733
Email: gmgangavns@gmail.com

NMCG: Executive Director (Projects)
Address: 1st Floor, Major Dhyanchand National Stadium,
India Gate, New Delhi - 110002
Tel: +91(11) 23049442
Fax: +91(11) 23049566
Email: ed.projects@nmcg.nic.in

Concessionaire: President Business Development
Address: 513/a, 5th floor, Kohinoor City, Kirol Road
Kurla (West), Mumbai, Mumbai City,
Maharashtra, India, 400070
Tel: 0120 – 4849500
Fax: N.A.
Email: Kamal.m@utility.esselgroup.com

- (b) Any notice or demand served by registered post or courier shall be deemed to be duly served 48 hours after posting and a notice or demand sent by facsimile shall be deemed to have been served at the time of its transmission and in proving service of the same it will be sufficient to prove, in the case of a letter, that such letter was sent by registered post or courier, addressed and placed in the post and in the case of a facsimile transmission, that such facsimile was duly transmitted to a current facsimile number of the addressee at the address referred above.
- (c) Each Party may change the above address by prior written notice to the other Parties.

23.5 Governing Law and Jurisdiction

This Agreement shall be governed by the laws of India and shall be subject to the exclusive jurisdiction of the courts at Allahabad.



23.6 Counterparts

This Agreement may be executed in three counterparts, each of which, when executed and delivered, will be an original, and all three counterparts together shall constitute one and the same instrument.

23.7 Language

- (a) The formal text of this Agreement and other agreements in relation to the Project shall be in the English language.
- (b) All notices and communications between the Parties under this Agreement shall be in English and all arbitration proceedings undertaken pursuant to this Agreement shall be conducted in English.

23.8 Confidentiality

- (a) No recipient Party shall, without the prior written consent of the disclosing Party, at any time divulge or disclose or suffer or permit its representatives to divulge or disclose to any person or use for any purpose unconnected with the Project any Confidential Information during the Term and for a period of 5 years after the expiry or termination of this Agreement, except to its representatives officers, directors, advisors, employers, agents and Associates (including the Jal Nigam Related Parties, the NMCG Related Parties and the Concessionaire Related Parties) who have a legitimate need to know the Confidential Information in order to perform their duties relating to the Agreement.
- (b) This Clause 23.8 shall not apply to Confidential Information, which:
 - (i) at the time of disclosure or thereafter has become part of public knowledge or literature without a breach of this Agreement;
 - (ii) is already in the possession of the Party receiving such Confidential Information before it was received from any other Party and which was not obtained under any obligation of confidentiality from the Party which disclosed such information;
 - (iii) was obtained from a third party (other than one disclosing it on behalf of a Party) who was free to divulge the same and who was not under any obligation of confidentiality in relation to such Confidential Information to the Party, which disclosed the information;
 - (iv) is disclosed by the Concessionaire to the Lenders, any actual or *bona fide* potential shareholders, investors or bankers (and their professional advisers) of the Concessionaire;
 - (v) is required to be disclosed pursuant to any legal and mandatory requirement of any court, legislative or administrative body or any Government Authority, or the rules of any applicable stock exchange;

- (vi) is disclosed by the Concessionaire to its Associates or the permitted assignees and transferees;
- (vii) is disclosed by the Concessionaire to any Subcontractor of the Concessionaire;
- (viii) is disclosed to actual or prospective insurers, re-insurers and insurance brokers;
- (ix) is disclosed to any professional advisors or consultants of any persons to whom a Party is entitled to disclose Confidential Information under this Clause 23.8(b);
- (x) is disclosed to any Person in connection with the dispute resolution provisions under this Agreement;
- (xi) is independently developed by the receiving Party without reliance on the Confidential Information disclosed by the disclosing Party; or
- (xii) is disclosed to any Government Authority or any other body in any relevant jurisdiction in connection with the obtaining or renewal of any Applicable Permit required for the Project.

Provided that the Party making a disclosure of Confidential Information pursuant to (iv) and (vi) to (ix) (inclusive) above shall ensure that any Person to whom it makes such disclosure undertakes to hold such Confidential Information subject to the same confidentiality obligations as those set out in Clause 23.8(a) above.

- (c) A Party making a disclosure of Confidential Information pursuant to Clause 23.8(a) shall:
 - (i) at the time of making such disclosure, inform its representatives and Associates of their obligation of confidentiality pursuant to this Agreement and ensure their compliance; and
 - (ii) be liable for any breach of such obligations by such representatives and Associates.
- (d) In the event that a Party is required or requested to make a disclosure of Confidential Information referred to in Clause 23.8(b)(v) above, such Party shall prior to such disclosure (to the extent permissible by Applicable Law) use its best efforts to promptly notify the disclosing Party or its Associate so that appropriate protection order and/or other action can be taken if possible. In the absence of such a protection order restricting disclosure, the Party required to make such disclosure may disclose only that portion of the Confidential Information which it is legally required to disclose and shall use reasonable efforts to obtain assurances that confidential treatment will be accorded to the Confidential Information.

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- (e) The recipient party agrees that it, its Associates and representatives shall, upon request by the disclosing Party promptly:
- (i) return, and use all reasonable endeavours to procure that any third party to whom the recipient party has disclosed the Confidential Information pursuant to this Agreement shall return, all the Confidential Information that is in tangible form (including, without limitation, Confidential Information contained on compact discs or other electronic storage media or devices) furnished, together with any copies or extracts; and
 - (ii) destroy, and use all reasonable endeavours to procure that any third party to whom the recipient party has disclosed the Confidential Information pursuant to this Agreement shall destroy, all analysis, compilations, studies or other documents which have been prepared and which reflect or refer to any Confidential Information,

provided that the recipient party shall be entitled to retain such Confidential Information which forms part of the permanent records of the recipient party or its Associates and which was prepared for the purposes of the review or decision-making process of the recipient party or such Affiliate and/or which the recipient party or its Associates is required to retain by Applicable Law if it continues to keep such Confidential Information confidential in accordance with this Agreement.

23.9 Amendments

- (a) Any provision of this Agreement may be amended, supplemented or modified only by an agreement in writing signed by all the Parties.
- (b) A Party may at any time request the other to enter into discussions to review the operation of any part of this Agreement and, but without commitment by the other Parties, to determine whether it should be amended by mutual agreement provided that, unless there is such mutual agreement, the provisions of this Agreement (as then most recently, if at all, amended) shall continue to apply whatever the outcome of any such discussions or review and whether or not any such discussions or review take place.

23.10 Waivers and Consents

- (a) Unless otherwise specified, any provision or breach of any provision of this Agreement may be waived before or after it occurs only if evidenced by an agreement in writing signed by the Parties.
- (b) Any consent under or pursuant to any provision of this Agreement must also be in writing and given prior to the event, action or omission for which it is sought.
- (c) Any such waiver or consent may be given subject to any conditions thought fit by the Party giving it and shall be effective only in the instance and for the purpose for which it is given.



23.11 Severability

- (a) If any provision of this Agreement is or becomes illegal, invalid or unenforceable in any respect under any Applicable Law, the legality, validity or enforceability of the remaining provisions will not, in any way, be affected or impaired.
- (b) The Parties shall negotiate in good faith with a view to agreeing one or more provisions which may be substituted for any such invalid, illegal or unenforceable provision and which produce as nearly as is practicable in all the circumstances the appropriate balance of the commercial interests of the Parties.

23.12 Assignment

- (a) Except as expressly permitted in this Agreement, the Concessionaire shall not be entitled to divest, transfer, assign or novate all or substantially all of its rights, interests, benefits and obligations under this Agreement, without the prior written consent of the Jal Nigam and NMCG.
- (b) The rights and obligations of Jal Nigam or NMCG under this Agreement shall not be assigned, novated or otherwise transferred (whether by virtue of any Applicable Law or otherwise) to any Person other than a public body or a government company or a statutory corporation that:
 - (i) is a single entity;
 - (ii) acquires the whole of the Agreement;
 - (iii) has the legal capacity, power and authority to become a party to and to perform the obligations of the Jal Nigam or NMCG under this Agreement, as the case may be; and
 - (iv) has sufficient financial standing or financial resources to perform the obligations of the Jal Nigam or NMCG under this Agreement, as the case may be.

23.13 No Agency or Partnership

Nothing contained or implied in this Agreement shall constitute or be deemed to constitute a partnership or agency between the Parties and none of the Parties shall have any authority to bind, commit or make any representations on behalf of the other Parties.

23.14 Costs and Expenses

- (a) Each Party shall be responsible for paying its own costs and expenses incurred in connection with the negotiation, preparation and execution of this Agreement, the Substitution Agreement and the Escrow Agreement.
- (b) The Concessionaire shall bear the applicable stamp duty and registration fee (if applicable) in respect of this Agreement, the Substitution Agreement and the Escrow Agreement.

23.15 Reservation of Rights

No forbearance, indulgence, relaxation or inaction by the Concessionaire at any time to require performance of any of the provisions of this Agreement shall in any way affect, diminish or prejudice the right of the Jal Nigam or NMCG to require performance of that provision, and no delay in exercising or omission to exercise any right, power or remedy accruing to the Jal Nigam or NMCG upon any default or otherwise under this Agreement shall impair any such right, power or remedy or shall be construed to be a waiver thereof or any acquiescence in such default, nor shall the action or inaction of the Jal Nigam or NMCG in respect of any default or any acquiescence by it in any default, affect or impair any right, power or remedy of the Jal Nigam or NMCG in respect of any other default.

23.16 Third Parties

This Agreement and all rights hereunder are intended for the sole benefit of the Parties and, to the extent expressly provided, for the benefit of the Jal Nigam Related Parties, NMCG Related Parties, the Concessionaire Related Parties and the Lenders, and shall not imply or create any rights on the part of, or obligations to, any other Person.

23.17 Waiver of sovereign immunity

The Jal Nigam and NMCG unconditionally and irrevocably:

- (a) agree that the execution, delivery and performance by it of this Agreement constitute commercial acts done and performed for commercial purpose;
- (b) agree 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 Jal Nigam and NMCG with respect to its assets; and
- (c) consent to the enforcement of any judgment or award against them in any such proceedings.



In witness whereof the Parties hereto have signed this Agreement on this Eleventh day of October 2017.

UTTAR PRADESH JAL NIGAM (JAL NIGAM)

By: Managing Director

Name: Rajesh Mittal

Title: Managing Director

NATIONAL MISSION FOR CLEAN GANGA (NMCG)

By: Executive Director (Projects)

Name: Hitesh Kumar S. Makwana

Title: Executive Director (Projects)

VARANASI STP PROJECT PRIVATE LIMITED (CONCESSIONAIRE)

By: President Business Development

Name: Kamal Maheshwari

Title: President Business Development

H
Jal Nigam

Hitesh Makwana

हितेश कुमार एस. मकवाना, भा.प्र.से.
Hitesh Kumar S. Makwana, I.A.S.
कार्यकारी निदेशक (परियोजना)
Executive Director (Projects)
National Mission for Clean Ganga
1st Floor, Major Dhyanchand National Stadium
India Gate, New Delhi-110002

VARANASI STP PROJECT PVT. LTD.

Director/ Authorised Signatory

ESSEL



Schedule 1
Scope of Work

- I. Design, development, finance, construction of Facilities, which shall include:
 - a. Design, development, finance, construction, testing & commissioning of civil, mechanical and electrical & instrumentation works of Varanasi STP with a design capacity of 50 MLD, at Ramana, Varanasi. The Varanasi STP shall, inter-alia, include provision of the following components - the online monitoring system to measure the volume and characteristics of the Sewage conveyed to the Varanasi STP and the volume and characteristics of Treated Effluent discharged from the Varanasi STP, on-site testing laboratory facilities and any other facility associated with the operations of the Varanasi STP.
 - b. Design, development, finance, construction of Effluent Disposal Pipeline (PSC pipeline of 1200 mm diameter and approx. 5.5 km in length) from STP to the Discharge Point at one meter above HFL (+74.0 m) along with outfall structure, an effluent disposal pumping station and a 250 kilolitre overhead tank for the disposal of Treated Effluent. The Effluent Disposal Pipeline shall be provided with outlet points (10 numbers of 300 mm diameter sluice valves), in locations as specified by the Jal Nigam, with valve chambers to enable usage of the treated effluent for irrigation purpose. The Effluent Disposal Pipeline shall be laid as per the proposed Right of Way and the Concessionaire shall be required to back fill the section where the Effluent Disposal Pipeline is underground with suitable compaction for light vehicle movement.
 - c. Provision of the following as part of the Facilities:
 - i. Construction of a flood protection earthen embankment of 1800 meters around the 20 hectares site (500mX400m) with a height which would be the higher of 4.5 m or one meter above HFL. A ramp of 6.0 meter width with flexible road has to constructed along earthen embankment for access to the 20 hectares site;
 - ii. Construction of a boundary wall of approximate length of 1800 meters with height of 1.5 meters above the top of earthen embankment around the STP Site with the pathway over earthen embankment illuminated;
 - iii. Construction of approach road to the Varanasi STP of 6 meter width and approximately 725 meters length;
 - iv. Construction of internal roads inside the STP site of 6.0 meter width;
 - v. Construction of roads connecting various units within the Varanasi STP of width 4.5 meter;
 - vi. Construction of 200/ 180 meters deep tube well, 25 kiloliters RCC overhead tank for potable water supply along with rising main for staff quarters and other appurtenant works as per Applicable Laws;
 - vii. Set up a two storied administrative building of 300 sqm built up area on each floor which shall including a laboratory, conference room etc.
 - viii. Set up a temporary site office for the use of Jal Nigam with all necessary equipment, two computers, printers and staff;
 - ix. Internal drainage system within the Site;
 - x. Firefighting arrangements at the STP site and MPS; and
 - xi. Construct staff quarters for its employees with one number of type D, two number of type C, seven number of type B and four number of type A with size and FSI as per the CPWD norms provided in "Revised Plinth Area Norms- for General Pool Residential Accommodation (GPRA) to be constructed for Central Govt. Employees and its applicability to all Govt. Departments, MOUD."

2. Design, finance, rehabilitate and restore the Associated Infrastructure

The purpose of rehabilitation and restoration of Associated Infrastructure would be to make them operational as per the requirements of the Concession Agreement. The extent of rehabilitation requirements shall be determined based on the condition assessment undertaken by the Concessionaire. The minimum scope of work related to the repair and rehabilitation of Associated Infrastructure shall include the following –

a. Main Pumping Station (MPS)

- i. Rehabilitation and construction of weir across Assi Nalla;
- ii. Desilting of the MPS;
- iii. Procurement & installation of new mechanical screen;
- iv. Repair/Rehabilitation of electro-mechanical and instrumentation equipment (if required);
- v. Raising of height of Nalla tapping structure up to HFL;
- vi. Construction of control room of 10 square meters area to house PLC and SCADA; and .
- vii. Any other works that could be required for commissioning and operating MPS as per the requirements of the Concession Agreement.

b. Rising Main, which would include desilting, repair works, strengthening, pipe protection and shifting in different sections of the 6.68 km. of 1000 mm PSC rising main as per the following:

- i. Desilting & CCTV inspection of rising main of length of approximately 300 meters;
- ii. Strengthening and pipe protection of rising main of a length of approximately 500 meters along the river Ganga;
- iii. In this stretch of 500 meters of rising main, where strengthening and pipe protection will be done, provision for & laying of 1000 mm diameter PSC rising main pipeline in a length of approximately 150 meters and shifting of rising main by approximately 250 meters near approach road of Samne Ghat bridge;
- iv. Any other repair of rising main required for commissioning and operating the rising main as per the requirements of the Concession Agreement;
- v. Extension of existing rising main to the Inlet Point at the STP Site; and
- vi. Hydro testing of the PSC rising main after desilting and restoration of the same.

The Concessionaire shall submit a physical model of the Facilities and the Associated Infrastructure (with minimum plan dimension of 2.5 m x 2.5 m) and shall be enclosed in a transparent cabinet with scratch resistant surface.

3. Operations and Maintenance of the Facilities and the Associated Infrastructure for a period of 15 years from the Commercial Operations Date, as per the Concession Agreement.

4. Overview of other activities to be undertaken

- a) Submit Basic Engineering Drawings as defined in the Agreement;
- b) Submit the Construction Plan for the for the Facilities and the Associated Infrastructure;
- c) Carry out all preparatory work like survey & investigations, clearing out debris and proper disposal of the extra surplus excavated earth to a suitable location as per Applicable Laws;

- d) Develop the site, landscaping, arboriculture and horticulture at the STP Site and by providing earth filling, greenery, plantation and diversion & extension of storm water drainage network, etc. and maintain condition of landscape establishment;
- e) Design and construct all necessary buildings for administrative, laboratory, PLC room buildings for E&M equipment as per Technical Specifications;
- f) Undertake electrical and instrumentation works as per provisions detailed in key single line diagrams and plant control configuration diagrams.
- g) Provide electrical substation, as required, in accordance with the requirements of UPPCL;
- h) Keep the Facilities in clean, hygienic, tidy and safe conditions;
- i) Illuminate the STP with suitable arrangement, as per the Technical Specifications;
- j) Undertake trial runs, testing, commissioning of Facilities as per the requirements of Concession Agreement;
- k) Based on its assessment of the power supply, make necessary arrangements, as required, to ensure continuous uninterrupted operations of the Facilities during any power supply failure from the grid;
- l) Undertake Operations and Maintenance of Facilities as per Technical Specifications and safe disposal of Treated Effluent and STP By-Products;
- m) Develop and implement the environment, social, health and safety plans as per the requirements of the Concession Agreement;
- n) Implement quality system and environmental management system in accordance with ISO 9001 and ISO 14001;
- o) Prepare appropriate records and reports as outlined in the Concession Agreement;
- p) Undertake security control of the Facilities
- q) Carry out the required tests and laboratory analysis;
- r) Obtain and renew licenses, permits and certificates necessary to operate the Facilities;
- s) Hand-back the Facilities and the Associated Infrastructure to the Jal Nigam at the end of the O&M Period;
- t) Develop the necessary Design and Drawings and other submissions, as per the requirements of the Concession Agreement. These submissions, *inter-alia*, are outlined in the table below:

Submissions required from the Concessionaire

Submission & Timeline	Description of submission
Construction Plan before Effectiveness	<p>Detailed construction plan for the Facilities and the Associated Infrastructure setting out the work plan to achieve each of the Payment Milestones, such that the Facilities and the Associated Infrastructure are completed on or prior to the Scheduled Construction Completion Date. The should include the following sections at the minimum:</p> <ul style="list-style-type: none"> • Site manpower and labor mobilization details. Details of project management and health & safety personnel to be deployed at the site to be provided separately. • Detailed implementation schedule (including details of construction milestones) • Construction method statements • Details of civil works and equipment control • Quality assurance plans • Subcontracting details
Designs and Drawings before Effectiveness	<p>Process design and calculations:</p> <ul style="list-style-type: none"> • Description of Proposed Technology including proposed treatment process, process design calculations and mass balance diagrams • Hydraulic calculations and Hydraulic Flow Diagram

Submission & Timeline	Description of submission
	<ul style="list-style-type: none"> • Details of the aeration device stating the turndown ratio • Details of the sludge digestion system stating maintenance mechanism from outside the digester (without draining its contents) <p>Site layout</p> <ul style="list-style-type: none"> • Facilities layout: general arrangement drawings for the buildings, tanks, foundations, process units, approach road, Inlet Point, Outlet Point • Alignment drawings for Effluent Disposal Pipeline • Location of site office, staff quarters, • Location of batching - plant, go-down / yard, store / workshop, etc. • Details of the storm water drainage inside the STP • Layout of the earthen embankment <p>Architectural Designs and Concepts</p> <ul style="list-style-type: none"> • Architectural design proposals for interior and exterior architecture along with an appropriate landscaping scheme • Architectural statement explaining the factors considered in the design • Architectural work shall include walls, roof, flooring and floor finish, roof water proofing, down water pipes, windows, ventilators, doors, glazing, equipment access doors, painting and other ornamental works <p>Structural designs and calculations</p> <ul style="list-style-type: none"> • Basic design calculations of foundations • General arrangement drawings and explanatory sketches • Methods statement describing work procedure before commencing concrete work <p>Power</p> <ul style="list-style-type: none"> • Power single line diagrams • Process data sheets to define design criteria, installed capacities and loading rates of principal items of plant and equipment • Control philosophy report • Electrical load list <p>Instrumentation and Control</p> <ul style="list-style-type: none"> • Process and Instrumentation Diagrams • Instrument schedule & I/O schedule for each Motor Control Centre • Functional Design Specification - Comprising an overall description of the plant, its functioning and control, and description of each section of the control system covering modes of operation, manual overrides, set-point and parameter selection and adjustment. It shall describe the 'fail-safe' features incorporated into the design for the event of failure of a plant item or system, or loss of an input signal affecting a control loop or process sequence. It shall also describe control actions taken and monitoring functions which remain available during a power failure, and any automatic controls or sequencing which take place during system start-up and shut-down. It shall include figures or drawings where appropriate. • Drawings and schedules – Including the following -

Submission & Timeline	Description of submission
	<ul style="list-style-type: none"> ○ Process and instrumentation diagram which shall comply with BS 1646 (all parts) and BS 1553-1:1977. ○ General arrangement drawings of field-mounted instruments showing installation details. ○ General arrangement drawings of instrument and control panels, fully-dimensioned in plan and elevation views, showing foundation and fixing details, access doors, clearances, cable-entry positions, weight and lifting arrangement. ○ Layout drawings of panel fascias showing instruments, controls and details of all labels. ○ Layout drawings of panel interior showing equipment, terminal blocks & cable ways. ○ Annunciator arrangement and engraving details. ○ Internal circuit and wiring diagrams for instrument and control panels. ○ Schematic control diagrams. ○ Instrument loop diagrams. ○ Instrument wiring and piping diagrams. ○ Interconnection wiring diagrams. ○ Cable block diagrams, drawings and schedules. ○ Instrument system and panel power distribution diagrams. ○ Programmable-device functional design specifications which shall include hardware details, logic flow charts, ladder diagrams and program listings. ○ Schedules of inputs to and outputs from programmable controllers and telemetry outstations. ○ Labelling schedules. ○ Comprehensive testing schedules for all off-site, on-site, pre-commissioning and commissioning tests and take-over tests. ○ Drawings necessary for the provision of ducts, openings, trenches, fixing holes for panels etc. ● Data and calculations <ul style="list-style-type: none"> ○ Manufacturer's catalogues and data sheets ○ Calculations to support control system design ○ Specification for protective coatings and painting ● Certificates <ul style="list-style-type: none"> ○ Manufacturer's works tests ○ Pre-installation checks ○ Pressure-testing schedules ○ Instrument loop test check sheets ○ Installed instrument performance tests ○ System tests ○ Statutory certificates of compliance (such as hazardous area equipment) <p>Pipework layout diagrams including all valves and penstocks</p> <p>Online Monitoring</p> <ul style="list-style-type: none"> ● SCADA/instrumentation/process control system architecture <p>Geotechnical analysis and topography survey report</p>

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Submission & Timeline	Description of submission
	<ul style="list-style-type: none"> • Topographical survey reports • Site details & topography of STP Site, L-sections of channels & other works • Survey records, borehole records and soil test reports <p>EHS Plan for Construction Period</p> <ul style="list-style-type: none"> • Health and Safety Standards • Environmental and Social Management Plan <p>Threshold Influent Standards proposed – which are the minimum standards, beyond the Influent Standards, that the Sewage must meet for it to be treated at the Facilities, in line with clause 7.2 (a) of the Concession Agreement.</p>
During Construction Period	<p>Detailed construction design and drawings:</p> <p>Information on equipment during installation</p> <ul style="list-style-type: none"> • Performance curves and drawings of equipment • Schedules of equipment • Quality plans for electrical, mechanical, instrumentation and SCADA works • Test and inspection certificates
Upon Construction Completion	<p>As-Built Drawings</p> <ul style="list-style-type: none"> • Final version of the design calculations • Key construction records and tests • Asset sheets
At least 30 days prior to the Scheduled Construction Completion Date	<p>O&M Manual including the following –</p> <ul style="list-style-type: none"> • O&M Procedures <ul style="list-style-type: none"> ○ Overall description of permits and standards, operation and control of Facilities and Associated Infrastructure, operation and control of sludge handling facilities, sampling and laboratory analysis, records and reporting, maintenance, emergency O&M procedures ○ Overall plan for O&M of the Facilities and Associated Infrastructure with due consideration to the reliability of performance, flexibility to cope with variability, diligence to maintain tidiness and cleanliness, capability to respond to emergency situations and effectiveness to handle complaints and to meet the KPIs; ○ Provision of spare parts and special tools with quantity and particulars throughout the O&M Period for effective and uninterrupted operation of the Facilities and Associated Infrastructure; ○ Sampling and testing methodologies to determine physical, chemical and biological characteristics of raw Sewage and Effluent Water as per CPHEEO manual; ○ Methodology for sampling and testing of heavy metals in line with the CPHEEO manual ○ Inventory control of consumables such as fuel, sand and various types of chemicals, dangerous goods and hazardous materials; ○ Safe and proper storage and transfer of various types of materials and

Submission & Timeline	Description of submission
	<p>chemicals, dangerous goods and hazardous materials to assure the continuous operation of the Facilities and Associated Infrastructure, the compliance with statutory requirements and avoidance of environmental nuisance;</p> <ul style="list-style-type: none"> ○ Upkeep of the central control and monitoring system to ensure availability of reliable on-line and archived data ○ Arrangements for ensuring data security and integrity, and prevention of unauthorized alteration ○ Arrangements for data recovery in case of accidental loss of essential operational data ○ Arrangements for allowing flexibility of the computer database to store and process data upon introduction of new technologies and data management system ○ Preventative maintenance and corrective maintenance requirements ○ Precautionary measures and arrangements for inclement weathers ○ Procedures to record and handle complaints ○ Operational arrangements related to tests for KPIs ○ Procedures to prepare and submit routine records and reports to the Jal Nigam <ul style="list-style-type: none"> ● Operational Contingency Plan <ul style="list-style-type: none"> ○ Identification of potential problems that may cause disruptions to operation and assessment of potential impacts ○ Measures to handle potential problems and prevent disruptions to operation ○ Measures to handle emergency situations that may cause disruptions to operation and shutdown of the Facilities ○ Precautions and procedures to resume operation after addressing of the emergency situations; and ○ Fire and emergency drill plans ● Human Resources Plan <ul style="list-style-type: none"> ○ Mobilization of labor for O&M ○ Means and flow of communication among field staff, staff at control rooms and truck drivers for disposal of the Digested Sludge; ● Scheduled Maintenance Program for the first year post COD ● Emergency Procedures for: <ul style="list-style-type: none"> ○ Fire ○ Vehicle breakdown and accidents ○ Facilities closure ○ Procedure to handle excessive incoming Sewage due to rain, storm or infiltration ○ Floods ○ Inclement weather conditions ○ Unscheduled and Forced Outage ○ Spillage of chemicals ○ Labour disputes

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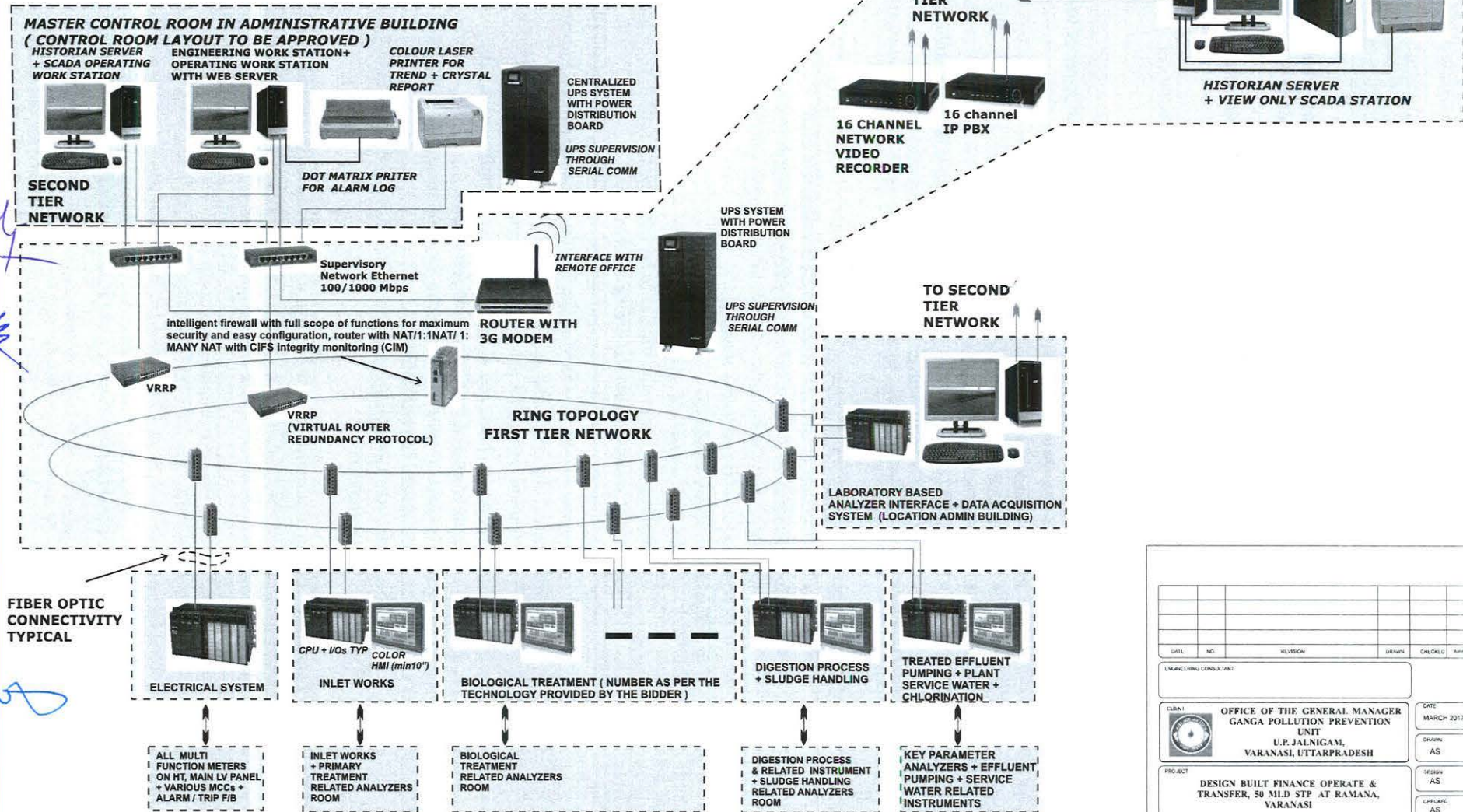
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Submission & Timeline	Description of submission
	<ul style="list-style-type: none"> • Asset Management Plan: <ul style="list-style-type: none"> ○ Composite manual describing the functions and operations of each equipment ○ Composite manual for testing and servicing every system and individual item ○ Assets overview <ul style="list-style-type: none"> ▪ description of various components of the Facilities and Associate Infrastructure ▪ dependencies between the components ▪ asset management strategy ○ System performance <ul style="list-style-type: none"> ▪ design lives of plant, buildings and structures; ▪ benchmarks, standards and guidelines adopted for performance tests, condition surveys and residual life assessments; ○ Asset remediation plans <ul style="list-style-type: none"> ▪ schedules for overhaul and replacement of plant ▪ schedules for refurbishment and renewal ▪ planned actions to bring or keep the assets above their minimum conditions required under the Concession Agreement ○ Operational arrangements related to the survey of the Hand-back Conditions <p>EHS Plan:</p> <ul style="list-style-type: none"> • Waste (Screenings & Grit and other waste) management plan • Sludge management plan, including a strategy and improvement measures and actions to treat and dispose of sludge, including sludge valorization opportunities in compliance with applicable standards • Health and safety standards <ul style="list-style-type: none"> ○ Hazardous material management plan ○ Health and safety requirements to be followed by staff & sub-contractors ○ Traffic management plan during construction ○ Identification, elimination and mitigation of safety and health risks associated with the O&M of the Facilities and Associated Infrastructure; • Environmental and social management system <ul style="list-style-type: none"> ○ Pollution prevention plan (water, air, noise) ○ Procedures, plans and actions to achieve compliance with the requirements of the Concession Agreement; ○ Measures to enhance and sustain the good image of the Facilities and the Associated Infrastructure ○ Plan for maintaining good communication and relationship with all stakeholders <p>Guaranteed Energy Consumption in the format provided in the table below (refer to clause 9.4 (e) (ii) (C)). The figures presented in the last column (which corresponds to peak flow) should be equal to those quoted in the Financial Proposal.</p>
O&M Period	Annual scheduled maintenance program every year

**PLANT CONTROL CONFIGURATION DIAGRAM WITH MINIMUM PLC/ SCADA LOCATIONS
(NUMBERS SHALL BE FINALIZED DURING DETAILED ENGINEERING)**

PLANT BASED UPJN OFFICE LOCATED IN ADMINISTRATIVE BLDG UNDER LOCK & KEY

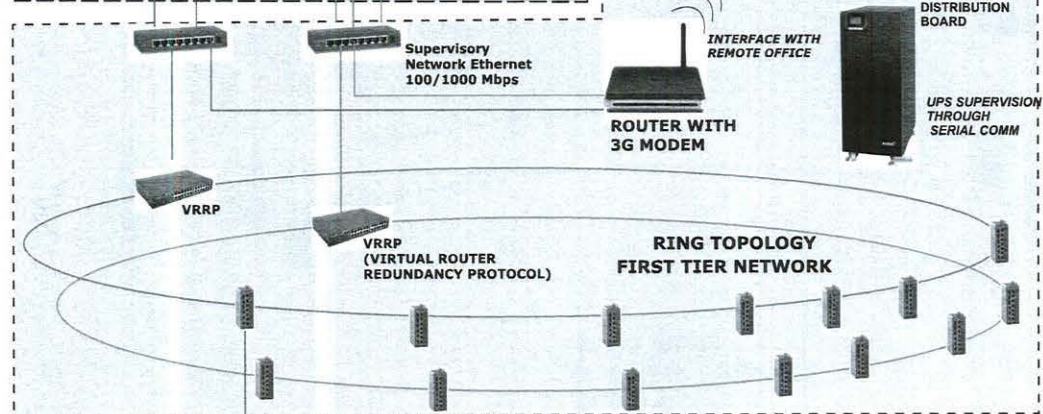
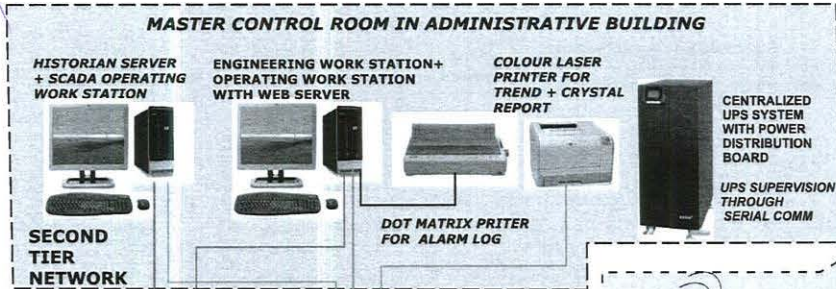


- NOTE :**
1. All PLC/SCADA /Control/Analyzers rooms shall be Air Conditioned
 2. All Analytical On-line instruments / analyzers barring those which are exclusively on-field instruments shall be kept in Air Conditioned rooms located at an appropriate location within the respective process section of the plant.
 3. All Analyzers room shall be separate from respective PLC rooms and shall have proper/redundant sampling system + drainage system.
 4. All process sampling drain shall be re-circulated to the system with the intermittent common sump, must not be merged with storm water drainage system

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED
ENGINEERING CONSULTANT					
 OFFICE OF THE GENERAL MANAGER GANGA POLLUTION PREVENTION UNIT U.P. JALNIGAM, VARANASI, UTTAR PRADESH					DATE MARCH 2017 DRAWN AS
PROJECT DESIGN BUILT FINANCE OPERATE & TRANSFER, 50 MLD STP AT RAMANA, VARANASI					DESIGN AS CHECKED AS
TITLE PLANT'S CONTROL CONFIGURATION DIAGRAM WITH MINIMUM REQUIRED CONTROL ELEMENTS					APPROVAL AS
DWG. NO. 11 E - 1					SHEET 01 OF 3
THIS DRAWING IS THE PROPERTY OF U.P. JALNIGAM. IT SHOULD NOT BE USED, COPIED OR REPRODUCED WITHOUT THEIR WRITTEN PERMISSION.					

PLANT CONTROL CONFIGURATION INTERFACE WITH SEWAGE MAIN PUMPING STATION

PLANT BASED UPJN OFFICE LOCATED IN ADMINISTRATIVE BLDG UNDER LOCK & KEY



FIBER OPTIC CONNECTIVITY TYPICAL

FOC IN HDPE CONDUIT



- MULTIFUNCTION METER, LV PANEL STATUS, XFRs STATUS, DG GEN SET STATUS + PUMP STATUS /CONTROL,
- SUMP LEVEL, SCREEN OPERATIONS,
- RISING MAIN HEADER PRESSURE,
- RISING MAIN FLOW METER (OPTIONAL)

CONSTRUCTION OF NEW CONTROL ROOM OF SIZE 10 SQ METER FOR SCADA & INSTRUMENTATION AT MPS SHALL BE IN THE SCOPE OF BIDDER AS PER THE APPROVED LAYOUT THE LEVEL OF THE FFL SHALL EITHER BE 1 METER ABOVE HFL (74M) OR AT PAR WITH THE FFL OF MPS OPERATING PLATFORM

DATE	NO.	REVISION	DESIGNED	CHECKED	APPROVED
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ENGINEERING CONSULTANT

	OFFICE OF THE GENERAL MANAGER GANGA POLLUTION PREVENTION UNIT U.P. JALNIGAM, VARANASI, UTTAR PRADESH	DATE	MARCH 2017
		DRAWN	AS

PROJECT	DESIGN BUILT FINANCE OPERATE & TRANSFER, 50 MLD STP AT RAMANA, VARANASI	DESIGN	AS
		CHECKED	AS

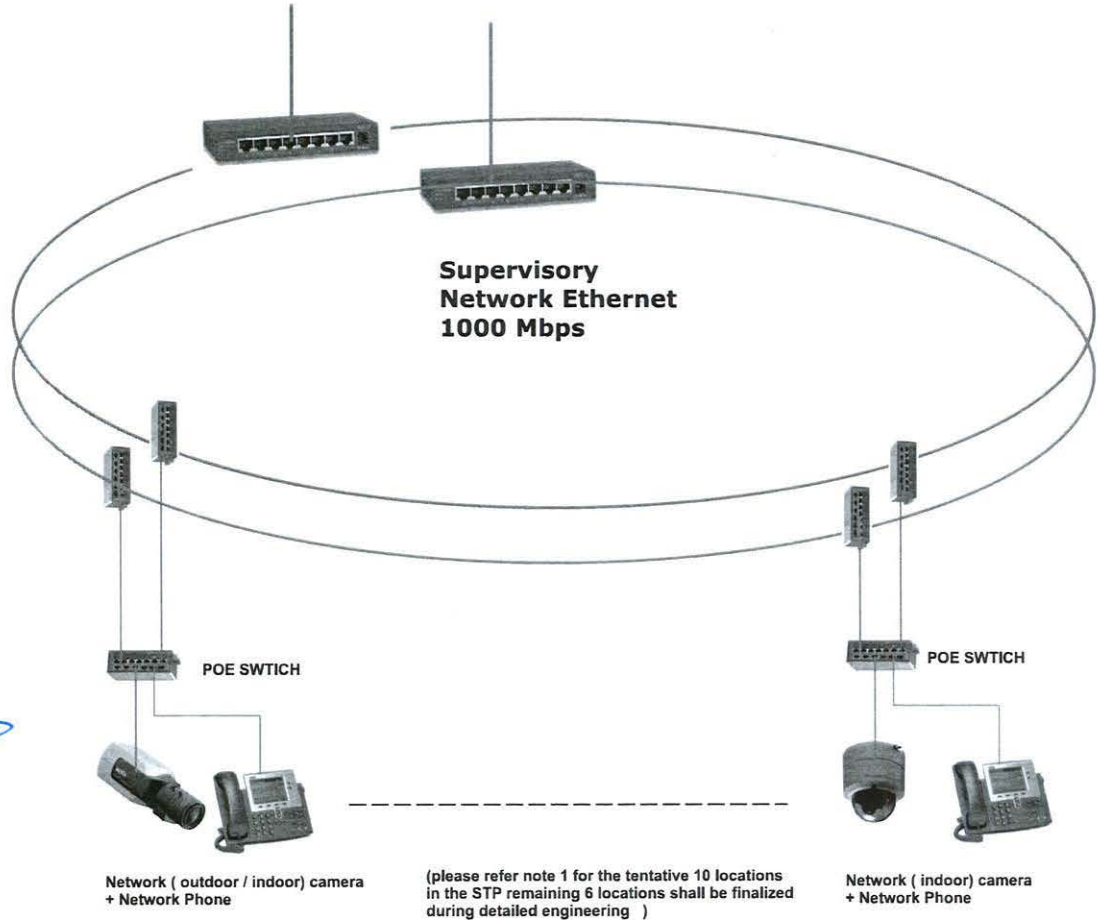
TITLE	PLANT'S CONTROL CONFIGURATION DIAGRAM WITH MINIMUM REQUIRED CONTROL ELEMENTS	APPROVED	AS
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DRG. NO.	11 E - 1	SHEET 3 OF 3
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Control Configuration for Cameras & Phones throughout the PLANT

THIS NETWORK SHALL BE MERGED WITH SECOND TIER NETWORK & SUBSEQUENTLY WITH SCADA SYSTEM/IPEPBX / NETWORK VIDEO RECORDER OR VIDEO MONITORING SYSTEM



(please refer note 1 for the tentative 10 locations in the STP remaining 6 locations shall be finalized during detailed engineering)

NOTE 2:

- CAMERAS REQUIRED FOR FOLLOWING 10 TENTATIVE LOCATIONS**
1. INLET WORKS AREA
 2. BIOLOGICAL TREATMENT AREA
 3. DIGESTION + SLUDGE HANDLING AREA
 4. ANALYZER ROOM FOR INCOMING SEWAGE
 5. ANALYZER ROOM FOR TREATED EFFLUENT
 6. TREATED EFFLUENT PUMP HOUSE
 7. ENTRANCE OF THE ADMIN BUILDING
 8. MAIN GATE
 9. LABORATORY
 10. MAIN CONTROL ROOM

IP PHONES REQUIRED FOR FOLLOWING 10 TENTATIVE LOCATIONS

1. INLET WORKS MCC/ PLC ROOM
2. BIOLOGICAL TREATMENT AREA MCC/ PLC ROOM
3. DIGESTION + SLUDGE HANDLING AREA MCC/PLC ROOM
4. ANALYZER ROOM FOR INCOMING SEWAGE
5. ANALYZER ROOM FOR TREATED EFFLUENT
6. TREATED EFFLUENT PUMP HOUSE
7. ADMIN BUILDING CLIENT'S VIEW ONLY SCADA ROOM (VIDEO PHONE)
8. MAIN GATE GUARD ROOM (VIDEO PHONE)
9. LABORATORY
10. MAIN CONTROL ROOM (VIDEO PHONE)

NOTE 2: 1. Supply & Installation of IP Camera, IP phones, Network Video Recorder, IPEPBX systems are mandatory
2. These Network Cameras + Network Phones are limited to Plant & process supervision only.
2. For Administrative activities there shall be separate phone lines with their standalone EPBX, which shall be limited to Admin Building Services.

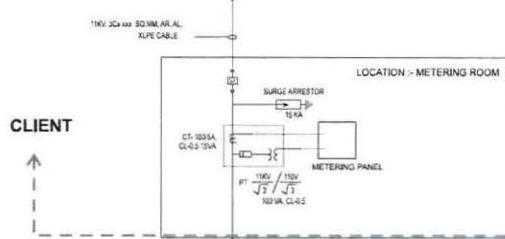
DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED
ENGINEERING CONSULTANT					
CLIENT: OFFICE OF THE GENERAL MANAGER GANGA POLLUTION PREVENTION UNIT U.P. JALNIGAM, VARANASI, UTTAR PRADESH					DATE: MARCH 2017
PROJECT: DESIGN BUILT FINANCE OPERATE & TRANSFER, 50 MLD STP AT RAMANA, VARANASI					DRAWN: AS
TITLE: PLANT'S CONTROL CONFIGURATION DIAGRAM WITH MINIMUM REQUIRED CONTROL ELEMENTS					DESIGN: AS
SHEET NO: 11 E - 1					CHECKED: AS
SHEET 3 OF 3					APPROVED: AS
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M

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FROM UPPCL SUBSTATION



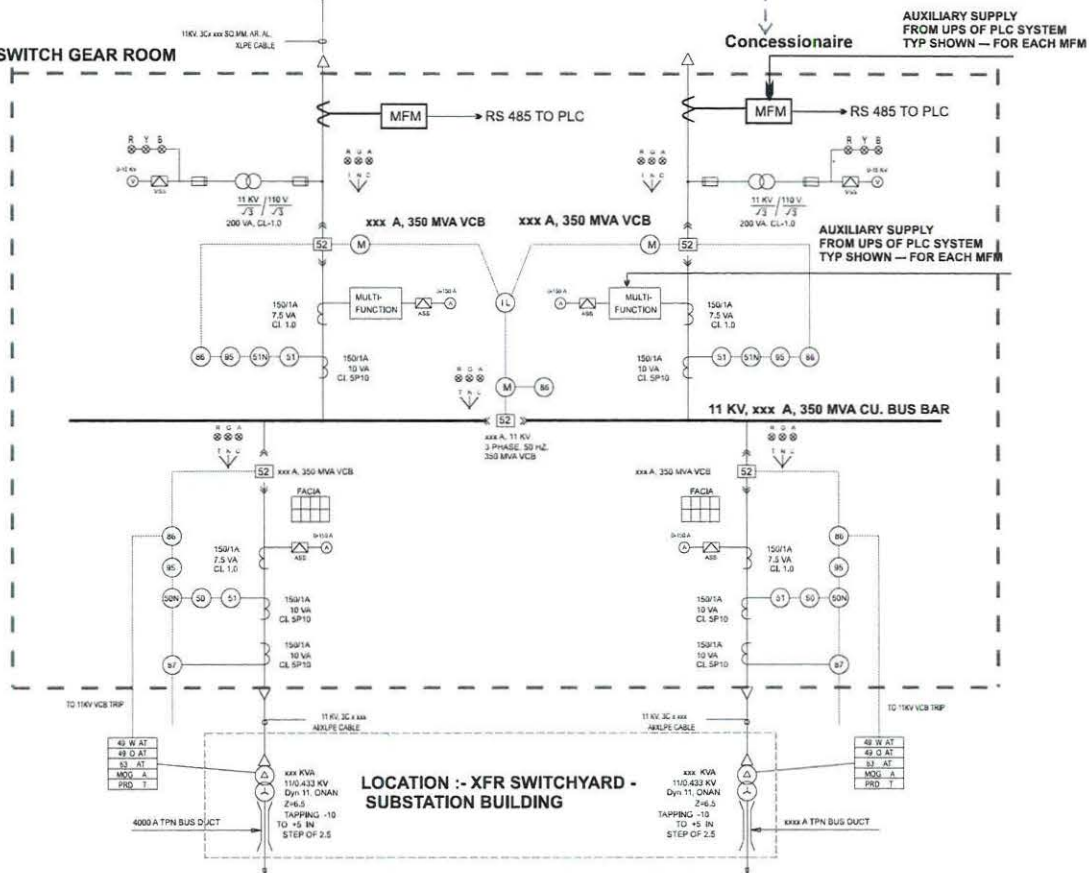
CONSTRUCTION OF THE METERING ROOM SHALL BE IN CONCESSIONAIRE'S SCOPE AS PER UPPCL NORMS

ELECTRICAL LIMIT OF SCOPE FOR CONCESSIONAIRE

General Description of Electrical System

- 11 kV shall be tapped from the metering panel room by the concessionaire with 11 kV rated 3 core Armored Aluminum XLPE cable
- 11 kV power sub-station shall be constructed in the Varanasi STP.
- The 11 kV switchboard of 350 MVA rating shall be housed in a separate room and shall feed 2 numbers 11/0.433 kV transformers with on load tap changer. Transformers shall be erected in a switch yard area adjacent to Substation building. Bus Bar of 11 kV switchboard shall be electrical grade Copper.
- Both the transformer shall feed the 0.433 kV to Main LV panel or PMCC panel with two incomer and buscoupler arrangement. Transformer to Main LV Panel / PMCC connectivity shall be with the help of BUSDUCT.
- Two automatic power factor correction (APFC) panel comprising microprocessor APFC relay shall be connected to both Bus. Both the APFC relay shall be configured with both bus CT of HT side to with the summation CT arrangement to take care of 100% availability of Power Factor Corrections in case of one incomer failure.
- All Multifunction Meters shall have inbuilt KWH metering in addition to other electrical parameters. Accuracy Class shall be of 0.5. All MFM shall be configured to PLC through RS 485 serial COMM.
- All microprocessor relays shall be configured to PLC with RS 485 serial communication.
- All cables shall be laid in concrete trench as mentioned under note!

LOCATION :- 11 KV SWITCH GEAR ROOM



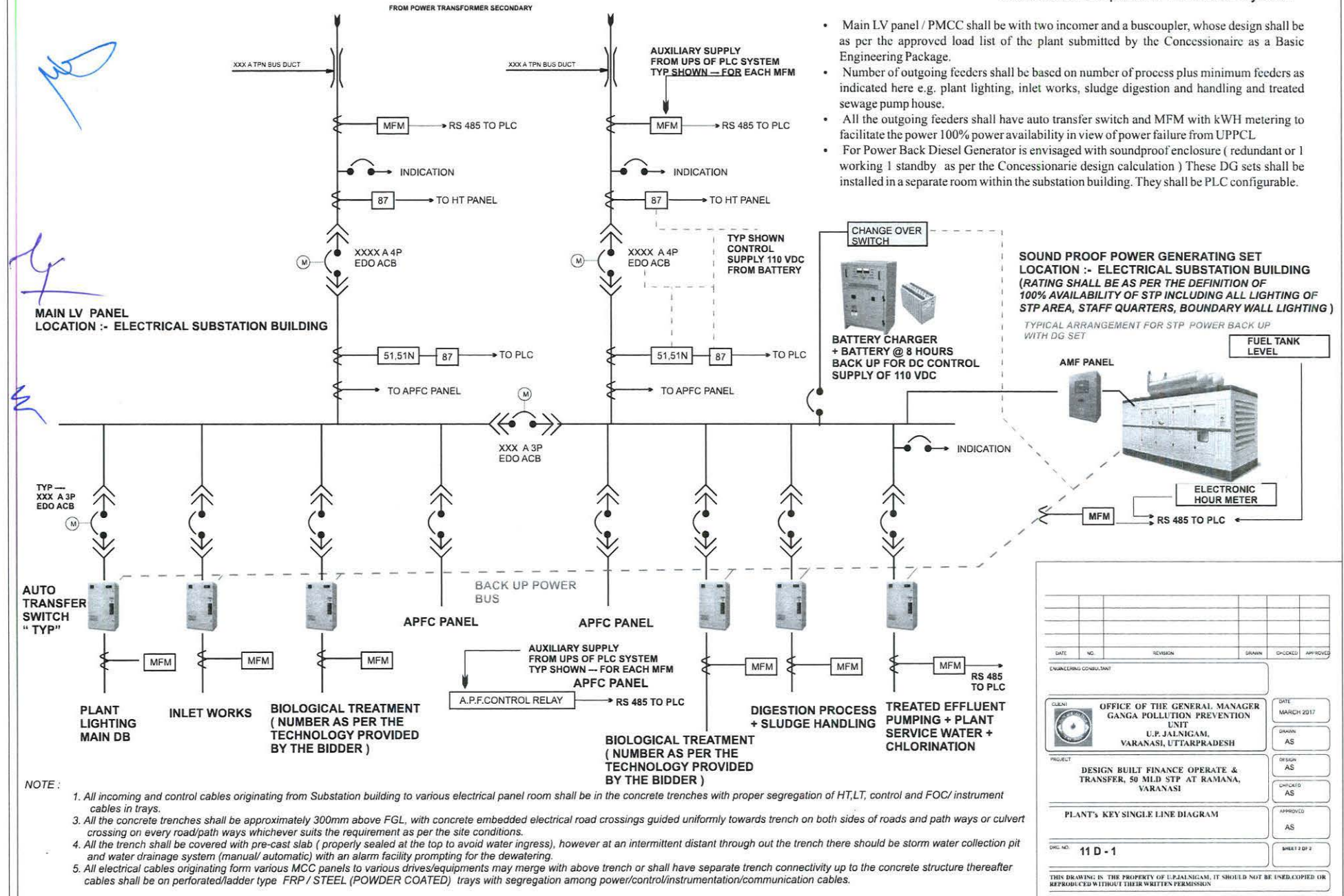
NOTE :

1. All incoming and control cables originating from Substation building to various electrical panel room shall be in the concrete trenches with proper segregation of HT,LT, control and FOC/ instrument cables in trays.
3. All the concrete trenches shall be approximately 300mm above FGL, with concrete embedded electrical road crossings guided uniformly towards trench on both sides of roads and path ways or culvert crossing on every road/path ways whichever suits the requirement as per the site conditions.
4. All the trench shall be covered with pre-cast slab (properly sealed at the top to avoid water ingress), however at an intermittent distant through out the trench there should be storm water collection pit and water drainage system (manual/ automatic) with an alarm facility prompting for the dewatering.
5. All electrical cables originating from various MCC panels to various drives/equipments may merge with above trench or shall have separate trench connectivity up to the concrete structure thereafter cables shall be on perforated/ladder type FRP / STEEL (POWDER COATED) trays with segregation among power/control/instrumentation/communication cables.

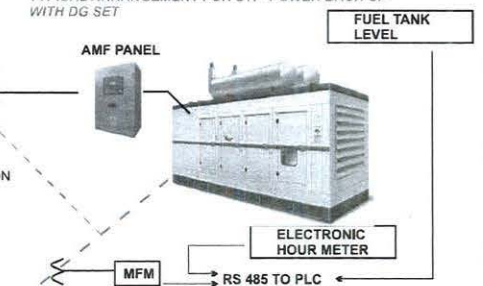
DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED
ENGINEERING CONSULTANT					
CLIENT	OFFICE OF THE GENERAL MANAGER GANGA POLLUTION PREVENTION UNIT U.P. JALNIGAM, VARANASI, UTTAR PRADESH				DATE MARCH 2017
PROJECT	DESIGN BUILT FINANCE OPERATE & TRANSFER, 50 MLD STP AT RAMANA, VARANASI				DRAWN AS
ISSUE	PLANT'S KEY SINGLE LINE DIAGRAM				DESIGN AS
DWG. NO.	11 D - 1				CHECKED AS
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					SHEET 1 OF 2

General Description of Electrical System

- Main LV panel / PMCC shall be with two incomer and a buscoupler, whose design shall be as per the approved load list of the plant submitted by the Concessionaire as a Basic Engineering Package.
- Number of outgoing feeders shall be based on number of process plus minimum feeders as indicated here e.g. plant lighting, inlet works, sludge digestion and handling and treated sewage pump house.
- All the outgoing feeders shall have auto transfer switch and MFM with kWh metering to facilitate the power 100% power availability in view of power failure from UPPCL.
- For Power Back Diesel Generator is envisaged with soundproof enclosure (redundant or 1 working 1 standby as per the Concessionarie design calculation) These DG sets shall be installed in a separate room within the substation building. They shall be PLC configurable.



SOUND PROOF POWER GENERATING SET
 LOCATION :- ELECTRICAL SUBSTATION BUILDING
 (RATING SHALL BE AS PER THE DEFINITION OF 100% AVAILABILITY OF STP INCLUDING ALL LIGHTING OF STP AREA, STAFF QUARTERS, BOUNDARY WALL LIGHTING)
 TYPICAL ARRANGEMENT FOR STP POWER BACK UP WITH DG SET



DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED
ENGINEERING CONSULTANT					
CLIENT: OFFICE OF THE GENERAL MANAGER GANGA POLLUTION PREVENTION UNIT U.P. JALNIGAM, VARANASI, UTTAR PRADESH					DATE: MARCH 2017 DRAWN: AS DESIGN: AS CHECKED: AS APPROVED: AS
PROJECT: DESIGN BUILT FINANCE OPERATE & TRANSFER, 50 MLD STP AT RAMANA, VARANASI					
PLANT'S KEY SINGLE LINE DIAGRAM					
DRL NO: 11 D - 1					SHEET 2 OF 2
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NOTE :

1. All incoming and control cables originating from Substation building to various electrical panel room shall be in the concrete trenches with proper segregation of HT,LT, control and FOC/ instrument cables in trays.
3. All the concrete trenches shall be approximately 300mm above FGL, with concrete embedded electrical road crossings guided uniformly towards trench on both sides of roads and path ways or culvert crossing on every road/path ways whichever suits the requirement as per the site conditions.
4. All the trench shall be covered with pre-cast slab (properly sealed at the top to avoid water ingress), however at an intermittent distant through out the trench there should be storm water collection pit and water drainage system (manual/ automatic) with an alarm facility prompting for the dewatering.
5. All electrical cables originating from various MCC panels to various drives/equipments may merge with above trench or shall have separate trench connectivity up to the concrete structure thereafter cables shall be on perforated/ladder type FRP / STEEL (POWDER COATED) trays with segregation among power/control/instrumentation/communication cables.

Schedule 2: Format of the Substitution Agreement

[ON APPROPRIATE STAMP PAPER]

This Substitution Agreement (**Substitution Agreement**) is executed on this [●] day of [●] 2017 at Varanasi:

AMONGST

- (1) **UTTAR PRADESH JAL NIGAM**, a statutory body constituted under the Uttar Pradesh Water Supply and Sewerage Act, 1975, with its registered office at 6, Rana Pratap Marg, Lucknow - 226001 (hereinafter referred to as the **Jal Nigam**, which expression shall, unless it be repugnant to the context or meaning thereof, include its successors and permitted assigns);

AND

- (2) **NATIONAL MISSION FOR CLEAN GANGA**, a statutory body constituted under the Environment (Protection) Act, 1986, with its registered office at 1st Floor, Major Dhyanchand National Stadium, India Gate, New Delhi - 110002 (hereinafter referred to as **NMCG**, which expression shall, unless it be repugnant to the context or meaning thereof, include its successors and permitted assigns);

AND

- (3) **VARANASI STP PROJECT PRIVATE LIMITED**, a company organized, incorporated, registered and existing under the Companies Act, with its registered office at 513/a, 5th floor, Kohinoor City, Kirod Road Kurla (West), Mumbai, Mumbai City, Maharashtra, India, 400070 acting through _____, _____ **[insert name of the authorised signatory and his/her designation]** duly authorized by resolution dated _____ (hereinafter referred to as the **Concessionaire**, which expression shall, unless it be repugnant to the context or meaning thereof, include its successors and permitted assigns);

AND

- (4) **[Insert name of the Lenders' Representative]** a [] organized/registered under the [], with its registered office/head office at _____ **[insert address]** (hereinafter referred to as the **Lenders' Representative**, which expression shall, unless it be repugnant to the context having its registered office at [●], acting for itself and for and on behalf of the Lenders listed in Annexure 1.

The Jal Nigam, NMCG, the Concessionaire and the Lenders' Representative are hereinafter collectively referred to as **Parties** and individually as **Party**.

WHEREAS:

- A. With a view to implement the Namami Gange programme and the Ganga 2016 Order, the Jal Nigam, in association with NMCG, has decided to undertake the development of an STP with a proposed Design Capacity of 50 MLD along with other Facilities and Associated Infrastructure at Varanasi on a PPP basis, through a hybrid annuity model.

- B. For this purpose, the Jal Nigam selected the Concessionaire post a bid process to: (i) design, develop, finance, construct, operate and maintain the Facilities on the Site; and (ii) rehabilitate, operate, and maintain the Associated Infrastructure on the Site, and after the expiry of the Term, transfer the Facilities and the Associated Infrastructure to the Jal Nigam (collectively the **Project**).
- C. The Jal Nigam, NMCG and the Concessionaire executed a Concession Agreement dated [] to implement the Project (**Concession Agreement**).
- D. The Lenders have agreed to finance the Project in accordance with the terms and conditions of the Financing Documents and have requested the Jal Nigam and NMCG to enter into this Substitution Agreement for securing their interests through substitution of the Concessionaire to a nominated Company, in accordance with this Substitution Agreement.
- E. The Parties have agreed to execute this Substitution Agreement on the terms and conditions mentioned herein below.

IT IS AGREED as follows:

1. DEFINITIONS AND INTERPRETATION

1.1. Definitions

The capitalised terms used but not defined in this Agreement shall have the meaning ascribed to them in the Concession Agreement:

Annexure	means an annexure to this Substitution Agreement.
Arbitration	has the meaning ascribed to it in Clause 8.2.
Article	means an article of this Substitution Agreement.
Clause	means a clause of this Substitution Agreement.
Companies Act	means the (Indian) Companies Act, 1956 or the (Indian) Companies Act, 2013, as amended from time to time, as the context may require.
Company	means a company incorporated under the Companies Act or a foreign company incorporated under the relevant statute of its jurisdiction.
Concession Agreement	has the meaning ascribed to it in Recital C.
Concessionaire Event of Default	means a Concessionaire Event of Default as defined under the Concession Agreement.
Dispute	means any difference or dispute of whatsoever nature relating to this Substitution Agreement between the Parties arising under, out of or in connection with this Substitution Agreement.



Financial Assistance	means all funded and non-funded financial assistance, including loans, advances and guarantees or any re-financing that the Concessionaire has availed of for the Project from the Lenders, as set out in the Financing Documents.
Financial Default	means a Concessionaire event of default as set out under the Financing Documents.
Financing Documents	means, collectively, the documents entered into or to be entered into by the Concessionaire with the Lenders, in respect of all funded and non-funded financial assistance, including loans, advances and or any re-financing that the Concessionaire may avail of for the Project from the Lenders and includes any document providing Security to the Lenders.
Indemnified Party	has the meaning ascribed to it in Clause 7.2.
Indemnifying Party	has the meaning ascribed to it in Clause 7.2.
Lenders	means the financial institutions set out in Annexure 1.
Lenders' Dues	means the aggregate of all monies owed by the Concessionaire to the Lenders under the Financing Documents on account of principal thereunder for funding the whole or any part of the cost to be incurred for implementing the Project and all accrued interest, additional interest, liquidated damages, commitment fees, commission, prepayment premium, costs, charges and other monies including financing charges and fees owed by the Concessionaire to the Lenders under the Financing Documents for the Project that are payable under the Financing Documents, up to the date of the Notice of Intent to Terminate or notice of termination issued under the Concession Agreement, or up to the date of issuance of the Notice of Financial Default under the Financial Documents, as the case may be.
Notice of Dispute	has the meaning ascribed to it in Clause 8.1.
Notice of Financial Default	has the meaning ascribed to it in Clause 3.2(a).
Notice of Intent to Terminate	means a notice issued by the Jal Nigam upon occurrence of a Concessionaire Event of Default in accordance with the Concession Agreement, conveying its intention to terminate the Concession Agreement.
Person	means any individual, company, corporation, partnership, joint venture, trust, society, sole proprietor, limited liability partnership, co-operative society, government company, unincorporated organization or any other legal entity.

Project	has the meaning ascribed to it in Recital B.
Proposal	shall have the meaning ascribed to it in Clause 4.1(c).
RFP	means the request for proposal dated 22 February, 2017 (as amended on 2 March, 2017 and 3 April, 2017) issued by the Jal Nigam, for conducting a bid process to implement the Project.
Selectee	means a new Company proposed by the Lenders pursuant to this Substitution Agreement for performing the rights and obligations of the Concessionaire for the remaining Term of the Concession Agreement.
Substitution Notice under Concession Agreement	has the meaning ascribed to it in Clause 3.3(c).
Substitution Notice under Financing Documents	has the meaning ascribed to it in Clause 3.2(b).

1.2. Interpretation

In this Substitution Agreement, unless the context otherwise requires:

- (a) Any reference to a statutory provision shall include such provision as modified or re-enacted or consolidated from time to time.
- (b) The words importing the singular shall mean the plural and vice-versa; and words importing the masculine shall include the feminine and neuter and vice-versa.
- (c) Headings in this Substitution Agreement are for convenience of reference only.
- (d) The references to the word 'include' or 'including' or to the phrase 'in particular', shall be construed without limitation.
- (e) References to any date or time of day are to Indian Standard Time; any reference to day shall mean a reference to a calendar day; any reference to a month shall mean a reference to a calendar month, any reference to a year shall mean a reference to a calendar year.
- (f) The references to any agreement or deed or other instrument shall be construed as a reference to such agreement, deed, or other instrument as may be amended, varied, supplemented or novated, from time to time.
- (g) A requirement that a payment be made on a day which is not a business day shall be

construed as a requirement that the payment be made on the next business day.

- (h) Whenever provision is made for the giving or issuing of any notice, endorsement, consent, approval, permission, certificate or determination by any person, such notice, etc., shall be reasonably given, shall not be unreasonably withheld or delayed and shall be in writing and the words 'notify', 'endorse', 'approve', 'permit', 'certify' or 'determine' shall be construed accordingly. Where any notice, consent or approval is to be given by either of the Parties, the notice, consent or approval shall be given on their behalf only by any authorized persons.
- (i) The words written and in writing include a facsimile transmission and any means of reproducing works in a tangible and permanently visible form.
- (j) The provisions of the Articles, Clauses and Annexures of this Agreement shall be interpreted in such a manner that will ensure that there is no inconsistency in interpretation between the intent expressed in the Articles, Clauses or Annexures.
- (k) In the event of any ambiguities or discrepancies between two Clauses of this Agreement, the provisions of the specific Clause relevant to the issue under consideration shall prevail over those in other Clauses.
- (l) The rule of construction, if any, that an agreement should be interpreted against the Party responsible for the drafting and preparation thereof shall not apply to this Agreement.

2. ASSIGNMENT

The Concessionaire hereby agrees to assign its rights, title and interest under the Concession Agreement to and in favour of the Lenders pursuant to and in accordance with this Substitution Agreement and the Concession Agreement by way of Security in respect of the Financial Assistance provided by the Lenders.

The Jal Nigam and NMCG hereby consent to assignment by the Concessionaire of its rights, title and interest under the Concession Agreement by way of Security to and in favour of the Lenders in connection with the Financial Assistance provided by the Lenders.

3. SUBSTITUTION OF THE CONCESSIONAIRE

3.1. Right of Substitution

- (a) The Jal Nigam and NMCG hereby irrevocably agree to substitute the Concessionaire with a Selectee, selected by the Lenders in accordance with the provisions of this Substitution Agreement and approved by the Jal Nigam.
- (b) The Lenders shall, at their sole discretion, exercise one of the 2 modes below for substituting the Concessionaire in accordance with the provisions set out in this Agreement and Applicable Laws:
 - (i) Novation: In this case, the Concession Agreement will be novated in favour of the Selectee, and the Selectee will be a party to the Concession Agreement; or

- (ii) Share sale: In this case, the Selectee will acquire the entire Capital of the Concessionaire, and upon such transfer, the 'Concessionaire' will be deemed to be the Selectee under and in accordance with this Agreement.
- (c) The Jal Nigam and NMCG agree that they shall provide all necessary consents and assistance to effect such substitution of the Concessionaire with a Selectee.
- (d) It is clarified that nothing contained herein shall entitle the Lenders to design, develop, construct, rehabilitate, complete, operate or maintain the Facilities or the Associated Infrastructure themselves under and in accordance with the Concession Agreement either individually or collectively.

3.2. Procedure in case of a Financial Default

- (a) Upon occurrence of a Financial Default, the Lenders' Representative shall notify the Concessionaire by a notice, with a copy simultaneously sent to the Jal Nigam and NMCG, about the occurrence of a Financial Default and the amount of the Lenders' Dues (**Notice of Financial Default**).

The Notice of Financial Default shall be conclusive evidence of occurrence of the Financial Default and the Lenders' Dues, and shall be final, conclusive and binding upon the Concessionaire for the purpose of this Substitution Agreement and the Financing Documents.

The Parties agree that the Jal Nigam shall have the right to trigger a Concessionaire Event of Default and issue a Notice of Intent to Terminate under the Concession Agreement upon receipt of a Notice of Financial Default.

- (b) The Lenders' Representative (on behalf of the Lenders) may, within 60 days after the issuance of the Notice of Intent to Terminate under Clause 3.2(a) above or such longer period as may be mutually agreed between the Jal Nigam and the Lenders, make a representation to the Jal Nigam, stating the intention to substitute the Concessionaire by a Selectee (**Substitution Notice under Financing Documents**).

In the event that the Lenders' Representative issues the Substitution Notice under Financing Documents, then, within 90 days of issue of such notice, the Lenders shall be entitled to undertake and complete the substitution of the Concessionaire by a Selectee, in accordance with the provisions of this Substitution Agreement. The Lenders' right to substitute the Concessionaire shall be without prejudice to any other right or remedy available to the Lenders under the Financing Documents and/or this Substitution Agreement.

- (c) If the Lenders' Representative does not convey the intention to substitute the Concessionaire with a Selectee within 60 days of the Notice of Intent to Terminate under Clause 3.2(a) above or such longer period as may be mutually agreed between the Jal Nigam and the Lenders, or the Lenders fail to substitute the Concessionaire within the time period set out in (b) above, the Jal Nigam shall be entitled to terminate the Concession Agreement in accordance with its provisions.

3.3. Procedure in case of a Concessionaire Event of Default

- (a) Upon occurrence of a Concessionaire Event of Default, the Jal Nigam shall issue a Notice of Intent to Terminate to the Concessionaire.
- (b) If, within 60 days from the date of the Notice of Intent to Terminate, the Concessionaire does not rectify or remedy the Event of Default to the satisfaction of the Jal Nigam or the Jal Nigam is not satisfied with the steps taken or proposed to be taken by the Concessionaire to remedy the Event of Default, the Jal Nigam shall issue a Notice of Intent to Terminate to the Lenders to exercise their substitution rights.

The Notice of Intent to Terminate issued by the Jal Nigam to the Lenders under this Clause 3.3(b) shall be conclusive evidence of occurrence of the Concessionaire Event of Default, and shall be final, conclusive and binding upon the Concessionaire for the purpose of this Substitution Agreement and the Financing Documents.

- (c) The Lenders' Representative (on behalf of the Lenders) may, within 60 days after the issuance of the Notice of Intent to Terminate under Clause 3.3(b) above or such longer period as may be mutually agreed between the Jal Nigam and the Lenders make a representation to the Jal Nigam, stating the intention to substitute the Concessionaire by a Selectee (**Substitution Notice under Concession Agreement**).

In the event that the Lenders' Representative issues the Substitution Notice under Concession Agreement, then, within 90 days of issue of such notice, the Lenders shall be entitled to undertake and complete the substitution of the Concessionaire by a Selectee, in accordance with the provisions of this Substitution Agreement. The Lenders' right to substitute the Concessionaire shall be without prejudice to any other right or remedy available to the Lenders under the Financing Documents and/or this Substitution Agreement.

- (d) If the Lenders' Representative does not convey the intention to substitute the Concessionaire with a Selectee within 60 days of issuance of the Notice of Intent to Terminate under Clause 3.3(b) above or such longer period as may be mutually agreed between the Jal Nigam and the Lenders, or the Lenders fail to substitute the Concessionaire within the time period set out in (c) above, the Jal Nigam shall be entitled to terminate the Concession Agreement in accordance with its provisions.

3.4. Criteria for Selection of Selectee

- (a) The Lenders' Representative shall apply the following criteria while selecting a Company as the Selectee:
 - (i) the Company shall meet the financial, eligibility and qualification criteria set out in the RFP, demonstrating that it has the necessary experience and technical qualification to construct and operate and maintain the Facilities and the Associated Infrastructure for the remaining Term. Provided that if the Financial Default or the Concessionaire Event of Default has occurred during the O&M Period, the Selectee shall be required to meet only the O&M qualification criteria set out in the RFP, in addition to the financial and eligibility criteria;

- (ii) the Company shall be capable of properly discharging the duties, obligations and liabilities of the Concessionaire under the Concession Agreement;
 - (iii) the Company shall provide Security to the satisfaction of the Lenders for the repayment of Lenders' Dues;
 - (iv) the Company shall have the capability and shall unconditionally consent to assume the liability for the payment and discharge of dues of the Concessionaire to the Jal Nigam under and in accordance with the Concession Agreement and of Lenders' Dues upon terms and conditions as agreed to with the Lenders;
 - (v) the Company shall have not been in breach of any agreement between itself and NMCG, the Jal Nigam, the GoI or the GoUP; and
 - (vi) any other appropriate condition or criterion determined by the Lenders or the Jal Nigam, whereby continuity in the performance of the Concessionaire's obligations under the Concession Agreement is maintained and the Security in favour of the Lenders under the Financing Documents is preserved.
- (b) At any time prior to the approval of a Company as the Selectee by the Jal Nigam pursuant to this Substitution Agreement, the Jal Nigam may require the Lenders' Representative to satisfy the Jal Nigam as to the eligibility of such Selectee and the decision of the Jal Nigam in this behalf shall be reasonable, final, conclusive and binding on the Lenders and such Selectee.

4. MODALITIES OF SUBSTITUTION

4.1. Modalities

The following modalities shall be applicable to any substitution of the Concessionaire by the Selectee:

- (a) the Lenders' Representative may invite, negotiate, procure offers either through private negotiations or public auction or process of tender or otherwise for the substitution of the Concessionaire by another Company;
- (b) the Lenders' Representative shall on behalf of the Lenders propose to the Jal Nigam, with a copy to NMCG, pursuant to Clause 4.1(c), the name of such Company proposed to be the Selectee for acceptance and shall apply to the Jal Nigam for grant to such Company, as substitute to the Concessionaire, the right to design, construct, rehabilitate, finance, operate, maintain and transfer the Facilities and the Associated Infrastructure under and in accordance with and subject to and on the terms and conditions set out in the Concession Agreement.

In case the Lenders intend to exercise their substitution rights through share transfer, the Lenders' Representative shall also apply to the Jal Nigam for permitting such share transfer to the Selectee upon approval in accordance with this Concession Agreement.

In case the Lenders intend to exercise their substitution rights through novation, the Lenders' Representative shall also apply to the Jal Nigam for: (i) novation of the Concession Agreement to such Company, upon being approved as the Selectee, on the same terms and conditions for the remaining Term under the Concession Agreement; and (ii) the execution of a new substitution agreement with such Company, upon being approved as the Selectee, for the remaining Term, on the same terms and conditions as set out in this Substitution Agreement

- (c) the Lenders' Representative shall be entitled, within the time period set out in Clause 3.2(b) or Clause 3.3(c) above as the case may be, to select and propose a Company as the Selectee to the Jal Nigam (with a copy to NMCG) for its approval (**Proposal**). The Proposal of the Lenders' Representative pursuant to this Clause 4.1(c) shall contain the details of such Company (including information in relation to the Company's ability to meet the technical and financial criteria set out in the RFP), the Lenders' Dues and any other data and information as may be relevant for the Jal Nigam to consider and take a decision on the Proposal.

Without prejudice to the foregoing, the Lenders' Representative agrees and undertakes to provide to the Jal Nigam (and NMCG), such further and other information and clarifications in respect of any data, details or information, furnished by the Lenders' Representative as the Jal Nigam and/or NMCG may reasonably require. The Jal Nigam shall convey its approval or otherwise of such Proposal, including such Company proposed as the Selectee, in its sole discretion within 15 days of (i) the date of receipt of the Proposal by the Jal Nigam; or (ii) the date when the last of any further information and clarifications in respect of any data, details or information comprised in the Proposal, have been provided by the Lenders' Representative to the Jal Nigam, whichever is later. It is expressly agreed between the Parties that the Proposal shall be accompanied by an unconditional undertaking of the Company proposed as the Selectee that it shall, upon approval by the Jal Nigam of the Proposal, perform and fulfill the terms and conditions of the Concession Agreement as if such Company was the original signatory to the Concession Agreement and shall be liable for and shall assume, discharge and pay the Lenders' Dues under and in accordance with the terms and conditions of the Financing Documents. Upon approval of the Proposal by the Jal Nigam, the Company shall become the Selectee hereunder;

- (d) the Jal Nigam shall, upon its satisfaction of the eligibility of the Selectee and in accordance with the provisions of this Substitution Agreement and subject to the provisions of Clause 4.1(e), proceed to substitute the Concessionaire with the Selectee: (i) by novation of the Concession Agreement or such other form of document as the Jal Nigam and NMCG may reasonably require, on the same terms and conditions as set out under the Concession Agreement for the remaining Term; or (ii) by requiring the Selectee to acquire the entire Capital of the Concessionaire, in accordance with Applicable Laws;
- (e) the substitution as aforesaid shall be subject to the Selectee completing corporate compliances for executing the documents and obtaining Applicable Permits necessary for implementing and/or operating and maintaining the Facilities and the Associated Infrastructure under and in accordance with the Concession Agreement;

- (f) the Jal Nigam shall have the right to object to the choice of the proposed Selectee after hearing the Lenders' Representative, provided however, that in the event of a refusal as stated above, the Lenders' Representative may propose another Company as the Selectee, within 90 days of the issuance of the Substitution Notice under Financing Documents or Substitution Notice under Concession Agreement, as the case may be. In the event that no objection is raised with respect to the Company proposed to be the Selectee by the Jal Nigam within the period set forth in Clause 4.1(c), the Company proposed as the Selectee shall be deemed to have been accepted by the Jal Nigam;
- (g) the substitution as aforesaid, shall be deemed to be complete only upon the Selectee accepting and complying with the terms and conditions stipulated in the Concession Agreement; and
- (h) all actions of the Lenders' Representative hereunder shall be deemed to be on behalf of the Lenders and be binding upon them.

4.2. Waiver of Concessionaire's Right to Remedy

The Concessionaire hereby irrevocably agrees and waives any right to challenge the Lenders' decision to apply to the Jal Nigam for substitution as aforesaid and neither the Concessionaire nor the Jal Nigam shall be entitled to prevent the Lenders' Representative from proceeding to seek such a substitution of the Concessionaire by the Selectee as provided in this Article 4. The Parties acknowledge that the rights of the Lenders under this Article 4 are irrevocable and shall not be contested in any proceedings before any court of law and the Concessionaire shall not have any right or remedy to prevent, obstruct, injunct or restrain the Jal Nigam and/or the Lenders from effecting or causing the substitution as aforesaid. No third party shall have the right to question the decision of the Lenders/Lenders' Representative, the Jal Nigam or NMCG in relation to substitution of the Concessionaire.

4.3. No Guarantee

Nothing contained in this Article 4 shall mean or be interpreted as provision of any guarantee or surety by the Jal Nigam or NMCG and it is expressly agreed that the Jal Nigam and NMCG have not provided any surety, guarantee or counter guarantee whether directly or indirectly for the recovery of amount of Financial Assistance advanced by the Lenders to the Concessionaire.

5. INTERIM PROTECTION

If the Lenders notify the Jal Nigam of a Financial Default and until such time that a Selectee is approved in accordance with this Substitution Agreement, the Lenders agree that the Jal Nigam shall (either itself or through an entity nominated by it) be entitled to maintain, preserve and protect the Facilities and the Associated Infrastructure if, in the Jal Nigam's opinion, it is necessary and required for the construction or operation and maintenance of the Facilities and the Associated Infrastructure. In case of such interim protection during the O&M Period, the Jal Nigam or an entity nominated by the Jal Nigam shall operate and maintain the Facilities and the Associated Infrastructure pending the substitution of the Concessionaire by the Selectee.

6. STAND-STILL

The Jal Nigam agrees that on the occurrence of any Concessionaire Event of Default or a Financial Default, it shall not exercise: (a) its Nigam's right to step-in in place of the Concessionaire; (b) suspend or terminate the Concession Agreement; or (c) take any action for the winding-up of the Concessionaire or the appointment of a receiver or administrator in respect of the Concessionaire's business and assets, until expiry of the time period available to the Lenders to exercise the substitution rights, as set out in Article 3.

7. INDEMNITY

7.1 Indemnity

- (a) The Concessionaire shall indemnify, defend and hold harmless the Jal Nigam, NMCG, the Lenders and the Lenders' Representative against any and all proceedings, actions and third party claims for any loss, damage, cost and expenses of whatever kind and nature arising out of any breach by the Concessionaire of any of its obligations under this Substitution Agreement or on account of failure of the Concessionaire to comply with Applicable Laws and Applicable Permits.
- (b) The Lender shall indemnify, defend and hold harmless the Jal Nigam and NMCG against any and all proceedings, actions and third party claims for any loss, damage, cost and expenses arising out of the Lenders' or the Lenders' Representative's failure to fulfill their obligations under this Substitution Agreement, materially or adversely affecting the performance of the Concessionaire's, the Jal Nigam's or NMCG's obligations under the Concession Agreement, other than any loss, damage, cost and expenses arising out of acts done in discharge of their lawful functions by the Lenders/Lenders' Representative.

7.2 Notices and Contest of Claims

In the event that any Party receives a claim from a third party in respect of which it is entitled to the benefit of an indemnity under Clause 7.1 or in respect of which it is entitled to reimbursement (**Indemnified Party**), it shall notify the other Party responsible for indemnifying such claim hereunder (**Indemnifying Party**) within 30 days of receipt of claim and shall not settle or pay the claim without prior approval of the Indemnifying Party, such approval not being unreasonably withheld or delayed. In the event that the Indemnifying Party wishes to contest or dispute the claim, it may conduct the proceedings in the name of the Indemnified Party and shall bear all costs involved in contesting it. The Indemnified Party shall provide all cooperation and assistance in contesting any claim and shall sign all such writings and documents as the Indemnified Party may reasonably require.

8. DISPUTE RESOLUTION

8.1 Amicable Settlement

In the event of a Dispute, either Party may give the other written notice at any time of a Dispute having arisen (**Notice of Dispute**). The Notice of Dispute shall set out brief details of the nature of the Dispute.



The Parties agree that they shall endeavour to resolve any Dispute amicably and in good faith within 30 days of a Notice of Dispute being served by one Party on the other Party in respect of that Dispute. In the event that resolution of the Dispute is reached pursuant to this Clause 8.1, the resolution and its terms shall be recorded in writing and signed by one representative from each of the Parties.

8.2 Dispute Resolution by Arbitration

Failing amicable settlement and/or settlement of a Dispute pursuant to the provisions of Clause 8.1, each of the Parties unconditionally and irrevocably agrees to the submission of such Dispute to binding arbitration governed by the Arbitration and Conciliation Act, 1996.

Any arbitration proceedings commenced pursuant to this Clause 8.2 shall be referred to as the **Arbitration**.

If a Dispute is referred to Arbitration by any Party, such Dispute shall be resolved by a sole arbitrator to be appointed by mutual agreement of the Parties. If Parties fail to appoint an arbitrator within 30 days after service of the notice of Arbitration, such arbitrator shall be appointed in accordance with the provisions of the Arbitration Act.

8.3 Place of Arbitration

The place of the Arbitration shall be New Delhi.

8.4 English Language

The request for the Arbitration, the answer to the request, the terms of reference, any written submissions, any orders and rulings pursuant to the Arbitration shall be in English and, if oral hearings take place, English shall be the language to be used in the hearings.

8.5 Fees and Expenses

The fees and expenses of the arbitrator and all other expenses of the Arbitration shall be initially borne and paid by respective Parties, subject to determination by the arbitrator. The arbitrator may provide in the award for the reimbursement to the prevailing Party of its costs and expenses in bringing or defending the Arbitration claim, including legal fees and expenses incurred by such Party.

8.6 Performance of Obligations during the Pendency of the Arbitration Proceedings

The Substitution Agreement and rights and obligations of the Parties shall remain in full force and effect pending the award under any Arbitration proceedings pursuant to this Article 8.

8.7 Survival

The provisions of this Article 8 shall survive the termination of the Substitution Agreement.

9. GOVERNING LAW AND JURISDICTION

The Substitution Agreement shall be construed and interpreted in accordance with and governed by the laws of India, and the courts in Allahabad shall have exclusive jurisdiction over matters arising out of or relating to this Substitution Agreement.

10. MISCELLANEOUS

10.1 Duration of this Agreement

This Agreement shall come into force from the date hereof and shall expire at the earliest to occur of the following events:

- (a) termination of the Concession Agreement; or
- (b) no sum remains to be advanced and no sum are outstanding to the Lenders, under the Financing Documents.

10.2 Survival

- (a) Any cause or action which may have occurred in favour of any Party or any right which is vested in any Party under this Agreement as a result of any act, omission, deed, matter or thing done or omitted to be done by any Party before the expiry of the Term by efflux of time or otherwise in accordance with this Agreement, shall survive the expiry of the Agreement.
- (b) The provisions of this Agreement, to the fullest extent necessary to give effect thereto, survive the Term or the termination of this Agreement and the obligations of Parties to be performed or discharged following the termination of this Agreement, shall accordingly be performed or discharged by the Parties.

10.3 Counterparts

This Agreement may be executed in four counterparts, each of which, when executed and delivered, will be an original, and all four counterparts together shall constitute one and the same instrument.

10.4 Waivers and Consents

- (a) Unless otherwise specified, any provision or breach of any provision of this Agreement may be waived before or after it occurs only if evidenced by an agreement in writing signed by the Parties.
- (b) Any consent under or pursuant to any provision of this Agreement must also be in writing and given prior to the event, action or omission for which it is sought.
- (c) Any such waiver or consent may be given subject to any conditions thought fit by the Party giving it and shall be effective only in the instance and for the purpose for which it is given.



10.5 Severability

- (a) If any provision of this Agreement is or becomes illegal, invalid or unenforceable in any respect under any Applicable Law, the legality, validity or enforceability of the remaining provisions will not, in any way, be affected or impaired.
- (b) The Parties shall negotiate in good faith with a view to agreeing one or more provisions which may be substituted for any such invalid, illegal or unenforceable provision and which produce as nearly as is practicable in all the circumstances the appropriate balance of the commercial interests of the Parties.

10.6 Waiver of sovereign immunity

The Jal Nigam and NMCG unconditionally and irrevocably:

- (a) agree that the execution, delivery and performance by it of this Agreement constitute commercial acts done and performed for commercial purpose;
- (b) agree 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 Jal Nigam and NMCG with respect to its assets; and
- (c) consent to the enforcement of any judgment or award against them in any such proceedings.

10.7 Language

- (a) The formal text of this Agreement and other agreements in relation to the Project shall be in the English language.
- (b) All notices and communications between the Parties under this Agreement shall be in English.

10.8 Third Parties

This Agreement and all rights hereunder are intended for the sole benefit of the Parties, and shall not imply or create any rights on the part of, or obligations to, any other Person.

10.9 Representations and Warranties

The Parties hereto expressly represent and warrant that they are duly empowered to sign and execute this Substitution Agreement.

10.10 Notices

Notices under this Substitution Agreement shall be sent to the addresses first hereinabove mentioned and Annexure 1 (in case of Lenders). Any change in the address of any Party shall be duly notified by registered post acknowledgement due and delivered to other Parties.

10.11 Amendments to Substitution Agreement

- (a) This Substitution Agreement shall not be affected by re-organisation of any Lender, Lenders' Representative, the Jal Nigam or NMCG and the successor-in-interest of such Lender, Lenders' Representative, the Jal Nigam or NMCG shall have the benefit of this Substitution Agreement.
- (b) No amendment, variation or modification to this Substitution Agreement shall be valid and effectual unless made in writing and executed by the duly authorised representatives of all the Parties.
- (c) All stamp duties or other imposts and charges as are applicable on this Substitution Agreement or on novation of the Concession Agreement for the purpose of substitution as specified in this Substitution Agreement shall be borne by the Concessionaire. In the event of Lenders making such payment in the interim, such amount shall be deemed to be a part of the Lenders' Dues.

10.12 Harmonious Construction

- (a) For the purpose of giving full and proper effect to this Substitution Agreement, the Concession Agreement and this Substitution Agreement shall be read together and construed harmoniously. The terms of the Concession Agreement shall prevail in the event of any inconsistencies with this Substitution Agreement.
- (b) The consultation, recommendation or approval of the Lenders' Representative under this Substitution Agreement shall always be taken as consultation, recommendation or approval of every concerned Lender and each such Lender shall be bound by the same and hereby waives its right to question or dispute it.
- (c) This Substitution Agreement shall be in addition to and shall not be in derogation of the terms of the Financing Documents.
- (d) It shall not be necessary for the Lenders or the Lenders' Representative to enforce or exhaust any other remedy available to them before invoking the provisions of this Substitution Agreement.



In witness whereof the Parties hereto have signed this Agreement on this _____ day of _____ 2017.

UTTAR PRADESH JAL NIGAM

By:

Name:

Title: General Manager

NATIONAL MISSION FOR CLEAN GANGA

By:

Name:

Title:

[CONCESSIONAIRE]

By:

Name:

Title:

[LENDERS'REPRESENTATIVE]

By:

Name:

Title:



ANNEXURE 1

S.No.	Details of Lenders
1.	[_____ <i>insert name of the Lender</i>], registered under the [], with its registered office at [_____ <i>insert address</i>] and branch office at [_____ <i>insert address</i>]
2.	[_____ <i>insert name of the Lender</i>], registered under the [], with its registered office at [_____ <i>insert address</i>] and branch office at [_____ <i>insert address</i>]

Handwritten signature

Handwritten mark

Handwritten signature

Schedule 3: Format of the Escrow Agreement

(ON APPROPRIATE STAMP PAPER)

THIS ESCROW AGREEMENT (this **Escrow Agreement**) is entered into at [] on [] by and among:

- (1) **UTTAR PRADESH JAL NIGAM**, a statutory body constituted under the Uttar Pradesh Water Supply and Sewerage Act, 1975, with its registered office at 6, Rana Pratap Marg, Lucknow - 226001 (hereinafter referred to as the **Jal Nigam**, which expression shall, unless it be repugnant to the context or meaning thereof, include its successors and permitted assigns);

AND

- (2) **NATIONAL MISSION FOR CLEAN GANGA**, a statutory body constituted under the Environment (Protection) Act, 1986, with its registered office at 1st Floor, Major Dhyanchand National Stadium, India Gate, New Delhi - 110002 (hereinafter referred to as **NMCG**, which expression shall, unless it be repugnant to the context or meaning thereof, include its successors and permitted assigns);

AND

- (3) **VARANASI STP PROJECT PRIVATE LIMITED**, a company organized, incorporated, registered and existing under the Companies Act, with its registered office at 513/a, 5th floor, Kohinoor City, Kirod Road Kurla (West), Mumbai, Mumbai City, Maharashtra, India, 400070 acting through _____, _____
[insert name of the authorised signatory and his/her designation] duly authorized by resolution dated September 17, 2017 (hereinafter referred to as the **Concessionaire**, which expression shall, unless it be repugnant to the context or meaning thereof, include its successors and permitted assigns).

AND

- (4) *[Insert name of Escrow Bank]*, a bank duly constituted in accordance with Applicable Laws and carrying on the business of banking in India as a Scheduled Commercial Bank, with its registered office at *[insert address]* and acting for the purposes of this Escrow Agreement through its branch office at *[insert address]* (hereinafter referred to as **Escrow Bank**, which expression shall unless repugnant to the context or meaning thereof includes its successors and permitted assigns).

The Jal Nigam, NMCG, the Concessionaire and the Escrow Bank are collectively referred to as **Parties** and individually as **Party**.

WHEREAS:

- A. With a view to implement the Namami Gange programme and the Ganga 2016 Order, the Jal Nigam, in association with NMCG, has decided to undertake the development of an STP with a proposed Design Capacity of 50 MLD along with other Facilities and Associated Infrastructure at Varanasi on a PPP basis, through a hybrid annuity model.

- B. For this purpose, the Jal Nigam selected the Concessionaire post a bid process to: (i) design, develop, finance, construct, operate and maintain the Facilities on the Site; and (ii) rehabilitate, operate, and maintain the Associated Infrastructure on the Site, and after the expiry of the Term, transfer the Facilities and the Associated Infrastructure to the Jal Nigam (collectively the **Project**).
- C. The Jal Nigam, NMCG and the Concessionaire executed a Concession Agreement dated [] to implement the Project (**Concession Agreement**), which is annexed to this Escrow Agreement.
- D. In consideration of the Concessionaire designing, developing, financing, constructing, rehabilitating, operating and maintaining the Facilities and the Associated Infrastructure on the Site for the Term, NMCG is required to pay the Concessionaire: (i) during the Construction Period, the Construction Payments upon satisfactory completion of works corresponding to Payment Milestones; and (ii) during the O&M Period, O&M Payments comprising the Capex Annuity (along with interest), the O&M Charges and the Power Charges for the Facilities at actuals (subject to a cap based on the Guaranteed Energy Consumption) and the Power Charges for the Associated Infrastructure at actuals.
- E. As per the provisions of the Concession Agreement, NMCG, the Jal Nigam, the Concessionaire are required to enter into an escrow agreement with an escrow bank and NMCG is required to open an escrow account with such escrow bank and maintain the Minimum Escrow Balance for the payment of the Construction Payments and the O&M Payments.
- F. The escrow account shall be funded by NMCG in accordance with the terms of this Escrow Agreement and such account shall serve to secure NMCG's payment obligations towards the Concessionaire under the Concession Agreement.
- E. The Escrow Bank is willing to serve as an escrow bank in accordance with the terms and conditions of this Escrow Agreement.

NOW, THEREFORE, the Parties hereto agree as follows:

1. **DEFINITIONS AND INTERPRETATION**

- 1.1 Capitalized terms used but not defined in this Escrow Agreement shall have the meaning given to them in the Concession Agreement.
- 1.2 In this Escrow Agreement, unless the context otherwise requires:
- (a) Any reference to a statutory provision shall include such provision as modified or re-enacted or consolidated from time to time.
 - (b) The words importing the singular shall mean the plural and vice-versa; and words importing the masculine shall include the feminine and neuter and vice-versa.
 - (c) Headings in this Escrow Agreement are for convenience of reference only.
 - (d) The references to the word 'include' or 'including' or to the phrase 'in particular', shall be construed without limitation.

- (e) References to any date or time of day are to Indian Standard Time; any reference to day shall mean a reference to a calendar day; any reference to a month shall mean a reference to a calendar month, any reference to a year shall mean a reference to a calendar year.
- (f) The references to any agreement or deed or other instrument shall be construed as a reference to such agreement, deed, or other instrument as may be amended, varied, supplemented or novated, from time to time.
- (g) Whenever provision is made for the giving or issuing of any notice, endorsement, consent, approval, permission, certificate or determination by any person, such notice, etc., shall be reasonably given, shall not be unreasonably withheld or delayed and shall be in writing. Where any notice, consent or approval is to be given by either of the Parties, the notice, consent or approval shall be given on their behalf only by any authorized persons.
- (h) The words written and in writing include a facsimile transmission and any means of reproducing works in a tangible and permanently visible form.
- (i) The provisions of the clauses of this Escrow Agreement shall be interpreted in such a manner that will ensure that there is no inconsistency in interpretation between the intent expressed in the clauses.
- (j) In the event of any ambiguities or discrepancies between two clauses of this Escrow Agreement, the provisions of the specific clause relevant to the issue under consideration shall prevail over those in other clauses.
- (k) The rule of construction, if any, that an agreement should be interpreted against the Party responsible for the drafting and preparation thereof shall not apply to this Escrow Agreement.

2. **ESCROW ACCOUNT**

2.1 **Appointment**

- (a) NMCG, the Jal Nigam and the Concessionaire hereby appoint the Escrow Bank to serve as the escrow bank for the purposes of this Escrow Agreement and the Escrow Bank hereby accepts this appointment.
- (b) NMCG hereby settles in trust with the Escrow Bank a sum of INR 1,000 (Rupees one thousand). The Escrow Bank has accepted the above amount of INR 1,000 (Rupees one thousand) in trust declared and, subject to the terms and conditions in this Escrow Agreement, agreed to act as trustee for the benefit of the Concessionaire, NMCG and the Jal Nigam.
- (c) The Escrow Bank shall hold and safeguard the Escrow Account and any monies held therein, during the term of this Escrow Agreement and shall treat the amount in the Escrow Account as monies deposited by NMCG with the Escrow Bank in trust in accordance with the provisions of this Escrow Agreement. In performing its functions



and duties under this Escrow Agreement, the Escrow Bank shall act as an agent of NMCG, the Jal Nigam and the Concessionaire.

2.2 Escrow Account

- (a) Within 5 days of the date of this Escrow Agreement, NMCG shall establish a bank account in the name of [●], which shall be an interest bearing, no lien account, denominated in Indian Rupees for the benefit of the Concessionaire (the **Escrow Account**).
- (b) Immediately upon opening the Escrow Account, the Escrow Bank shall provide details of the Escrow Account in writing to the Concessionaire and the Jal Nigam, including the date of opening of the Escrow Account.
- (c) The Parties agree and acknowledge that:
 - (i) the Escrow Account shall be opened pursuant to, and specifically for the purposes of, this Escrow Agreement and shall be used and operated only for the purposes and in the manner provided in this Escrow Agreement and for no other use or purposes and in no other manner;
 - (ii) the Escrow Bank shall maintain the Escrow Account in accordance with the terms of this Escrow Agreement and its usual practices and applicable regulations;
 - (iii) the Escrow Bank and the Concessionaire, after consultation with NMCG, shall agree on the detailed mandates, terms and conditions and operating procedures for the Escrow Account but in the event of any inconsistency between this Escrow Agreement and such mandates, terms and conditions or procedures in this Escrow Agreement shall prevail; and
 - (iv) no instruction shall be given to the Escrow Bank which is not contemplated by or which is contrary to or inconsistent with this Escrow Agreement. In the event any such inconsistent or contrary instruction is given, the same shall be null and void and the Escrow Bank shall not be obliged to act upon, and shall ignore, such instructions and continue to comply with the provisions of this Escrow Agreement.

2.3 Deposits into Escrow Account

- (a) Minimum Escrow Balance
 - (i) NMCG shall deposit in the Escrow Agreement an amount equivalent to the first 2 Payment Milestones prior to the Effective Date. From the Effective Date and during the Construction Period, NMCG shall ensure that the Escrow Account is funded with an amount equivalent to the next 2 Payment Milestones; and
 - (ii) on and from the COD and during the O&M Period, NMCG shall deposit the

O&M Payments in the Escrow Account such that the Escrow Account is funded at all times with the Capex Annuities (along with interest), the O&M Charges and the estimated Power Charges for the next 2 years,

(the **Minimum Escrow Balance**).

- (b) NMCG shall ensure that the minimum balance in the Escrow Account at all times during the Term is not less than the Minimum Escrow Balance.

If at any time during the Construction Period or the O&M Period, the balance in the Escrow Account falls below the Minimum Escrow Balance, NMCG shall promptly, and in any event, no later than 90 days, fund the Escrow Account such that the Minimum Escrow Balance is maintained.

- (c) The Parties agree that a failure to maintain the Minimum Escrow Balance for 90 days would be treated as a NMCG Event of Default and in such case, the consequences set out in the Concession Agreement shall apply.
- (d) It is clarified that any interest earned on the amounts deposited by NMCG in the Escrow Account will be counted towards the Minimum Escrow Balance.

2.4 **Withdrawals from Escrow Account during the Construction Period**

- (a) Upon successful completion and verification of a Payment Milestone as per the Concession Agreement, the Jal Nigam is required to approve the Invoice raised by the Concessionaire within 10 days of receipt of the Invoice and issue a Payment Certificate to the Escrow Bank. The Payment Certificate shall convey the Jal Nigam's approval for the release of the amount specified in the Invoice for the relevant Payment Milestone, less any necessary deductions or adjustments in accordance with the Concession Agreement and/or Applicable Laws (including for payments to be made by the Concessionaire under applicable labour laws).
- (b) If, within 10 days from the date of receipt of an Invoice, the Jal Nigam does not dispute an Invoice, then the Invoice shall be deemed to have been accepted by the Jal Nigam, and the Concessionaire shall have the right to issue instructions to the Escrow Bank (with a copy to the Jal Nigam and NMCG) to release the amounts specified in the Invoice, upon the expiry of the 10-day period. Any such instruction issued by the Concessionaire to the Escrow Bank shall be accompanied with the Invoice raised by the Concessionaire for the relevant Payment Milestone.
- (c) Immediately upon receipt of a Payment Certificate from the Jal Nigam in accordance with clause 2.4(a) above or upon receipt of instructions from the Concessionaire in accordance with clause 2.4(b), the Escrow Bank shall release the amount specified in the Payment Certificate or if no Payment Certificate has been issued, then the amount specified in the relevant Invoice to the bank account of the Concessionaire mentioned below:

Bank:

Account number:

BIC (SWIFT):



Address of Bank:
[Insert bank account details]

The Concessionaire may change the above bank account details by giving a 5-day prior written notice to the Escrow Bank, NMCG and the Jal Nigam.

- (d) Upon any termination of the Concession Agreement during the Construction Period, NMCG shall issue instructions to the Escrow Bank requesting it to release and transfer any amounts due and payable to the Concessionaire, including termination payments, if any, as certified by NMCG in a statement and any remaining amounts standing to the credit of the Escrow Account shall be transferred to the following account of NMCG:

Bank:
Account number:
BIC (SWIFT):
Address of Bank:
[Insert bank account details]

NMCG may change the above bank account details by giving 5-day prior written notice to the Escrow Bank, the Concessionaire and the Jal Nigam.

2.5 Withdrawals from Escrow Account during the O&M Period

- (a) For O&M Payments in each quarter, the Jal Nigam is required to approve the Invoice raised by the Concessionaire within 10 days of receipt of the Invoice and issue a Payment Certificate to the Escrow Bank. The Payment Certificate shall convey the Jal Nigam's approval for the release of the amount specified in the Invoice, less any necessary deductions or adjustments in accordance with the Concession Agreement and/or Applicable Laws (including for payments to be made by the Concessionaire under applicable labour laws).
- (b) If, within 10 days from the date of receipt of an Invoice, the Jal Nigam does not dispute an Invoice, then the Invoice shall be deemed to have been accepted by the Jal Nigam, and the Concessionaire shall have the right to issue instructions to the Escrow Bank (with a copy to the Jal Nigam and NMCG) to release the amounts specified in the Invoice, upon the expiry of the 10-day period. Any such instruction issued by the Concessionaire to the Escrow Bank shall be accompanied with the Invoice raised by the Concessionaire.
- (c) Immediately upon receipt of a Payment Certificate from the Jal Nigam in accordance with clause 2.5(a) above or upon receipt of instructions from the Concessionaire in accordance with clause 2.5(b), the Escrow Bank shall release the amount specified in the Payment Certificate or if no Payment Certificate has been issued, then the amount specified in the relevant Invoice to the bank account of the Concessionaire mentioned below:

Bank:
Account number:
BIC (SWIFT):
Address of Bank:

[Insert bank account details]

The Concessionaire may change the above bank account details by giving a 5-day prior written notice to the Escrow Bank, NMCG and the Jal Nigam.

- (d) Upon any termination of the Concession Agreement during the O&M Period, NMCG shall issue instructions to the Escrow Bank requesting it to release and transfer any amounts due and payable to the Concessionaire, including termination payments, if any, as certified by NMCG in a statement and any remaining amounts standing to the credit of the Escrow Account shall be transferred to the following account of NMCG:

Bank:

Account number:

BIC (SWIFT):

Address of Bank:

[Insert bank account details]

NMCG may change the above bank account details by giving 5-day prior written notice to the Escrow Bank, the Concessionaire and the Jal Nigam.

2.6 Identification and Separation

The Escrow Bank shall clearly identify in its records the Escrow Account as an escrow account and shall keep the funds standing to the credit of the Escrow Account separated and segregated from the Escrow Bank's own funds or funds of any of its other customers or third parties.

2.7 Fees

NMCG shall pay [Rs. [] per annum] as fees to the Escrow Bank for the establishment and management of the Escrow Account. NMCG shall pay such fees to the Escrow Bank within 10 days of receipt of an invoice from the Escrow Bank.

2.8 Escrow Account Statements

The Escrow Bank shall provide monthly statements regarding the Escrow Account to NMCG, the Jal Nigam and the Concessionaire.

3. ESCROW AMOUNT

- 3.1 Promptly upon NMCG transferring any amount to the Escrow Account, the Escrow Bank shall send a notice to the Concessionaire and the Jal Nigam notice informing them of the transfer.
- 3.2 The Escrow Bank shall hold all amounts in the Escrow for the sole benefit of the Concessionaire. Subject to clause 2.4(d) and clause 2.5(d) of this Escrow Agreement, the Escrow Bank shall not release any amount in the Escrow Account to any person other than the Concessionaire.
- 3.3 The Escrow Bank shall not apply any right of set-off against the amount in the Escrow Account, grant any lien over such amount, or apply any fee or deduction in relation to such amount.

4. **RIGHTS, DUTIES AND OBLIGATIONS OF THE ESCROW BANK**

4.1 The Escrow Bank:

- (a) may, in the absence of bad faith, fraud, wilful default or gross negligence on its part, rely as to any matters of fact which might reasonably be expected to be within the knowledge of NMCG or the Jal Nigam, as the case may be, upon a certificate signed by or on behalf of NMCG or the Jal Nigam, as the case may be;
- (b) may, in the absence of bad faith, fraud, wilful default or gross negligence on its part, rely upon the authenticity of any communication or documents believed by it to be authentic;
- (c) shall, within 5 days after receipt, deliver a copy to the Jal Nigam and NMCG of any notice or document received by the Escrow Bank from the Concessionaire or any other Person hereunder or in connection herewith;
- (d) shall, within 5 days after receipt, deliver a copy to the Concessionaire of any notice or document received by the Escrow Bank from the Jal Nigam or NMCG in connection herewith; and
- (e) shall maintain all records of deposits and withdrawals from the Escrow Account for the term of this Escrow Agreement.

4.2 The duties of the Escrow Bank are only as herein specifically provided, and are purely administrative in nature. The Escrow Bank shall neither be liable for, nor chargeable with knowledge of, the terms and conditions of any other agreement, instrument or document in connection herewith, including, without limitation, the Concession Agreement, and shall be required to act in respect of the amounts in the Escrow Account only as provided in this Escrow Agreement. This Escrow Agreement sets out all the obligations of the Escrow Bank with respect to any and all matters pertinent to the Escrow Account contemplated hereunder and no additional obligations of the Escrow Bank shall be implied from the terms of any other agreement. The Escrow Bank shall incur no liability in connection with the discharge of its obligations under this Escrow Agreement or in connection therewith, except such liability as may arise from the Escrow Bank's negligence, wilful misconduct or otherwise from any breach of this Escrow Agreement. Such liability, however, shall not exceed the amount in the Escrow Account at the date of the said breach by the Escrow Bank.

4.3 The Escrow Bank shall not be required to perform any acts which will violate any Applicable Laws.

4.4 In the event of any bankruptcy proceedings or enforcement proceedings against any of the Parties pursuant to Applicable Laws, the Escrow Bank shall, notwithstanding the provisions of this Escrow Agreement, act and perform in accordance with Applicable Laws.

5. **ESCROW AGREEMENT DEFAULTS**

5.1 Any breach by the Concessionaire of the terms of this Escrow Agreement, which breach the Concessionaire fails to remedy within 5 days to the satisfaction of the Jal Nigam and NMCG



will be treated as an **Escrow Default**, unless such breach has occurred as a result of any act or omission of NMCG or the Jal Nigam.

5.2 The Parties agree that an Escrow Default in terms of this Escrow Agreement shall be treated as a Concessionaire Event of Default under the Concession Agreement, and the consequences of an Escrow Default shall be dealt with in accordance with the Concession Agreement.

5.3 Upon the occurrence of an Escrow Default, the Concessionaire agrees that NMCG shall have the right to direct the Escrow Bank to suspend withdrawals from the Escrow Account until further notice from NMCG.

6. MISCELLANEOUS

6.1 Representations and Warranties

Each Party represents and warrants that:

- (a) it has the authority to enter into this Escrow Agreement;
- (b) this Escrow Agreement constitutes a legally valid and binding obligation, enforceable against it in accordance with its terms;
- (c) its entry into and/or performance under this Escrow Agreement will not be in breach of any express or implied terms of any contract with or other obligation to any third party; and
- (d) it is solvent and able to perform all of its obligations under this Escrow Agreement.

6.2 Notices

Any notice or other communication to be given or made under this Escrow Agreement to the Parties shall be in writing. Except as otherwise provided in this Escrow Agreement, such notice, request or other communication shall be delivered by registered mail or facsimile to the Party(ies) at the following addresses:

NMCG: []

Uttar Pradesh Jal Nigam: []

[Concessionaire]: []

Escrow Bank: []

6.3 Entire Agreement

This Escrow Agreement and the Concession Agreement constitutes the entire agreement and understanding between the Parties with respect to its subject matter (i.e., escrow arrangement) and replaces and supersedes all prior agreements, arrangements, undertakings or statements regarding such subject matter.

6.4 Amendments

No variation of or amendment to this Escrow Agreement shall be effective unless made in writing and executed by all the Parties hereto.

6.5 Harmonious Construction

For the purpose of giving full and proper effect to this Escrow Agreement, the Concession Agreement and this Escrow Agreement shall be read together and construed harmoniously. The terms of the Concession Agreement shall prevail in the event of any inconsistencies with this Escrow Agreement.

6.6 Assignment

Neither this Escrow Agreement nor any of the rights or obligations hereunder may be assigned by a Party without the prior written consent of the other Parties, provided that the Concessionaire shall be entitled, to the extent permitted by Applicable Law and as may be required under any Financing Documents entered into by the Concessionaire, to assign or create liens over its rights and interests under or pursuant to this Escrow Agreement.

6.7 Severability

Whenever possible, each provision of this Escrow Agreement shall be interpreted in such a way as to be effective and valid under Applicable Law, but if any provision of this Escrow Agreement is unenforceable or invalid under Applicable Law, such provision shall be ineffective only to the extent of such unenforceability or invalidity, and the remaining provisions of this Escrow Agreement shall continue to be binding and in full force and effect.

6.8 Confidentiality

The Parties, their employees, representatives and agents shall keep the provisions of this Escrow Agreement strictly confidential and, except as may be required by Applicable Laws, shall make no disclosure thereof to any Person, except the Parties' respective legal counsels and professional advisers, without the prior written consent of the other Parties.

6.9 Termination

This Escrow Agreement shall be automatically terminated upon the expiry of the Term or termination of the Concession Agreement and after disbursement of all amounts due and payable to the Concessionaire under the Concession Agreement, including Termination Compensation, if any, and any remaining amounts to NMCG in accordance with clause 2.4(d) and clause 2.5(d) of this Escrow Agreement.

6.10 Dispute Resolution Mechanism

- (a) If any dispute arises out of or in connection with this Escrow Agreement, this dispute shall not affect the Parties' duty to continue the performance of all of their undisputed obligations.

- (b) If any dispute arises, a Party shall give notice to the other Parties of the same, whereupon the Parties shall meet promptly and in good faith to attempt to reach an amicable settlement.
- (c) All disputes not settled amicably pursuant to (b) above shall be heard by the competent courts of Uttar Pradesh.

6.11 Governing Law

This Escrow Agreement shall be governed by and construed in accordance with the laws of India.

IN WITNESS WHEREOF, the Parties hereto have caused these presents to be executed by its authorized representatives as of the date first written above.

For NMCG

By.

Name: []

Designation: []

For Uttar Pradesh Jal Nigam

By.

Name: []

Designation: []

For Concessionaire

By.

Name: []

Designation: []

For Escrow Bank

By.

Name: []

Designation: []

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Schedule 4: Format of the Mobilization Advance Guarantee

[ON APPROPRIATE STAMP PAPER]

Guarantee No. : [●]
Amount of Guarantee : [●]

This Mobilization Advance Guarantee is executed on this [●] day of [●] at [●]

BY

[●] with its registered office at [●] and a branch office at [●] (hereinafter referred to as the "**Bank**", which expression shall unless repugnant to the context thereof, be deemed to include its successors-in-interest and permitted assigns)

IN FAVOUR OF

Uttar Pradesh Jal Nigam, a statutory body constituted under the Uttar Pradesh Water Supply and Sewerage Act, 1975, with its registered office at 6, Rana Pratap Marg, Lucknow - 226001 (hereinafter referred to as the "**Jal Nigam**", which expression shall unless repugnant to the context thereof, be deemed to include its successors-in-interest and permitted assigns).

WHEREAS

- A. **VARANASI STP PROJECT PRIVATE LIMITED** with its registered office at 513/a, 5th floor, Kohinoor City, Kirol Road Kurla (West), Mumbai, Mumbai City, Maharashtra, India, 400070, hereinafter referred to as the "**Concessionaire**", which expression shall unless repugnant to the context thereof, be deemed to include its successors-in-interest and permitted assigns) has executed a concession agreement dated [●] with the Jal Nigam and National Mission for Clean Ganga ("**Concession Agreement**") in relation to design, construction, rehabilitation, operation and maintenance of a sewage treatment plant with a proposed capacity of 50 MLD along with other facilities and associated infrastructure at Ramana, Varanasi, by the Concessionaire.
- B. In terms of Clause 5.16 of the Concession Agreement, the Concessionaire is required to furnish a Mobilization Advance Guarantee to the Jal Nigam in the form of an unconditional, irrevocable and on demand bank guarantee for securing the Mobilization Advance made to the Concessionaire in accordance with the Concession Agreement ("**Mobilization Advance Guarantee**") for INR 11,22,00,000 (Rupees Eleven Crores Twenty Two Lakhs) ("**Guaranteed Amount**").
- C. At the request of the Concessionaire and for sufficient consideration, the Bank has agreed to issue this guarantee in favour of the Jal Nigam.

NOW THEREFORE THIS DEED WITNESSETH AS FOLLOWS:

1. Capitalised terms used herein but not defined shall have the meaning ascribed to them in the Concession Agreement.

2. The Bank shall upon a written demand from the Jal Nigam informing the Bank of the Concessionaire's failure to fulfill its obligations under the Concession Agreement, pay to the Jal Nigam, within 5 (five) days of receipt of such written demand from the Jal Nigam, without further proof or conditions and without contest, recourse, demur or protest and without any enquiry to the Jal Nigam or the Concessionaire, forthwith and in full amount, without any deductions or set off or counter claims whatsoever, the sum claimed by the Jal Nigam in such demand not exceeding an amount equivalent to the Guaranteed Amount. The Bank will pay the amount specified in the demand notwithstanding any direction to the contrary given or any dispute raised by the Concessionaire or any other person.

The Bank agrees that this Mobilization Advance Guarantee does not limit the number of claims that may be made by the Jal Nigam against the Bank provided that such claims taken together shall not exceed the Guaranteed Amount.

Any payment made hereunder shall be made free and clear of and without deduction for, or on account of, any present or future taxes, deductions or withholdings of any nature whatsoever and by whomsoever imposed, and where any withholding on a payment is required by any Applicable Law, the Bank shall comply with such withholding obligations and shall pay such additional amount in respect of such payment such that the Jal Nigam receives the full amount due hereunder as if no such withholding had occurred.

3. This Mobilization Advance Guarantee shall be a continuing guarantee during its currency and shall remain in force and effect until 21 months from the Effective Date or until the entire Mobilization Advance has been adjusted against the Construction Payments in accordance with the Concession Agreement, whichever is later, upon which the obligations of the Bank under this Mobilization Advance Guarantee shall stand discharged.
4. The obligations of the Bank herein are absolute and unconditional, irrespective of the value, genuineness, validity, regularity or enforceability of the Concession Agreement or the insolvency, bankruptcy, reorganisation, dissolution or liquidation of the Concessionaire or any change in ownership of the Concessionaire or any purported assignment by the Concessionaire or any other circumstance whatsoever which might otherwise constitute a discharge or defence of a guarantor or a surety.

Further, this Mobilization Advance Guarantee is in no way conditional upon any requirement that the Jal Nigam first attempts to procure the Guaranteed Amount from the Concessionaire or any other person, or resort to any other means of obtaining payment of the Guaranteed Amount.

5. The Bank hereby agrees that its liability under this Mobilization Advance Guarantee shall not be discharged by virtue of any agreement between the Concessionaire and the Jal Nigam, whether with or without the Bank's knowledge, or by reason of the Jal Nigam showing any indulgence or forbearance to the Concessionaire.
6. The Bank's obligations under this Mobilization Advance Guarantee for the Guaranteed Amount is primary, independent and absolute and not by way of surety only.
7. The obligations of the Bank under this Mobilization Advance Guarantee shall not be affected by any act, omission, matter or thing which, but for this provision, would prejudice or diminish

the Guaranteed Amount in whole or in part, including (whether or not known to it or the Jal Nigam):

- (a) any time or waiver granted to, or composition with, the Concessionaire or any other person;
 - (b) any incapacity or lack of powers, authority or legal personality of or dissolutions or change in the status of the Concessionaire or any other person;
 - (c) any variation of the Concession Agreement so that references to the Concession Agreement in this Mobilization Advance Guarantee shall include each variation;
 - (d) any unenforceability, illegality or invalidity of any obligation of any person under the Concession Agreement or any unenforceability, illegality or invalidity of the obligations of the Bank under this Mobilization Advance Guarantee or the unenforceability, illegality or invalidity of the obligations of any person under any other document or guarantee, to the extent that each obligation under this Mobilization Advance Guarantee shall remain in full force as a separate, continuing and primary obligation, and its obligations be construed accordingly, as if there were no unenforceability, illegality or invalidity;
 - (e) any extension, waiver, or amendment whatsoever which may release a guarantor or the Bank (other than performance or indefeasible payment of a Guaranteed Amount); or
 - (f) any part performance of the Concession Agreement by the Concessionaire or by any failure by the NMCG to timely pay or any failure by NMCG or the Jal Nigam to timely perform any of its obligations under the Concession Agreement.
8. So long as any sum remains due from the Concessionaire to the Jal Nigam, the Bank shall not exercise any right of subrogation or any other rights of a guarantor or enforce any guarantee or other right or claim against the Concessionaire (whether in respect of its liability under this Mobilization Advance Guarantee or otherwise) or claim in the insolvency or liquidation of the Concessionaire or any such other person in competition with the Jal Nigam. If the Bank receives any payment or benefit in breach of this Clause 8, it shall hold the same in trust for the Jal Nigam.
9. The Bank represents, warrants and undertakes to the Jal Nigam that:
- (a) it has the power to execute, deliver and perform the terms and provisions of this Mobilization Advance Guarantee and has taken all necessary action(s) to authorize the execution, delivery and performance by it of this Mobilization Advance Guarantee;
 - (b) the Bank has duly executed and delivered this Mobilization Advance Guarantee, and this Mobilization Advance Guarantee constitutes its legal, valid and binding obligation enforceable in accordance with its terms except as the enforceability thereof may be limited by applicable bankruptcy, insolvency, moratorium or other similar laws affecting the enforcement of creditors' rights generally and by general equitable principles;

- (c) neither the execution, delivery or performance by the Bank of this Mobilization Advance Guarantee, nor compliance by it with the terms and provisions hereof will: (i) contravene any material provision of any law, statute, rule or regulations or any order, writ, injunction or decree of any court or governmental instrumentality; (ii) conflict or be inconsistent with or result in any breach of any of the material terms, covenants, conditions or provisions of, or constitute a default under any agreement, contract or instrument to which the Bank is a party or by which it or any of its property or assets is bound; or (iii) violate any provision of the Bank's constituent documents;
- (d) no order, consent, approval, license, authorization or validation of, or filing, recording or registration with (except as have been obtained or made prior to the date hereof), or exemption by, any governmental or public body or authority, or any subdivision thereof, is required to authorize, or is required in connection with: (i) the execution, delivery and performance of this Mobilization Advance Guarantee; or (ii) the legality, validity, binding effect or enforceability of this Mobilization Advance Guarantee; and
- (e) this Mobilization Advance Guarantee will be enforceable when presented for payment to a Scheduled Commercial Bank (as defined by the Reserve Bank of India Act, 1934) at **[Insert name of place]**.
10. This Mobilization Advance Guarantee is a continuing one and all liabilities to which it applies or may apply under the terms hereof shall be conclusively presumed to have been created in reliance hereon. No failure or delay on the part of the Jal Nigam in exercising any right, power or privilege hereunder and no course of dealing between the Jal Nigam and the Bank, or the Concessionaire, shall operate as a waiver thereof, nor shall any single or partial exercise of any right, power or privilege hereunder preclude any other or further exercise thereof or the exercise of any other right, power or privilege.
11. If any one or more of the provisions contained in this Mobilization Advance Guarantee are or become invalid, illegal or unenforceable in any respect, the validity, legality and enforceability of the remaining provisions shall not in any way be affected or impaired thereby, and the Bank shall enter into good faith negotiations with the Jal Nigam to replace the invalid, illegal or unenforceable provision.
12. The Bank hereby agrees to execute and deliver all such instruments and take all such actions as may be necessary to make effective fully the purposes of this Mobilization Advance Guarantee.
13. This Mobilization Advance Guarantee may be executed in one or more duplicate counterparts, and when executed and delivered by the Bank and the Jal Nigam shall constitute a single binding agreement.
14. Any demand, notice, request or other communication to be given or made under this Mobilization Advance Guarantee shall be deemed to have been duly given or served:
- (a) Upon the Jal Nigam, at Ganga Pollution Prevention Unit, STP Campus, Bhagwanpur, Lanka, Varanasi-221005, marked for the attention of **[Please insert name]** (General Manager);



(b) Upon a Scheduled Commercial Bank (as defined by the Reserve Bank of India Act, 1934), at [●], India.

15. The Bank:

(a) acknowledges that the Lenders will review this Mobilization Advance Guarantee and may require changes thereto as a condition of granting any Financial Assistance and/or providing political risk insurance; and

(b) shall consider any such requirements in good faith.

16. This Mobilization Advance Guarantee shall be governed by, and construed in accordance with, the laws of India. The Bank irrevocably agrees that any legal action, suit or proceeding arising out of or relating to this Mobilization Advance Guarantee may be brought in the courts in [●].

17. The Jal Nigam may assign or transfer all or any part of its interest herein together with the Concession Agreement to any other person with prior consent of to the Bank. The Bank may not assign or transfer any of its rights or obligations under this Mobilization Advance Guarantee.

IN WITNESS WHEREOF the Bank has set its hands hereunto on the day, month and year first hereinabove written.

Signed and delivered by [*insert name of Bank*] Bank by hand



Schedule 5
Scope of Work of the Project Engineer

The Project Engineer shall assist the Jal Nigam in supervising the construction, rehabilitation, operation and maintenance of the Facilities and the Associated Infrastructure and shall work closely with the Jal Nigam to monitor compliance with the KPIs. The detailed scope of work of the Project Engineer, to be read in conjunction with the provisions of the Concession Agreement, is outlined below:

- a) The Project Engineer shall review the Designs and Drawings to be provided by the Concessionaire. These will include, *inter-alia*, the site layout plan, process design, drawings, structural calculations, mechanical, electrical and instrumentation works, quality plans, implementation schedules, and the environment, health & safety plans. On the basis of its review, the Project Engineer shall provide its recommendations to the Jal Nigam.
- b) During the Construction Period, the Project Engineer shall inspect the Facilities and the Associated Infrastructure at least once a month and prepare an inspection report, setting out the progress of the construction of the Facilities and the rehabilitation of the Associated Infrastructure, defects or deficiencies, if any, and status of compliance with the Construction Plan, Technical Specifications and Designs and Drawings.
- c) The Project Engineer shall be responsible to monitor the implementation of the approved environment, health & safety plan by the Concessionaire. The Project Engineer shall also verify the material safety data sheets of hazardous chemicals if any.
- d) The Project Engineer shall review the construction progress of the project as per the Payment Milestones proposed by the Concessionaire and provide necessary recommendations to the Jal Nigam for the purpose of issuance of Milestone Construction Certificates.
- e) The Project Engineer shall assist Jal Nigam in estimating the Delay Liquidated Damages as applicable.
- f) At the end of the Construction Period, the Project Engineer shall review the Facilities and provide necessary recommendations to the Jal Nigam with regards to the issuance of the Construction Completion Certificate to the Concessionaire to certify completion of construction of the Facilities, rehabilitation of the Associated Infrastructure and the satisfaction of all other conditions required to be fulfilled by the Concessionaire.
- g) The Project Engineer shall monitor the Trial Operations of the Facilities and the Associated Infrastructure during the Trial Period and provide necessary recommendations to the Jal Nigam for the purpose of the issuance of the COD Certificate to the Concessionaire. The review shall be based on the Trial Operations Procedures outlined in the Concession Agreement and include the following.
 - Verify quality of installations, operation of equipment and workmanship;
 - Verify the Discharge Standard of the Treated Effluent and STP By-Products;
 - Verify the consumption of electricity and generation of power if any vis-à-vis the Guaranteed Energy Consumption.
- h) The Project Engineer shall review the O&M Manual and the Scheduled Maintenance Program submitted by the Concessionaire and provide its recommendations to the Jal Nigam.







- i) During the O&M Period, the Project Engineer shall inspect the Facilities and the Associated Infrastructure at least once a month and prepare an inspection report, setting out the defects or deficiencies, if any, and status of compliance with the KPIs (including specifically, the Influent Standards and the Discharge Standards).
- j) The Project Engineer shall review the reports generated from the Online Monitoring System to assess adherence to the KPIs and submit the monthly KPI Adherence Reports to the Jal Nigam. These reports may be in the indicative formats provided in the tables below.
- k) The Project Engineer shall assist Jal Nigam in estimating the Availability Liquidated Damages, the Performance Liquidated Damages and the Power Consumption Liquidated Damages as applicable.
- l) The Project Engineer shall inspect laboratories where tests are conducted on samples to ensure conformance and compliance with laboratory procedures and requirements.
- m) During the Term, and as requested by the Jal Nigam, the Project Engineer shall provide its opinion and assessment on the implications of the events related to Emergency, Change in Law, Force Majeure, Fundamental Change in Law, Minor casualty, Total casualty, Variation and Unforeseen Site Conditions.
- n) The Project Engineer shall participate in the survey to determine the Hand-back Conditions as per the Hand-back Requirements. It shall review the survey report of the Hand-back Conditions submitted by the Concessionaire and provide its recommendations to the Jal Nigam on the compliance with the Hand-back Requirements.

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Schedule 6
Liquidated Damages

1. Availability of Facilities and Associated Infrastructure

Parameter	Value
Guaranteed Availability of Facilities and the Associated Infrastructure	100%
Hours in the month for which the Facilities and/or the Associated Infrastructure were not Available (A)	—
Non-Availability (B)	$= [(A) / 720] \times 100$
LDs for non- adherence (INR)	$= (B) \times 30,000$

2. Treated Effluent Standards and Sludge standards

Parameter	Liquidated Damages (INR)
A. Treated Effluent	
BOD and/or Fecal Coliform	10,000
COD and / or TSS Standard	5,000
Total Nitrogen and / or Ammonia Nitrogen and / or Phosphorous	7,000
B. Digested Sludge	
Outlet Concentration of dewatered sludge	3,000
Fecal coliform limit	3,000

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[Signature]

Schedule 7
Applicable Permits

Concessionaire Applicable Permits

No.	Applicable Permit	Authority
1.	Temporary Power Connection (During Construction Period)	Electricity Board/ other temporary sources
2.	Consent to Operate	State Pollution Control Board
3.	Consent for storage of hazardous materials	Director of Explosives

The Concessionaire will be liable to obtain all Applicable Permits (other than the Jal Nigam Applicable Permits) that are necessary for construction, operation and maintenance of the Facilities.

Jal Nigam shall assist the Concessionaire in obtaining all the required permits.

Jal Nigam Applicable Permits

No.	Applicable Permit	Authority
1.	Power Connection (During O&M Period)	Electricity Board
2.	Consent to establish	State Pollution Control Board
3.	Tree cutting	Forest Dept.
4.	Road cutting & crossing	Public Works Department
5.	Revenue road cutting & crossing	Panchayat/Local Authority

The Concessionaire shall proactively assist the Jal Nigam in obtaining all the required permits.

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Schedule 8
Discharge Point



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Schedule 9 EHS Standards

1.1 General

This schedule lays out the Environment, Health and Safety (EHS) Standards, including the environmental, social, labor, health and safety related and any other requirements, which the Concessionaire is required to comply with, in developing, operating and maintaining the Facilities and the Associated Infrastructure. Several activities associated with this Project may have an impact upon the environment, health and safety of the workers and local community.

The Concessionaire shall hence develop the EHS plan which shall adhere to various requirements stated under Applicable Laws, and the IFC Performance Standards (PS) - PS 1, PS 2, PS 3, PS 4, PS 6 and PS 8 at the minimum. The Concessionaire shall develop an EHS Plan during the Conditions Precedent Period, as per the requirements of Applicable Laws, the Concession Agreement and as per guidelines laid out in this Schedule.

Where environmental or social risks and impacts are identified, the Concessionaire shall be required to manage them through the EHS Plan in accordance with the Applicable Laws and the IFC guidelines for Environmental, Health and Safety available at <http://www.ifc.org/performancestandards> and IFC EHS guidelines [specifically General, Water and Sanitation, and Waste Management Facilities].

The EHS Plan shall be developed by the Concessionaire and submitted to the Project Engineer for review. The Project Engineer will provide its recommendation to the Jal Nigam on the EHS Plan, which will be approved by the Jal Nigam, as per requirements of the Concession Agreement. The EHS Plan will be applicable for both Construction and O&M Periods. This plan should be reference document for implementation, control and monitoring of environmental, occupational health and safety aspects of the project by the Concessionaire.

The Concessionaire shall comply with Applicable Laws, including all relevant statutory requirements of Government of India including, but not limited to the following -

- Air (Prevention and Control of Pollution) Act, 1981 amended 1987
- Water (Prevention and Control of Pollution) Act, 1974 amended 1988
- Water (Prevention and Control of Pollution) Rules, 1975
- The Environment (Protection) Act, 1986, amended 1991
- Environmental (Protection) Rules, 1986 (Amendments in 1999, 2001, 2002, 2002, 2002, 2003, 2004)
- Hazardous Waste (Management and Handling) Rules, 1989 amended 2000 and 2003
- Manufacture Storage and Import of Hazardous Chemicals Rules, 1989 amended 2000
- Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996
- Batteries (Management and Handling) Rules, 2001.
- The Petroleum Act, 1934
- The Petroleum Rules, 2002
- The Motor Vehicle Act, 1988
- The Central Motor Vehicle Rules, 1989

This being an STP project does not require an Environmental Clearance from Government of India however, the Concessionaire shall obtain necessary permission from Central/State Pollution Control Boards.

1.2 General EHS Guidelines

The Concessionaire needs to conduct an environmental and social assessment in co-ordination with government agencies and third parties as appropriate. The Concessionaire will also establish an overarching policy defining the environmental and social objectives and principles that guide the project to achieve sound environmental and social performance in line with Applicable Laws and the applicable IFC PS.

The Concessionaire shall establish and maintain a process for identifying the environmental and social risks and impacts of the Project and shall establish management programs that will describe mitigation and performance improvement measures and actions that address the identified environmental and social risks and impacts of the project. The Concessionaire shall establish procedures to monitor and measure the effectiveness of the management program, as well as compliance with any related legal and/or contractual obligations and regulatory requirements.

1.3 General EHS guidelines for labor and working conditions

The Concessionaire shall comply with the requirements given under the various laws and rules of State/ Central Government including the following:

- Public Liability Insurance Act, 1991 amended 1992
- Public Liability Insurance Rules, 1991 amended 1993
- Factories Act, 1948
- Uttar Pradesh Factory Rules 1950
- Workmen's Compensation Act 1923
- Contract Labor (Regulation and Abolition) Act, 1970
- Minimum Wages Act, 1948
- Payment of Wages Act, 1936
- Equal Remuneration Act, 1979
- Child Labour (Prohibition and Regulation) Act, 1986
- Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979
- The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and the Cess Act of 1996
- The Concessionaire should also abide by the Antiquities and Art Treasures Act 1972 and the Ancient Monuments and Archeological sites and Remains Act, 1958 (and its amendment) to protect the cultural heritage of the nation.

The Concessionaire shall develop/maintain written human resources (HR) policies and procedures in accordance with Applicable Laws and IFC PS requirements and ensure the relevant policies are available to all employees.

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The HR policy/procedure shall clearly describe working conditions, terms of employments, management of worker relationship, and roles and responsibilities among the Concessionaire and the workers.

1.4 General EHS guidelines for safety

The Concessionaire shall comply with the requirements of applicable BIS Standards including, but not limited to the following:

IS 3696(Part 1):1987	Safety code of scaffolds and ladders: Part 1 Scaffolds
IS 3696(Part 2):1991	Safety code of scaffolds and ladders: Part 2 Ladders
IS 3764:1992	Code of safety for excavation work (first revision)
IS 4014(Part 2):1967	Code of practice for steel tubular scaffolding: Part 2 Safety regulations for scaffolding
IS 4081:1986	Safety code for blasting and related drilling operations (First Revision)
IS 4130:1991	Safety code for demolition of buildings (second revision)
IS 4138:1977	Safety code for working in compressed air (first revision)
IS 4756:1978	Safety code for tunneling work (first revision)
IS 4912:1978	Safety requirements for floor and wall openings, railings and toe boards (first revision)
IS 5121:1969	Safety code for piling and other deep foundations
IS 5916:1970	Safety code for construction involving use of hot bituminous materials
IS 7293:1974	Safety code for working with construction machinery
IS 7969:1975	Safety code for handling and storage of building materials
IS 8989:1978	Safety code for erection of concrete framed structures
IS 10067:1982	Material constants in building works
IS 10291:1982	Safety code for dress divers in civil engineering works
IS 13415:1992	Code of safety for protective barriers in and around
IS 13416(Part 1): 1992	Recommendations for preventive measures against hazards at workplaces: Part 1 Falling material hazards prevention
IS 13416(Part 2): 1992	Recommendations for preventive measures against hazards at workplaces: Part 2 Fall prevention
IS 13416(Part 3): 1994	Recommendations for preventive measures against hazards at workplaces: Part 3 Disposal of debris
IS 13416(Part 4): 1994	Recommendations for preventive measures against hazards at workplaces: Part 4 Timber structure
IS 13416(Part 5): 1994	Recommendations for preventive measures against hazards at workplaces: Part 5 Fire protection
IS 13430:1992	Code of practice for safety during additional construction and alteration to existing buildings
IS 15883 (Part 5)	Construction Project Management - Guidelines: Part 5 Health and Safety Management
IS: 11972-1987 -	Safety precautions to be taken when entering a sewerage system

In addition, as stated above and the IFC PS, IFC Guidance Note 2 for Labor and Working Conditions would also be applicable to the Project.

The Concession shall consider the following at a minimum while developing EHS Plan:

- Job- and task-specific hazard analysis and controls for all activities (including exposure to chemical, biological and pathological hazards);
- Provision of personal protection equipment (PPE), requirements for use of PPE, and enforcement of PPE use;
- Safety training for all personnel in their language, covering hazards and safety protocols of their jobs;
- Special training for specific hazards: open water, trenches, slippery walkways, working at heights, energized circuits, heavy equipment, entry into confined spaces, fires and explosions.
- Recording incident statistics, including total work hours, lost time incidents, major injuries, fatalities, near miss incidences etc.
- Adherence oh the EHS Plan by sub-contractors.

1.5 General EHS Guidelines for Construction Period

- Concessionaire shall remove all waste material and debris from and around the work area and properly clean up the area at the end of each day before leaving the work site. Concessionaire shall take all necessary precautions not only for safe working of his own workmen but also deploy all precautions to ensure safety of structures, equipment and workmen of other agencies in and around his work site. The Concessionaire shall ensure that his workmen do not trespass into prohibited areas. Jal Nigam or the Project Engineer, on behalf of the Jal Nigam, shall have the right to inspect at any time, all items of machinery or equipment brought to site by the Concessionaire, his representatives or workmen and to prohibit the use on the site of any item, which in the opinion of the Jal Nigam is or may be detrimental to the safety of the site. The exercise of such right or the omission to exercise it in any particular case shall not absolve the Concessionaire or his representatives or workmen of their responsibility of adhering to the safe working practices.
- Concessionaire shall execute the work in a manner causing the least possible interference with the business of the Jal Nigam, or with the work of any other private entity who may be engaged on the premises and shall at all times co-operate with the other any other contractors working at Site or on adjoining property. Concessionaire shall obtain necessary permits from the Jal Nigam and any other relevant government agencies, as per Applicable Laws and requirements, before starting any work at site. The work permits are issued to prevent the Concessionaire from working in un-authorized areas and shall be valid for specific area for a stipulated period.
- Activities requiring permit to work shall be decided before starting the construction and shall be suitably documented in the project health and safety plan. Some of the activities which may require permit to work are:
 - Excavation
 - Entry into confined spaces
 - Electrical work (HV/LV)
 - Opening manholes, covers and grills
 - Blasting operation
 - Hot work
 - Industrial radiography

- Work on plant, machinery and other power driven equipment.
- Working at height
- Working at night
- The Concessionaire may establish a permit to work system for any other hazardous activity which they feel need to be controlled administratively for safe execution.
- The Concessionaire shall be responsible for the following safety aspects -
 - Preventing injury to personnel, damage to plant and equipment and fire.
 - Instituting ways to improve existing work methods from safety point of view.
 - Legal and contractual requirements affecting safety, health, and welfare of his workmen
 - Provision and use of protective clothing and equipment and use of fire fighting equipment
 - Suitability of new and hired equipment from a safety viewpoint
 - Identifying potential hazards.
 - Changes in safety requirements and fire precautions
 - Carrying out site surveys to see that only safe work methods are in operation, health and safety requirements are being observed and welfare and first aid facilities are adequate and properly maintained.
 - Determining the cause of an accident or dangerous occurrence and recommend means of preventing recurrence.
 - Supervising the recording and analysis of information on injuries, damage and production loss.
 - Assess accident trends and review overall safety performance.
 - Ensure the following:
 - a. All electrical equipment's are securely earthed.
 - b. Standard access platforms and ladders are provided for inspection, operation and maintenance of equipment.
 - c. The equipment are periodically inspected for their condition, maintained properly and operated by trained personnel at design speeds and loads.

1.6 **General EHS Guidelines for resource efficiency and pollution prevention**

- During the project life-cycle, the Concessionaire will consider ambient conditions and apply technically and financially feasible resource efficiency and pollution prevention principles and techniques that are best suited to avoid, or where avoidance is not possible, minimize adverse impacts on human health and the environment. In addition the Concessionaire will consider alternatives and implement technically and financially feasible and cost-effective options to reduce project-related GHG emissions during the design and operation of the project.
- All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on the site should be the property of the Government and should be dealt with as per provisions of the relevant legislation.
- Reasonable precautions should be taken to prevent workmen or any other persons from removing and damaging any such article or thing. Concessionaire should, immediately upon discovery thereof and before removal acquaint the Project Engineer and Jal Nigam of such discovery and carry out the instructions as given for dealing with the same, waiting which all work should be stopped.
- The direction from the Archaeological Survey of India (ASI) should be taken before instructing to recommence the work in the site.

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1.7 General guideline for development of environmental and social management system (ESMS) as part of EHS

- Establish a baseline measurement for all environmental and social aspects considered relevant to the project, and applicable regulatory requirements/framework, which will serve as a reference for comparison to anticipated or existing project influenced impact.
- The EHS Plan will at least include the following components:
 - an overarching policy that states the principles, including reference to applicable aspects of IFC PS and Good International Industry Practice (GIIP), to manage environmental and social risks and impacts in a structured way on an ongoing basis
 - organizational capacity and competency to implement the ESMS and process to build internal capacity on E&S matters;
 - process to identify the E&S risks and impacts associated to the project over the entire concession period. The assessment process shall be commensurate to the extent and magnitude of the activities;
 - management programs to define mitigation and performance improvement measures and actions that address identified E&S risks and impacts and define detailed timelines for implementation of specific measures. The programs shall consist of documented combination of operational procedures, practices, plans and relevant supporting documents. They shall also include detailed monitoring plans and procedures to undertake in case the results of monitoring indicates the need of mitigation actions;
 - A process to engage with affected communities around issues such as appropriate behavior in the event of an unplanned release beyond the plant boundaries due to irregular plant operation/accident, or during transportation of material to the plants as well as nuisances (e.g. odor, noise, traffic increases during construction) that may affect communities. The process shall also include a mechanism to receive and address grievances from affected communities.
- Review and identify for ameliorative action by Jal Nigam, any regulatory gaps, inconsistencies or inadequacies in the Concession Agreement that may impede or delay implementation of corrective actions or ability to maintain assured compliance at all times.
- Jal Nigam and Concessionaire shall jointly establish and implement a community / stakeholder engagement program inclusive of a comprehensive grievance redressal mechanism to ensure continued community support of the project and associated facilities through the life of the project.
- The cost of implementing E&S including monitoring of parameters shall be borne by the Concessionaire.



Schedule 10
Key Performance Indicators

1. Key Performance Indicators

1.1 Availability

The Concessionaire shall ensure that the Availability of the Facilities and the Associated Infrastructure on every day during the O&M Period shall be 100% (the "Guaranteed Availability").

1.2 Treated Effluent Quality

The Treated Effluent shall meet the following requirements.

Parameter	Unit	Value
pH		6.5-9.0
BOD ₅	mg/L	≤10
TSS	mg/L	≤10
TN	mg/L	≤10
NH ₄ -N	mg/L	≤5
COD	mg/L	≤50
TP	mg/L	≤2
Fecal Coliform	MPN/100 mL	<100

The Concessionaire shall not be responsible for adherence to the above requirements of Treated Effluent in an event the values of the Influent Standards are as per table below.

Item/ Parameter/ Description	Units	Values
pH		>8.5
BOD ₅ @ 20 deg C	mg/L	< 80 & >230
COD	mg/L	>450
TSS	mg/L	>500
TKN	mg/L	>45
Total Phosphorus	mg/L	>7

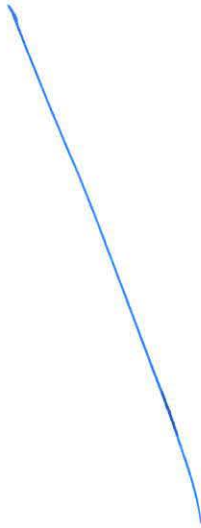
1.3 Digested Sludge

The Digested Sludge shall meet the following requirements.

Units	Digested Sludge Consistency
Outlet Concentration of dewatered sludge	More than 20% solids
Fecal coliform limit	Less than 20,00,000 Most Probable Number per gram of total dry solids (20,00,000 MPN / gTS).

1.4 Assessment of compliance to KPIs

The assessment of compliance to KPIs for each of the parameters shall be checked in accordance with the reports from online monitoring system or laboratory tests as set out in the Schedule 11 (Part G).



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Schedule 11 (Part A)
Process Requirements

1.1 Flows and raw Sewage characteristics

Currently Sewage is tapped from Assi nalah. The influent standards for design purpose are stated below.

Item/ Parameter/ Description	Units	Values
Design Capacity	MLD	50
pH		6.0-8.5
BOD	mg/L	80 - 230
COD	mg/L	450
TSS	mg/L	500
TKN	mg/L	45
Total Phosphorus	mg/L	7

1.2 General design requirements

The Concessionaire shall design the Facilities in accordance with the provisions of the IS codes, Central Public Health and Environmental Engineering Organisation (CPHEEO) manual on Sewerage and Sewage Treatment, Good Industry Practices and Applicable Laws.

The precedence for process and hydraulics shall be CPHEEO manual followed by the IS codes and Good Industry Practices. The precedence for civil, structural, mechanical & electrical processes shall be IS Codes followed by CPHEEO manual and Good Industry Practices.

The Varanasi STP shall be designed by the Concessionaire to receive and treat all combinations of Sewage influent flows and loads arriving at the Varanasi in accordance with the Influent Standards specified above.

The peak factor for the design shall be 2.25. It is observed that peak hours are generally from 5 a.m. to 10 a.m. and from 5 p.m. to 8 p.m.

1.3 Design Life

The Varanasi STP components shall be designed and constructed to provide the minimum service life listed below for each component:

- Buried Piping: 75 years
- Reinforced Concrete Structures: 50 years
- Other Concrete Structures: 50 years
- Steel Structures: 50 years
- Mechanical Equipment: 15 years
- Electrical Equipment: 15 years

- Buried Earth Electrode System: 40 years
- Control Panels: 15 years
- Instrumentation Systems: 15 years
- Computer Systems: 10 years

1.4 Process requirements

The following main treatment processes and requirements must be provided:

- Preliminary treatment (screenings & grit removal)
- Secondary biological treatment
- Effluent pumping station and outfall
- Sludge digestion
- Sludge thickening, dewatering & storage
- Transportation of Screenings, Residual Grit and Digested Sludge from the Facilities and Associated Infrastructure to the Waste Disposal Site.

1.5 Description of process and Facilities

This section outlines the major processes and Facilities that the Concessionaire is required to design, construct, and operate as per this Concession Agreement.

1.5.1 Influent rising main

The connection to the existing influent rising main shall be made by the Concessionaire.

1.5.2 Stilling chamber

A stilling chamber shall be provided at the inlet of Varanasi STP to receive the raw Sewage from the pumping station. The stilling chamber shall reduce the turbulence of raw water entering into it. The stilling chamber should be kept clean by removing silt, sand deposited and the algae growth at the bottom and sides.

1.5.3 Fine screens

The raw Sewage from rising main shall flow to fine screen inlet channel by gravity. The mechanical fine screen shall be either bar/ drum type/perforated screen. The screens shall have clear openings not exceeding 6 mm. The screens shall be equipped with an automatic cleaning system and can be controlled by both an adjustable timed cycle and a pre-set differential head across the screen using ultrasonic level sensors. All screens shall be provided with thimble mounted isolation sluice gates both on upstream and downstream. The Concessionaire may provide a bypass channel with manual screen parallel with the automated screens.

1.5.4 Grit basins with Grit washers and classifiers

The Concessionaire shall provide Grit separators downstream of the screens. The Grit separators shall be capable of removing at least 95% of particles with a specific gravity of 2.65 g/cm³ and

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with a diameter of at least 0.2 mm. A Parshall Flume shall be provided downstream of Grit separators. The flow measurement shall be instantaneous.

1.5.5 Primary clarifiers

If proposed, the primary clarifiers with scum removal shall be designed as per CPHEEO manual.

1.5.6 Biological treatment

The biological systems shall be designed for required nutrient removal to comply with the KPIs. The Varanasi STP should be suitable for continuous feed of raw Sewage and operation without any break. The Concessionaire shall provide suitable arrangements for draining the aeration tanks. The Concessionaire shall take account of the fact that a fully nutrient removal process may become established at the specified design loading rates.

If MBBR technology is provided, the Concessionaire shall provide equalization tank and anoxic tank as minimum requirements.

1.5.7 Aeration systems

The aeration system shall be designed to maximise oxygen transfer and to adapt to the changing oxygen demands in biological treatment systems. The aeration system shall be capable of complete and uniform mixing and suspension of mixed liquor suspended solids.

1.5.8 Alum dosing system

An alum dosing system, if required, to comply with KPIs as required by the Concession Agreement, may be provided to accomplish chemical phosphorus removal in the event of inadequate biological phosphorous removal.

1.5.9 Tertiary treatment

If tertiary treatment is proposed, to comply with KPIs as required by the Concession Agreement, filtration system should be designed such that filtration rate shall be within the acceptable range as per CPHEEO manual while operating at average as well as peak flow rate. If sand filters are provided, the filtration media and gravel shall be as per IS: 8419 (Part-1) 1977.

1.5.10 Disinfection

Disinfection shall be provided to comply with KPIs as required by the Concession Agreement, through chlorination systems or UV disinfection or ozonation. The Concessionaire shall ensure that disinfectants used shall not exceed the limits as per the provisions of the Environment (Protection) Rules, 1986. Such excess disinfectant levels, if any, need to be neutralized before disposal to inland surface water or land for irrigation.

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1.5.11 Sludge Thickeners

The sludge thickeners may be either gravity thickeners or mechanical thickeners. All associated ancillaries such as all pumps and polymer dosing equipment shall be arranged. If mechanical thickeners are proposed, required standby arrangement shall be provided.

1.5.12 Sludge digestion

The design of the sludge digestion system shall ensure that maintenance of all equipment and components can be safely and easily accomplished from outside the digester and without draining its contents.

If anaerobic digestion is proposed, the Concessionaire shall provide gas holders and gas burners. If provided, the sludge heating system may be complete with heat exchangers, sludge re-circulation pumps, hot water pumps. The heat requirement of digesters during winter season will be met through the heat available from bio gas engine and additional requirement to be fulfilled through boiler, if required.

The Concessionaire shall ensure safety and security of operation as the result of the presence of biogas in both normal and abnormal operation.

1.5.13 Dewatering system

Digested Sludge shall be dewatered to produce a cake concentration of at least 20% dry solids and the solids recovery shall not be less than 95%. The dewatering facility and associated ancillaries such as all pumps and polymer dosing equipment shall be arranged in at least two parallel streams (1 working + 1 standby), each sized to handle the average daily sludge quantities over not more than 16 hours per day.

The dewatered sludge shall be disposed off and no temporary storage is allowed at STP site.

The concessionaire shall ensure at least 38% of reduction of Volatile solids for Vector Attraction Reduction during sludge treatment. The Concessionaire shall also ensure less than 20,00,000 most probable number per gram of total dry solids(20,00,000 MPN/gTS) in sludge before disposal.

1.5.14 Facilities drain sump and pump station

A drain pump station shall be provided to collect recyclables such as filtrates from thickener/dewatering units and other miscellaneous waste flows such as sewage generated from Facilities, cleaning and wash-down flows and pump them back up to the inlet chamber of the Facilities.

1.5.15 Treated Effluent pumping station

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A Treated Effluent pumping station and rising main shall be provided to discharge the effluent to the Discharge Point.

1.6 Optional facilities within Varanasi STP

1.6.1 Energy generation (Optional)

The Concessionaire may generate heat and electrical energy from the biogas produced by the sludge digestion process. The Concessionaire shall design the energy generation system to be capable of using the maximum biogas produced by the sludge digestion process at design loadings to produce energy. The Concessionaire shall utilize electrical power generated by the energy recovery system where possible within the Facilities.

The design and specification of the units shall take into account the contaminants that will be present in the biogas from the digesters, such as hydrogen sulphide (H_2S) and ammonia (NH_3), and any harmful effects resulting from their combustion. The Concessionaire shall provide a H_2S gas scrubbing system, to protect the engine and maintain its design life.

1.6.2 Gas holders

The gas holders shall as per CPHEEO manual. A flame arrestor and flow meter shall be provided on the gas line from each digester.

1.6.3 Biogas burner

The bio gas burner (if provided) shall be designed as per CPHEEO manual and should be provided in 2 numbers (1 working / 1 standby) for complete destruction of all contaminants in the gas. All gas pipework and weld on flanges shall be stainless steel 316L.

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Schedule 11 (Part B)
General Civil Specifications

1.1 Structural designs

1.1.1 Design

The design considerations described hereunder establish the minimum basic requirements of plain and reinforced concrete structures, masonry structures and structural steel works. However, any particular structure shall be designed for the satisfactory performance of the functions for which the same is being constructed. The Concessionaire shall also take care to check and remedy, if required, the stability of partly completed or existing structures associated with the Varanasi STP. The Concessionaire shall submit, as part of Designs and Drawings, all requirements laid out in the Concession Agreement.

1.1.2 Design loadings

The design loads shall include dead load, live load, wind load, seismic load, stresses due to temperature changes, shrinkage and creep in materials, dynamic loads and uplift pressure, as per Applicable Laws and in line with Good Industry Practices.

1.1.3 Design requirements

The civil & structural design shall be carried out in accordance with BIS:456, and BIS:3370 and other relevant Indian Standard codes. For the seismic forces, the structure should be designed as per IS: 1893 and all the factors as applicable for Zone III.

The following are the design requirements for all reinforced or plain concrete structures:

- i. All blinding and leveling concrete shall be minimum 100 mm thick in concrete grade M10 for Building & other Structures and 150 mm thick in concrete grade M15 for water retaining structures.
- ii. All structural reinforced concrete shall be with a maximum 20 mm stone aggregate size.
- iii. The minimum grade of concrete shall be M-25 for RCC structures other than liquid retaining structures, for which minimum grade of concrete shall be M 30.
- iv. The minimum reinforcements in walls, floors and roofs of liquid retaining structures in each of two directions at right angles shall be 0.3% HYSD bars.
- v. The crack width of the RCC liquid retaining structure shall be 0.1mm
- vi. Any pipelines crossing below roads shall be designed for Class AA of IRC loading or as classified by the respective authority. NP3 RCC pipe as encasing shall be used below roads inside the Varanasi STP.
- vii. All pipes and ducts laid below the structural plinth and road works shall be encased with concrete of grade M-15 of minimum thickness 150 mm.
- viii. Minimum reinforcement and cover to the reinforcement shall be provided as per IS: 1786, IS 2502, IS 5525, SP 34.

1.2 Particular civil requirement

All the building and structure works shall generally comply with the following requirements.

- i. Unless otherwise shown on drawing plinths of all buildings and treatment units shall be protected with 1000 mm wide plinth protection.
- ii. Building plinth shall be minimum 500 mm above finished ground level around building.
- iii. Parapet over roof shall be minimum 500 mm high of RCC work for non-approachable roof and 1000 mm high of RCC work for approachable roof.
- iv. The design of buildings shall be such so as to allow entry of natural light to the maximum possible extent. Use of glazed paneling shall be kept to a minimum and preference shall be given to wall openings protected by weather canopies.
- v. All building works shall be of reinforced concrete framework with concrete floors and roofs. All external walls shall be in 230 mm thick brick masonry built in cement mortar 1:4.
- vi. Transoms and mullions of 115 mm x 230 mm size with four numbers 8 mm bars and 8 mm links at 150 mm c/c shall be provided to form panels not exceeding 3500 mm x 3500 mm in size in 230 / 350 mm thick brick masonry.
- vii. All internal partition walls except for toilets shall be in 230 mm thick brick masonry built in cement mortar 1:4 with transoms and mullions as mentioned above. Toilet partition walls shall be in 115 mm thick brick masonry built in cement mortar 1:3.
- viii. Plastering on brick / RCC work shall be as follows:
 - a. Exterior surface - 20 mm thick in CM 1:4
 - b. Interior surface - 12 mm thick in CM 1:4 for single brick thick wall
- 12 mm thick in CM 1:3 for half brick thick wall
 - c. Ceilings - 6 mm thick in CM 1:3
- ix. Surface preparation of all RCC and plastered surfaces to be painted shall be made dust free, remove any type of loose material, oil, grease with chiseling (if required) or by grinding.
- x. Pot holes in cement plastered surfaces shall be cured with rich cement mortar 1:3 (1 cement: 3 coarse sand) and providing a proper curing of minimum 3 days.

Painting of plastered surface not in direct contact with water

Apply one coat of single component Acrylic based anti-carbonation primer on the surface which fills the capillaries in the concrete and creates a saturated surface for the anti-carbonation paint. The curing time of primer will be minimum 4 hours. Consumption can vary from 200 – 300 gms / sq.m depending upon the product manufacturer.

Apply anti-carbonation paint on the surface of desired color based on single component acrylic co-polymer technology. The paint should be anti-fungal, should have crack bridging capacity of minimum 1 mm with elongation above 300%, solid contents 55% and DFT of 200 micron after two coats.
- xi. Painting of exposed RCC surfaces not in direct contact with waste water - Exposed RCC surfaces of all the units and buildings shall be applied with two or more coats of APEX

exterior paint.

1.2.1 Painting of exposed RCC surfaces and in direct contact with waste water or splashes

Protective coating shall be provided from the minimum water level to the top of concrete including splash zone (free board area) of the liquid retaining concrete structures. Coating shall be appropriate to the exposure to sewage. It shall be provided on a properly/ recommended prepared surface so that the roughness, water content/ saturation is within the required limit to give un-flawed coating. The coating shall be suitable for withstand alternating drying and wetting, structural expansion / contraction and biological & chemical exposure of the sewage. The chemical base of the product shall be Polyurethane Resin(s). It shall have a specified mixed density of ~1.35 kg/l at 27°C, solid content of ~84% by weight and/or ~77% by volume and bond strength on concrete shall be >1.5 N/mm². As per surface condition, appropriate recommended primer may be used. The usage/ coverage should be ~0.15 kg per m² per coat depending on porosity of substrate. The method of application shall be as recommended by the manufacturer to give the best results. The stable color(s) used shall be such as to distinctly distinguish it from sewage/ liquid. Test certificates of the product shall accompany each batch of the product. In general products older than 6 months from date of production shall not be used in the Varanasi STP.

- i. Internal surfaces of all buildings shall be painted conforming to IS: 428.
- ii. All internal plastered surfaces shall be treated with white cement based wall care putty. Interior surfaces of all buildings shall be painted conforming to IS: 428.
- iii. RCC staircases shall be provided to permit access to approachable roof of all building and platforms of treatment units.
- iv. All non-approachable roof tops of building and pump houses shall be provided SS Cat ladder.
- v. All covered RCC staircases (tread and riser) shall be in 30 mm thick Kota stone and shall have flexible PVC nosing (bull nose/ angled edge) fixed with adhesives for the full length of the tread.
- vi. All elevated RCC platforms, walkways around and across the various units of Varanasi STP including along the channels and uncovered staircases shall have flooring of chequered tiles of minimum 30 mm thick. The risers of all uncovered staircases shall be in Terrazzo tiles.
- vii. All elevated walkways, staircases, uncovered openings and RCC platforms in treatment units shall be minimum 1200 mm wide and shall have SS hand-railing on one or both side.
- viii. All buildings shall have reinforced concrete roofs which shall be made waterproof by laying integral cement based water proofing treatment with brick bats. The finished roof surface shall have adequate slope to drain quickly the rain water to down take inlet points. The rain water inlet points near down take pipes shall have uPVC gratings.
- ix. False ceiling with white face insulating building board in administrative building and site office. The insulating boards shall be supported on sufficiently strong frame work suspended from the ceiling.

- x. Top exposed surfaces of chajjas / lintels / canopies shall be given required slope so that no water is allowed to stand on it.
- xi. All doors, windows, ventilators in administrative block including toilets shall be of Aluminum. All doors, windows, ventilators in other buildings including toilets shall be of uPVC. Glazing material and size as per approved drawings.
- xii. Rolling shutter to be provided in workshop, chlorine building, gas generation room and other such buildings shall conform to the requirements of IS 4759, IS 209, IS 2629, IS 2633 and IS 6745.
- xiii. All doors, windows, rolling shutters shall have lintels above in order to prevent the rain water splashing into the building. The minimum width i.e., projection from the building wall of chajjah / lintels for doors, windows and rolling shutters shall be 750 mm, 600 mm & 900 mm respectively.
- xiv. For roofing drainage, sand cast iron / uPVC rainwater down take pipes shall be provided. For roof areas up to 40 sq.m minimum two nos. 110 mm outer diameter down take pipes shall be provided. For every additional area of 40 sq.m or part thereof, at least one no. 110 mm outer diameter down take pipe shall be provided.
- xv. All concrete channels and ducts carrying waste water and connecting different treatment units shall be of minimum 500 mm width and shall be constructed in RCC having smooth finish. All such channels which are more than 1000 mm above the FGL shall be provided with RCC elevated walkway for access.
- xvi. Emergency exit doorways shall be provided in all buildings in compliance with local and international safety regulations. All emergency exit points shall have extended paved path / areas for smooth escape of the people.
- xvii. The side walls of buildings shall, except those used for storage and handling of chlorine gas, comprise at least 15% ventilated brickwork fitted with louvres. Ventilated brickwork or louvres shall not be used where the ingress of driven rain could affect plant or stored materials. Flat roofed areas shall be provided with roof vents to further encourage a through flow of air.
- xviii. All hardware fittings and fixtures for doors, windows and louvers (e.g. hinges, bolts, locks, latches, stay doorstops, door closers, floor springs, etc.) shall be chrome plated brass and anodized aluminum, durable and of type matching to the size and weight of the door/window/ventilator shutters. These shall operate easily without hindrance and jamming, secured properly and shall require nominal maintenance.
- xix. Suitable steps and/or ramp shall be provided conforming to requirement, at the entrance of the buildings.
- xx. Steps / ramps shall be provided for access to building/sheds for pedestrian/vehicular, equipment entry. Minimum 1000 mm wide platform shall be provided in between entrance door and steps/ramps. Following dimensions of the steps/ramps shall be adhered to the following:
 - a. Tread = 250 mm minimum
 - b. Riser = 175 mm maximum

- c. Slope of ramp = Slope of Ramp = Not steeper than 1:10. Ramp shall be finished with metallic hardener topping with anti-skid grooves at top surfaces.
- xxi. Passage /corridors shall be provided to integrate various spaces. Width of the passage / corridors shall be conforming to following schedule:
- a. Singly Loaded Passage/Corridor: Minimum 1500 mm.
 - b. Doubly Loaded Passage/Corridor: Minimum 1800 mm.
- xxii. One white vitreous china laboratory sink of size 600 x 450 x 200 mm with two CP drinking water taps 20 mm long body, etc. complete shall be provided each in laboratory, chlorine and workshop building.
- xxiii. One SS kitchen sink (without drainage board) of size 610 x 460 x 200 mm with two CP drinking water taps 20 mm etc. complete shall be provided in all the buildings having toilet facilities other than laboratory, chlorine and workshop buildings.
- xxiv. The workshop, chlorine house, centrifuge building, digester control room, blower room and other such structures shall generally be made of 150 mm thick concrete grade slab on 230 mm thick rubble soling. The grade slab shall be provided with 8 mm reinforcement bars at 200 mm c/c both ways alternately or as per the approved drawings.
- xxv. Flooring of buildings shall be as follows:
- a. Administration building : Vitrified glazed tiles 600 x 600 mm
 - b. Workshop / sub station / centrifuge / gas engine room / digester control room / air blower room / pump houses / other operation buildings : Cement concrete flooring with metallic hardener topping.
 - c. Toilet : Matt finish pressed ceramic tiles 300 x 300 mm.
 - d. Corridors and other covered passages : Terrazzo / Kota stone
- xxvi. Dado work in buildings shall be as follows:
- Laboratory / chlorine building / pump houses at pump installations / toilet : 2.1 meter high from floor in glazed pressed ceramic tiles of size 300 x 200 mm.
- Pump house operational room at ground floor : 0.9 meter high from floor in glazed pressed ceramic tiles of size 300 x 200 mm.
- xxvii. Each toilet proposed to be provided in the buildings shall have the following features:
- a. The finished floor level of toilet shall be 25 mm below general finished floor level elsewhere in the building.
 - b. One WC (European / Indian type) along with fittings, cistern, etc. all complete.
 - c. One white vitreous china wash basin of size 630 mm x 450 mm with a pair of C.P. brass pillar taps 20 mm and other fittings. One soap dispenser at each washbasin.

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- d. One mirror of superior glass of approved quality with plastic molded frame with 6 mm thick hard board backing of size 450 mm x 350 mm wall mounted type fitted over wash basin.
- e. One CP brass towel rail of minimum 600 mm long.
- f. Stopcocks, bib taps, valves and pillar cocks shall be heavy duty chromium plated brass in required numbers.
- g. All fittings such as 'P' or 'S' traps, floor traps, vent pipes, down take pipes, etc.
- h. One triple layer polyethylene storage tank of 1000 liter capacity shall be provided at the roof of the building / toilet along with internal water supply GI piping, fittings and connections to the toilets and sinks. In administrative building where multiple toilets are to be constructed the capacity of storage tanks shall be minimum 2000 liters.
- i. Connection with plant water supply and sewerage system.
 - a. Provide toilet facilities at all site & office buildings and plant units.
 - b. Water proofing of toilet floor slab by applying cement slurry mixed with water proofing compound and sealing all joints, corners, junction of pipes and masonry with polymer mixed slurry.
 - c. Men toilets shall have 2 nos. white vitreous china Bowl urinals each of size 580 x 500 x 300 mm separated by a marble / Kota stone partition of size 600mm x 400mm.

1.2.2 Operations building

The operations buildings shall be RCC framed structure with brick walls & RCC floor slab.

1.3 Acoustic system for blower and power generation buildings

The blower room and generator room shall be provided with necessary acoustic treatment and additional measures required to reduce to acceptable level of noise generated during running of the proposed blower and generator set. The acoustic system of the buildings shall be designed for "air borne noise" as well as "structure borne impact noise". The acoustic insulation provided in the building should be able to maintain the noise level outside the building at 60 dB(A) or lower.

1.4 Cable and pipe work trenches

As far as possible, the alignment of the cable route shall be decided after taking into consideration the present and likely future requirements of other services like drains, water supply pipelines, etc. Cable and pipe trenches shall generally be constructed in reinforced concrete. Trenches within the buildings or plant areas not exposed to direct rain shall be covered with M.S chequered plates, suitably painted and those outside the buildings shall be covered with factory made precast concrete covers.

1.4.1 Pipes and ducts for road crossings

RCC pipe pipes and ducts carrying utilities like cables, water and sewerage lines, storm water, etc. shall have minimum one meter cover while laid under roads.

1.5 Staircase, walkway platforms and hand railings

- a. All individual treatment units shall have RCC staircase from FGL to the walkway platform level. All such staircases shall be provided outside the treatment units only.

- b. The RCC walkway platforms around and across the treatment units of Varanasi STP shall be designed for all possible loading conditions.
- c. Kerbs shall be provided below the hand railing on platforms and walkways in the treatment units as per relevant sections of factory act.
- d. SS Handrail of 40 NB size shall be provided with stainless steel AISI 304 SS handrail and balustrade system.

1.6 Potable water supply & fire-fighting system

1.6.1 Potable water supply

Potable water supply as per CPHEEO manual to administrative block, staff quarters and other buildings shall include construction of tube well and water supply network and an over-head tank of 25 KL capacity. The Concessionaire shall design and construct distribution network of suitable size (including water appurtenances like sluice valve, scour valve, air valve, non-return valve etc.), connecting all the overhead / underground water tanks / structures and additional connection points for cleaning purpose.

1.6.2 Fire-fighting system

Source of water supply shall be final Treated Effluent sump. The Concessionaire shall design and construct suitable firefighting system along with pump sets and other accessories for meeting the firefighting requirement of buildings located in the plant area. Delivery head for the pump should be sufficient to supply the water to all water structures and to meet the firefighting requirement. Fire hydrant shall be provided near all the units of buildings/ pump houses/ panel rooms. All firefighting network shall be of pressurized steel pipes conforming to IS: 226 or IS: 2062

1.7 Sewerage system within Varanasi STP

The Concessionaire shall design the sewerage network for the plant area considering pipe material as RCC pipes conforming to IS: 454. The wastewater coming out from administrative block, chlorine house, workshop, staff quarters and other buildings and toilets shall be conveyed to the sump of the Varanasi STP drain pumping station through the proposed sewerage network. From plant drain pumping station waste water shall be pumped to the inlet chamber of Varanasi STP through a suitably designed and sized rising main.

1.8 Equipment for removal of screening

The following equipment shall be mobilized by the Concessionaire for removal and transportation of Screenings, Residual Grit, Digested Sludge and any other STP By-Products to Waste Disposal Site.

- Light hand cart of 12 cu. ft. capacity made of 1.6 mm thick MS Sheet with 40 mm x 40 mm x 5 mm angle frame = 12 Nos.
- Aluminum ladder made up of aluminum side 'C' section of size 66.6 mm x 31.8 mm with step made up of 25.4 mm dia and non slip chequered pipe = 5 nos.



1.9 Gates & security cabin

MS heavy duty gate (minimum 5.0 m wide) with RCC pillars shall be provided at entrance. One no. security guard room of minimum 10 m² area shall be provided near main gate. The security guard room shall be constructed in brickwork.

1.10 Land development, horticulture, arboriculture and landscaping

Concessionaire shall do the land development of the plant area during construction based on the topography of the area and shall also provide DI or HDPE pipe network with hydrants at 50 meter intervals for horticulture purpose. The source of water supply shall be the final treated effluent sump. Suitable pumping arrangement and network shall be designed and constructed for horticulture purposes.

The work shall include the following but not limited to this:

- i. Green belt plantation;
- ii. Lawns;
- iii. Indoor plantation for admin building along with decorative pebbles;
- iv. Static Water fountain with all necessary civil works;
- v. Pathways with interlocked rubber moulded paver blocks of specified design and shade;
- vi. Sprinkler system for lawns.

1.11 Signage and warning boards

All buildings and treatment units shall be provided with sign boards indicating the name and function of these.

Necessary signage and warning boards shall be erected. The signboards shall be partially reflective flex type on SS Grade 304 minimum 1.2 mm thick supported with frame of aluminum channels / double back channels minimum 3 mm thick through aluminum rivets. The signboards shall be subsequently attached to the post(s) through steel bolts. The posts shall be 75 mm diameter galvanized steel with welded top cap in case the signboard is supported on one post only, however, if two posts are used to support the signboard the diameter of each shall be minimum 40 mm and thickness 1.6 mm. The steel posts shall be embedded in RCC footing of size. The total height of the post shall be 1800 mm + size / depth of the signboard.

All the signboards displaying name of the technical units and directions shall be written in English and Hindi.

1.12 Rain water harvesting system

The scope of work shall cover major buildings considered for collection of rain water, rainfall considered, conveyance of rainwater, type of filters proposed, cleaning chambers and detailed civil works along with drawings and details.

It shall include, inter-alia, the following:

1. PVC downpipes (along with clamping system),

2. PVC gutters / pipes for conveying rain water to filters,
3. First rain separator arrangement,
4. Leaf trap,
5. Filter,
6. Storage tank with overflow pipe,
7. Water tap,
8. Bore well, etc.

1.13 Earthworks - excavation

Unless otherwise specified all excavation shall be done by mechanical means and includes working in or under water and /or liquid mud and / or under foul positions as per IS 3764 (1992).

- No blasting is allowed for any type of excavation.
- In case of excavations adjacent to existing structures, care should be taken to avoid damage/settlement to existing structure.
- Excavated material shall be dumped in regular heaps, bunds, riprap with regular slopes within the lead specified and leveling the same so as to provide natural drainage. Excavated material should be stored as directed so as to provide necessary access for functioning of existing structures conforming to client's requirements. Rock/soil excavated shall be stacked separately. Topsoil shall be stock piled separately for later re-use.
- Timber Shoring "closed" or "open" depending upon the nature of site and site conditions shall be carried out.
- The Concessionaire shall plan necessary drainage system at the site and ensure that the excavated areas shall not get filled / submerged in rain / surface water.
- The earth and sand used for filling shall be free from all roots, grass, shrubs, vegetation, trees, sapling and rubbish.
- No filling shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with.
- Anti-termite treatment of soil beneath the building and around the foundation shall be done with suitable insecticide.

1.14 Concrete and allied works

1.14.1 Material

Water, cement, fine and coarse aggregates and steel reinforcement shall conform to relevant codes / standards.

Cement shall be of 43 grade Ordinary Portland Cement as per IS 8112:1989 – Specification for 43 grade ordinary Portland

The virgin steel used for reinforcement shall be Thermo Mechanically Treated (TMT) bars of grade Fe 500 D. IS:1786 - Specification for High strength deformed steel bars and wires for concrete reinforcement.

1.14.2 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.

1.14.3 Formwork and reinforcement steel

Formwork shall be properly designed for various types of loads anticipated to be imposed during the construction process. The design should also take into account the effect of vibrations created during operation of vibrators. The forms shall be capable of producing a consistent quality surface as required.

All the staging to be of tubular steel structure with adequate bracings or made of built up structural sections from rolled structural steel sections. Only steel shuttering shall be used, except for unavoidable portions and very small works for which 12 mm thick water proofing ply of approved quality may be used.

1.14.4 Concrete

Nominal mix concrete shall be used for concrete of grade M 15 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) or lower or if the quantity of concrete is less than 6 cum at a location on a single day.

Design mix concrete shall be used for concrete of grade M 20 and above or if the quantity of concrete is more than 6 cum at a location on a single day.

The mixing of concrete shall be strictly carried out in the batching and mixing plant for concrete. A concrete batching plant shall be erected as per site requirement. For small concreting works, mechanical concrete mixers may be used. Hand mixing of concrete shall not be permitted at all.

1.14.5 Construction joints & other types of joints

All construction joints shall be provided as recommended in BIS: 3370, 3411 and 6494. However, concessionaire is allowed to reduce the number of construction joints as per Good Industry Practices.

The positions of construction joints should be specified by the designer & indicated on the drawings.

1.14.6 Preformed fillers and joint sealing compound

Preformed filler for expansion/ isolation joints shall be non-extruding and resilient type of bitumen impregnated fibres conforming to BIS: 1838 Part I or BIS 1838 Part 2.

Bitumen coat to concrete/ masonry surfaces for fixing the preformed bitumen filler strip shall conform to BIS: 702. Bitumen primer shall conform to BIS: 3384.

Sealing compound for filling the joints above the preformed bitumen filler shall conform to Grade 'A' as per BIS: 1834.

Other organic solvents such as polysulphate based joint sealants to BIS: 11433 Part-I or BIS 12118 Part-I may be used.

1.14.7 Hydrostatic testing of liquid retaining concrete structures

Testing of concrete structures for leakage shall be done as per relevant BIS Code IS: 3370.

Water testing of concrete structures shall be done with potable water arranged by the Concessionaire at its own cost. Hydro-static test for water tightness shall be done at top level of structure and in case of digester it shall be up to the top of dome or soffit of cover slab. This test shall be carried out preferably in dry season.

1.14.8 Screed concrete

In all treatment units used for clarification or fitted with moving parts like scraper or sump / channel etc., the floor slab of the unit shall be finished with 50 mm thick M-20 grade screed concrete with neat finish at top surface.

1.14.9 Grouting

(i). Standard grout

The proportions of standard grout shall be such as to produce a flow able mixture consistent with minimum water content and shrinkage. Surfaces to be grouted shall be thoroughly roughened and cleaned. All structural steel elements to be grouted shall be cleaned of oil, grease, dirt etc. The use of hot, strong caustic solution for cleaning purpose will be permitted. Prior to grouting, the hardened concrete shall be saturated with water and just before grouting, water in all pockets shall be removed. Grouting once started shall be done quickly and continuously.

The grout proportions shall be limited as follows:

Use	Grout Thickness	Mix Proportions	W/C Ratio (max)
a) Fluid mix	Under 25mm	One part Portland Cement to one part sand	0.44
b) General mix	25mm and over but less than 50mm	One part Portland Cement to 2 parts of sand	0.53
c) Stiff mix	50mm and over	One part Portland Cement to 3 parts of sand	0.53

(ii). Non-Shrink Grout

Non-shrink grout shall be provided in strict accordance with the manufacturer's instructions. Non shrink grout material properties shall comply with ASTM C1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink). Application of non shrink grout shall be as per manufacturer instructions.

1.15 Structural steel works

1.15.1 Material

All materials used shall be new, unused and free from defects. Structural steel and other related materials for construction shall conform to IS 2062. Where steel castings are to be used the same shall conform to IS: 1030.

Corrosion allowance of 2 mm shall be taken in case of M.S. Plates over and above the minimum thickness of 6 mm or design thickness of plates.

Test certificate from the manufacturer for the material shall be made available along with each lot supplied at site. Scratched or abraded steel shall be given a coat of primer for protection after unloading and handling prior to erection.

1.15.2 Painting on structural steel work

Primer and finish paints shall be compatible with each other to avoid cracking and wrinkling and shall be from the same manufacturer for each painting system.

a. Primer

Two coats of primer shall be applied on the steel structures. First coat of lead-free, oil-based, high-quality, corrosive resistant steel primers such as Red Oxide/ Zinc Chromate as specified shall be applied before any member of steel structure are placed in position or taken out of workshop. Second coat of primer shall be applied after the erection is completed and before painting commences.

b. Paint

Two coat of epoxy paint shall be applied on all structural steel members. Paint delivered to the fabrication shop/site shall be ready mixed, in original sealed containers, as packed by the manufacturer. The application of paint shall be as per manufacturer's instructions. The coating thickness shall consist of the following minimum dry film thickness, or as recommended by the manufacturer, if thicker:

First coating : 75 μm

Second coating : 100 μm

1.15.3 Galvanizing of structural steel

Galvanising of structural member shall conform to IS 4759, 209, 2629, 2633 and 6745.

1.16 All roads upto and within Varanasi STP, culvert / cross drainage, roadside drains and ground pathways

1.16.1 Approach road upto Varanasi STP

The approach road to Varanasi STP, with a length of approximately 725 m and a width of 6.0 m shall be designed as flexible pavement in accordance with IRC:SP-73 and IRC - 37.



1.16.2 Internal roads within Varanasi STP

All internal plant roads shall be designed as flexible pavement in accordance with IRC:SP-73 and IRC :37.

1.16.3 Slab & box culvert

The Concessionaire shall study the soil investigation report and based on the recommendations shall carryout structural designing of the culvert.

Road side drains

All road side drains shall be designed in accordance with IRC:P:50-2013. Connection of road side storm water drain to the nearby natural drain for final discharge of the storm water generated within the plant premises shall be made. If there is no natural drain nearby then pumping arrangement has to be made for disposal of storm water.

1.16.4 Factory made cement concrete interlocking rubber moulded paver block

Road shoulder top shall have factory made precast rubber moulded paver blocks 80 mm thick of M-40 grade. Ground pathways shall have factory made precast rubber moulded paver blocks 60 mm thick of M-35 grade.

1.17 General building works

1.17.1 Brickwork

The brick work shall conform to IS-2212:1991 Damp - proof course. Where specified, all the walls in a building shall be provided with damp-proof course cover at plinth to prevent water from rising up the wall. The damp-proof course shall run without a break throughout the length of the wall, even under the door or other openings. Damp-proof course shall consist of 40 mm thick cement concrete of 1:2:4 (1 cement : 2 coarse sand : 4 graded stone 12.5 mm nominal size) nominal mix with approved water-proofing compound admixture conforming to IS: 2645.

1.17.2 U PVC doors, windows and ventilators

uPVC extruded sections - All profiles shall be made from uPVC (Unplasticised Polyvinyl Chloride) Type A material & only those additives are used that are essential in producing sound extrusions in accordance to IS 14164 (2008).

1.17.3 Aluminum doors, windows and ventilators

Aluminum extruded sections shall conform to IS: 733 and IS: 1285 for chemical composition and mechanical properties. Screws and fasteners shall be of aluminum alloy or brass oxidised. Screw thread of machine screws used in the manufacture of aluminum doors, windows and ventilators shall conform to the requirement of IS: 4218. The aluminum fittings shall be anodized to natural matt finish or dyed anodic coating not less than grade AC 10 of IS: 1868. The stainless screws shall be of grade AISI: 304.

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1.17.4 Galvanized steel rolling shutters

Rolling shutter shall be provided in workshop, chlorine building, gas generation room and other such buildings. GI sheets and plates used for manufacturing the guide channels, brackets and lock plate should be of hot rolled steel of thickness not less than 18 gauge conforming to IS5986. All components of rolling shutter to be hot dip galvanized with a zinc coating containing not less than 97.5% pure zinc. The galvanization of members shall conform to the requirements of IS 4759, IS 209, IS 2629, IS 2633 and IS 6745.

Rolling shutters shall conform to IS: 6248 and shall be suitable for fixing in position as specified i.e. outside or inside on or below lintel or between jambs of the opening. Shutters up to 10 sqm shall be on push and pull type and shutters with an area of over 10sqm shall generally be provided with reduction gear operated by mechanical device with chain or handle. The crank handle shall be removable.

1.17.5 Base concrete

The surface of the base shall be roughened with steel wire brushes without disturbing the base concrete. The base concrete shall be in M-15 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm size) and of minimum 40 mm thickness.

1.17.6 Cement concrete flooring with metallic hardener topping

Wherever floors are required to withstand heavy wear and tear such as in pump house floors, workshops, etc. the use of metallic hardener topping is used.

1.17.7 Terrazzo tiles in flooring, risers of steps, skirting and dado

Terrazzo tiles shall generally conform to IS: 1237. The size of tiles shall be as required in the approved drawings.

1.17.8 Chequered tiles in flooring / stair treads

The chequered tiles shall conform to IS: 13801.

1.17.9 Kota stone slab flooring / risers and treads of steps, skirting and dado

The stone slabs shall be of approved shade and selected quality, hard, sound, dense and homogenous in texture, free from cracks, decay, weathering and flaws.

1.17.10 Pressed ceramic tile finish

Flooring / skirting and dado - The tiles shall be conformed to IS: 15622. They shall be flat and true to shape and free from blisters, crazing, chips, welts, crawling or other imperfections detracting from their appearance.

1.17.11 Vitrified tile work – flooring / skirting

The tiles shall be conformed to IS: 15622.

1.17.12 Carborundum tile finish

Carborundum tiles shall generally conform in all respects to the standards stipulated in IS: 1237 for heavy duty tiles.

1.17.13 Epoxy lining work

The epoxy resin and hardener formulation for laying of joint-less lining work in floors and walls of concrete structures etc. shall be conforming to the requirements of IS: 9197 (Specification for epoxy resin, hardeners and epoxy resin composition for floor topping).

The hardener shall be of the liquid type such as Aliphatic Amine or an Aliphatic/Aromatic Amine Adduct for the epoxy resin. The hardener shall react with epoxy resin at normal ambient temperature.

The concrete surfaces over which epoxy lining is to be provided shall be thoroughly cleaned of oil or grease by suitable solvents, wire brushed to remove any dirt/dust and laitance. The surfaces shall then be washed with dilute hydrochloric acid and rinsed thoroughly with plenty of water or dilute ammonia solution. The surfaces shall then be allowed to dry. It is essential to ensure that the surfaces are perfectly dry before the commencement of epoxy application.

Lining shall be allowed to set without disturbance for a minimum period of 24 hours. The facility shall be put to use only after a minimum period of 7 days of laying of the lining.

1.17.14 Water-proofing

All water proofing admixtures used shall be conforming to IS: 2645.

1.17.15 Cement plastering work

All cement plastering work shall be conforming to IS: 1661.

1.17.16 Metal lath and wire fabric

Materials to be used as follows -

- Welded steel wire fabric shall conform to IS: 4948.
- Expanded metal steel sheet shall conform to IS: 412.
- Galvanized wire mesh shall be of approved quality.

1.18 Water supply and sanitary works

1.18.1 Sanitary installation

All sanitary ware shall be glazed earth ware of fireclay. Sand Cast Iron soil waste pipes and specials shall be of approved quality and shall conform to IS: 1729. Galvanized iron pipes and specials shall be of "C" heavy type, first quality and shall conform to IS: 1239.

1.18.2 Water closet and cistern

Indian type water closet

This shall be Orissa pattern of size 580 x 440 mm with integrated type footrest made of white vitreous china conforming to IS 2556 part-III. High level flushing cistern of 10 litres capacity of Vitreous china (IS: 774) or Plastic cisterns (IS: 7231).

European type water closet

This shall be "Siphonic Wash down type" of white vitreous china conforming to IS: 2556 (Part VIII). Standard toilet paper roll holder of approved type shall be provided, and this shall be surface mounted type fixed with CP counter sunk brass screws. Low level flushing cistern of 10 litres capacity of Vitreous china (IS: 774) or Plastic cisterns (IS: 7231) with all fittings and accessories.

1.18.3 Urinals

The urinal shall be Bowl urinals of size 580 x 500 x 300 mm of white glazed vitreous china conforming to IS 2556 (Part VI). Automatic flushing cistern (5 / 10 litres as required) for urinals conforming to IS.2326 shall be provided.

1.18.4 Wash basins

Wash basin shall be of white glazed vitreous china of size 630 x 450 mm with a pair of 20 mm CP brass pillar taps and other fittings.

1.18.5 Sinks

The laboratory sink shall be white vitreous china conforming to IS 771 (Part-III) & IS 2556 (Part-V). The Stainless steel kitchen sink shall conform to IS 13983. The waste fittings and plug fittings shall be brass chromium plated. The chromium plating shall be of service grade No.2 conforming to IS 1068.

1.18.6 Stop cocks and Bib Cock

Stopcocks and bib tap shall be of brass heavy class, chromium plated and pattern complying with IS: 781. They shall be of specified size and of the screw down type. The bib cocks shall open in anticlockwise direction. Chromium plating shall be done in accordance with IS: 1068.

1.18.7 Sand cast iron or centrifugally cast (spun) iron pipes and fittings

Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings, fittings and accessories shall conform to IS: 1729. Centrifugally cast iron S & S soil, waste and ventilating pipes, fittings and accessories shall conform to IS: 3989.

1.18.8 UPVC pipes for rain water pipes, soil waste and vent pipes and fittings

All UPVC pipes and fittings shall conform to IS: 13592 (Type-A for rain water pipes & Type-B for soil pipes).

1.18.9 Pipes – galvanized iron

The pipes (tubes) shall be galvanised mild steel hot finished seamless (HFS) or welded (ERW) HRIW or HFW screwed and socketed conforming to the requirements of IS 1239 Part-I for medium grade. Galvanising shall conform to IS 4736.

1.19 PSC pipes / laying and jointing in Varanasi STP

While RCC pipes can cater to the needs where pressures are upto 3.0Kg/cm² and C.I and steel pipes cater to the needs of higher pressures around 24 Kg/cm², the P.S.C pipes cater to intermediate pressure range for which the metallic pipes are expensive while RCC pipes would not be suitable. PSC pipes / laying and jointing shall conform to IS 784- 2001.

1.19.1 Manholes

Circular manholes of varying sizes depending on the depth of sewer line shall be constructed at an interval of 15 m centre to centre, at every turning and change in size of sewer line.

1.19.2 Valve chambers

Valve chambers shall be of the inside clear size as per the approved drawings. The construction shall be similar to that for inspection chambers except for benching for the drain pipes. Locking arrangement shall be provided in addition to the cast iron cover.

1.19.3 Ductile iron pipes and fittings

All ductile iron pressure pipes shall be class K-9 conforming to IS: 8329. All ductile iron fittings shall conform to IS: 9523. Socket and Spigot type shall consist of elastomeric rubber ring gasket for forming an integral joint between pipes or pipe and fitting shall conform to IS: 12820. Flanged Joints, wherever specified in the drawings, shall conform to IS: 8329.

1.19.4 Reinforced cement concrete pipes

RCC pipes shall be in accordance with the relevant clauses of IS: 454. The manufacturing and dimensions of finished pipes shall be as per IS: 458. During manufacture, tests on concrete shall be carried out as per IS: 456. The pipes shall be Socket and Spigot or Plane ends suitable for color-jointing.

1.19.5 Centrifugally cast (spun) iron pipes

The spun iron pipes shall be of cast iron cast centrifugally and shall conform to IS: 1536. The specials shall conform to IS: 1538.

1.19.6 Thrust blocks

Thrust blocks shall be designed and installed wherever there is a change in the direction/size of the pipe line or the pressure line diagram, or when the pipe line ends at a dead end.

1.19.7 Surface / substrate preparation & rehabilitation works

The edges of all repairs will be cut by angle grinder or similar to produce a regular profile

(rectangular/square) with a minimum depth of 10 mm. No feather edges will be accepted in any repair work.

1.20 Civil rehabilitation in MPS

- 1) All the damaged plaster in existing building shall be removed completely and finished with new plaster after applying cement slurry (with appropriate admixture) as a bond coat.
- 2) For building internal surface- oil bound distemper.
- 3) Exterior of MPS buildings shall be painted with two or more coats of anti-carbonation painting as per specifications.
- 4) Removing of existing and re-fixing of new rain water pipes (UPVC) inclusive of clamping to structure bends fittings etc.
- 5) Repair/new plinth protection shall be done all around the building. The apron shall be 1000 mm wide and in PCC M-20 grade laid to slope of 100 mm to 75 mm. The apron shall rest on well compacted, watered, levelled and thoroughly consolidated ground. Necessary bonding agents and admixtures to be used for repair mixes.
- 6) The unserviceable roof top of the existing buildings should be made approachable by providing stainless steel cat ladder, as per requirements.
- 7) Replace existing doors, windows and ventilators with new uPVC doors, windows and ventilators.

1.21 Repair / rehabilitation / laying of sections of rising main from MPS to Varanasi STP

- 1) The influent rising main from MPS to Varanasi STP is to be restored for operation.
- 2) Any repair, rehabilitation or new laying of the existing PSC rising main from the MPS upto Varanasi STP, as required as per the Schedule I - Scope of Work, required shall be as per IS 784- 2001. The laying and jointing shall conform to IS: 783 - 1985.
- 3) Desilting and Closed Circuit Television (CCTV) inspection of rising main from MPS to Varanasi STP Inlet Point shall be done to assess the repair/rehabilitation works.

1.22 PSC Effluent Disposal Pipeline from Varanasi STP to Discharge Point

Design and development of the Effluent Disposal pipeline, Varanasi STP upto Discharge Point, as required as per the Scope of Work laid out in Schedule I, shall be as per IS 784- 2001. The laying and jointing shall conform to IS: 783 - 1985. The Concessionaire shall provide adequate number of air valves including scour valves at appropriate places, suitably designed and sized.

1.23 HDPE Pipes

HDPE Pipes of class PE – 80, PN – 4 & SDR – 19 HDPE shall be used. All pipes shall be ISI marked, manufactured as per IS 14333 – 1996 (Amended up to date). The pipes shall be procured only after approval of the manufacturer by the Engineer.

Jointing of HDPE Pipes

Jointing between HDPE pipes and specials shall be done as per IS: 7634 part II. Method of jointing between the pipes to pipes and pipes to specials shall be with butt fusion welding using



semi automatic, hydraulically operated, superior quality butt fusion machines which will ensure good quality butt fusion welding of HDPE pipes.

1.24 Construction of Earthen Embankment/Bund at Varanasi STP Site

The construction of earthen embankment/bund around STP Site shall be as per IS 12169 -1987.

1.25 General painting requirements at Varanasi STP

The painting work shall conform to the following requirements:

- 1) The surface preparation shall be carried out generally in accordance with IS: 1477 Part I and IS: 6005.
- 2) After surface preparation, two coats of primer-red oxide zinc chromate with modified phenolic alkyd base conforming to IS: 2074 shall be applied. Dry film thickness of each coat shall be 25 microns.
- 3) For finish painting, after application of primer as in (b) above, two coats of synthetic enamel conforming to IS: 2932 shall be applied. Dry film thickness of each coat shall be 25 microns.
- 4) Colours shall be selected as per IS:5

Standards to be followed for the protective coatings to be applied to structural steel, metalwork and ironwork as corrosion protection systems.

- 1) B.S.5493 "code of practice for the protective coating of iron and steel against corrosion"
- 2) Protective coating shall be designed in accordance with B.S. 5493
- 3) For the purposes of system design the general environment shall be as specified in B.S. 5493 Table 3 Part 2 'Exterior exposed polluted inland'.

Cast Iron and Steel Pipework: (Internal surfaces)

- 1) Where a bitumen based coating is used, it shall be in accordance with Type 2 of B.S. 4147.
- 2) The lining shall be in accordance with B.S. 534.
- 3) The coating shall be applied in accordance with the manufacturer's instructions and with Appendices J and K of B.S. 3416.

Other requirements:

- 1) All buried steel pipes and fittings shall be coated and unwrapped with hot or cold applied, self-adhesive, polyethylene in accordance with AWWA C214 or equivalent Standard.
- 2) Fusion-bonded Epoxy Powder Coatings - All fabricated steel pipework and other plant where specified, shall have a lining and coating, not less than 250 microns thick, of 100% solids, thermosetting fusion-bonded, dry power epoxy coating. All grit and dust shall be removed and coating shall be started before formation of visible oxidation of the surface. The metal shall be pre-heated to a temperature recommended by the manufacturer and the epoxy powder applied by immersion in a fluidized bed, after which excess powder shall be removed. The powder shall be allowed to flow out completely before curing. The thickness of the coating, including

any repaired areas, shall be checked with a calibrated tester. Spark testing, for pinholes, voids, contamination, cracks and damaged areas, shall use a high-voltage spark generator. Repairs due to coating imperfections or damage shall be done using a brush-applied compatible two-pack liquid epoxy compound. The area to be repaired shall be cleaned to remove dirt, grease, scale and damaged coating, which shall be feathered. Pinhole surface preparation is not required other than removal of detrimental contaminants which could impair the adhesion of the repair material. The surface coating shall be applied by an approved applicator. GRP covers and guards shall be pigmented to give the finished colour without painting.

The painting system shall be deemed to have failed if:

- 1) After painting, damage has been caused by handling, impact, abrasion or welding;
- 2) Any portion of the paint film separates from any other or the parent metal;
- 3) After painting the total dry-film thickness is less than that specified.
- 4) Failure shall not include: Loss of gloss; variation of shade, not affecting the anti-corrosive properties of the system.

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Schedule 11 (Part C)
Mechanical Equipment General and Particular Specifications

1.1 General requirements

The Concessionaire shall provide and arrange the works to comply with the following general guidelines:

- 1) Sufficient space shall be provided between items of Facilities or fixed structures to permit safe and convenient access for operation and maintenance.
- 2) Layout of the site structures/equipment shall be cognizant of code distances required between non-hazardous and hazardous structures/plant/equipment, etc.
- 3) An area adjacent to all mechanical equipment shall be provided as maintenance lay down area.
- 4) Electrically operated cranes, fixed runways, lifting eyes or other means shall be provided to permit the removal of larger items of Varanasi STP that may logically be required to be removed during the course of its normal operational life for maintenance or replacement purposes.
- 5) Areas where leakage of water is likely to occur, whether in normal use or during maintenance, shall be provided with covered drainage channels which shall direct spillage either to a suitable drain or to a sump from where it can be pumped to an appropriate place for safe disposal.
- 6) Where necessary, the equipment shall be provided with removable acoustic coverings to limit the noise produced during normal operation to the limits detailed elsewhere.
- 7) Wherever the electric motors, gear box are exposed to open atmosphere, a sunshade shall be provided.
- 8) Pipework shall be designed and installed to prevent blockages and to permit their clearance without dismantling pipework or equipment.
- 9) The Concessionaire shall take due regard to the potential of hazardous mixing of chemicals, particularly as a result of leaks and spillages, and their drainage and containment.
- 10) Chemical pipework shall be secured to racks or trays, to walls of tanks and walls of buildings as necessary. It shall be arranged to facilitate maintenance and removal of individual runs without dismantling adjacent pipes.
- 11) All chemical pipes shall be colour banded and suitably labelled to enable individual lines to be identified throughout their run.
- 12) The Concessionaire shall provide all signage necessary to inform of chemical and operational hazards and to comply with statutory legislation.

1.2 Relevant standards

The design, manufacture, supply, storage of all equipments shall comply with all Indian

Standards, (or in the absence of Indian Standards, the appropriate International Standards), Applicable Laws, including local statutes covering:

- 1) Health and Safety
- 2) Dangerous Goods
- 3) Factories and Commercial Premises
- 4) Buildings
- 5) Electricity Regulations and Codes of Practice

The Standards referred shall form part of this Concession Agreement. Other Standards, Codes of Practice and Regulations not referred to, but which would be applicable to the design, manufacture, installation, testing or commissioning of the equipment under this Concession Agreement shall be deemed part of the Concession Agreement.

1.3 Pumping systems

- 1) Provisions of pumping systems with isolation valves, non-return valves, and all necessary pipework and fittings.
- 2) Provision of pipe supports, hangers and anchors to support and control movement of pipes and valves all in accordance with recognized international piping standards.
- 3) Unless otherwise specified, provision of all pumping systems with standby pump sets of the same type and capacity as the duty pumps, providing a standby capacity of not less than 50% of the total duty. All pumps shall operate at high efficiency throughout their duty range and they shall be capable of continuous operation throughout their required operational range. The minimum diameter of pipe for sludge transfer shall be 150mm.
- 4) Lubrication arrangements shall be designed to avoid any contamination of pumped fluid.
- 5) Dry well mounted pumps shall provide effective means for collecting gland/seal leakage water which shall be piped to a floor drain or sump.

1.4 Materials of construction

- 1) All materials of construction for tanks, vessels, pipelines, pumps, valves, etc. shall be suitable for long term contact with the liquid or chemical concerned and at the prevailing concentrations. Equipment shall be coated and protected in accordance with painting and protective coatings.
- 2) All pipework employed shall comply with the schedule below. It is the responsibility of the Concessionaire to ensure compatibility of all pipelines with fluids or sludge carried and with external and internal loadings and pressures.

Service	Size range	Pipe material
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Service	Size range	Pipe material
Potable and raw water including supernatant	Up to and including DN 300	Ductile iron (DI)/GI Unplasticised polyvinyl chloride (uPVC) Poly-ethylene (PE)
	DN 300 – DN 600	Ductile iron (DI) Steel Poly-ethylene (PE)
	Greater than DN 600	Ductile iron (DI)
Sewage (pumped below ground)	All diameters	Ductile iron (DI)
Above ground pipe-work and within structures	Up to and including DN 300	Ductile iron (DI) uPVC Stainless steel (316L)
	Greater than DN 300	Ductile iron (DI) Steel
All sewage pipework underneath structures	Up to and including DN 300	Ductile iron (DI)
	Greater than DN 300	Ductile iron (DI) Steel Stainless Steel (316L) All pipes under roadways & structures to be concrete encased.
Compressed air	All diameters	Galvanised mild steel
Sampling	All diameters	(uPVC) Heavy Duty
Instrumentation process piping	All diameters	Copper (plain/coated) uPVC Nylon Stainless steel
Chemical dosing	All diameters	Sch. 80 PVC & According to manufacturer's recommendations
Natural Gas		MDPE below ground Stainless steel or steel above ground/inside buildings
Sludge	All diameters	Ductile iron K-9
Biogas	All diameters	Stainless steel 316L (below ground, inside/outside buildings)
Process Air piping	Blower discharge – Distribution piping around aeration tanks - All diameters	Ductile iron or Steel
	Drop legs and Headers	Stainless steel (304L)

MS

m

1/2

Service	Size range	Pipe material
	(under water)	
	Diffuser grid (manifolds and air distributors)	Diffuser grid of uPVC and Anchors bolts, nuts fasteners, supports and clamps of SS 304.

1.5 Isolation and drain down

Provision of facilities for isolating and draining down all pipework, chambers and storage tanks. Wherever duty/standby equipment is provided, it shall be possible to isolate and drain-down each of the duty or standby items while the other items are in service.

1.6 Medium and fine screens

1.6.1 Scope of supply

The scope of supply shall provide complete automatic mechanical screen systems with all accessories and appurtenances, including, but not limited to:

- Mechanically operated screen;
- Screenings collection, washing and disposal system;
- Automatic screen control system;
- Electrical & instrumentation for compliance of automatic system (electrical wiring between all screen components, instruments, control devices and the local control panels and the screen controls)

1.6.2 Guaranteed flow rate and head loss

The screen shall effectively screen all flows up to the design flow. Provision of guarantee the following screen performance parameters:

- Clean water flow rate capacity (l/s) at the maximum allowable water depth downstream of the screen
- Clean water head loss at the max flow rate and maximum allowable water depth downstream of the screen

1.6.3 Screening arrangements

Provision of automatic mechanical fine screen to remove particles at MPS and STP as per design requirements.

It is proposed to install sufficient number of appropriately sized automatically operated mechanical fine screens (stainless steel grade – SS316) screening out floating materials such as plastic pouches, bags, rags, floating debris, weeds, paper wastes and other floating materials from the Influent coming from the pumping station. Capacity of each channel shall be equal to of average flow. Fully automatic mechanical screen along with the level sensing instrument for automatic operation of screen mechanical and allied accessories, (local control panel near screen,) shaft less screw conveyor with/cum compactor are to be provided.

The fixed as well as movable bars/ perforated band, mechanism, support frame, fixings discharge chute shall be manufactured from stainless steel grade 304 for long life in the aggressive sewage environment.

1.6.4 Automatic screen clearing and screenings removal

The screen shall be provided with the necessary controls and sensors to anticipate blockage of the screen, and automatically clear the screen and remove the accumulated screenings from the screen surface. The screen shall operate automatically when the upstream water level increases beyond a pre-set limit and it shall stop when the upstream level decreases to pre-set low level.

1.6.5 Screenings conveyance

The screening system shall be supplied to convey the screenings to the automatic screenings press and discharge system that discharges the screenings through a chute to the screenings storage system.

1.6.6 Screenings discharge chute

The screenings discharge chute shall terminate 1.5 meters above ground level. A plastic screenings bag shall be secured around the chute, thereby creating a totally enclosed screenings collection system.

1.6.7 Screen covers

All screenings equipment shall be supplied with integral stainless steel covers that prevent access to moving and wash water sprays. The covers need to be airtight to ensure that no odours emanate from the screen.

1.6.8 Portable screenings container

Portable screenings containers made of galvanised steel duly epoxy painted shall be provided to store the screenings until time of pick up. The container shall have capacity of approximate 5 m³ and shall be of a convenient height to permit the discharge of screenings directly into the container without having to transfer the screenings manually.

1.6.9 Electrical motor

The motor shall be TEFC type with IP 55 protection & Class F insulation and shall be suitable for operation on 3 phase, 415V \pm 10% and frequency of 50Hz \pm 5%. Motors shall be squirrel cage type conforming to IS 325. The power rating of motor shall be at least 125% of maximum power requirement.

1.6.10 Control panel

The control panel shall have IP 65 protection, painted with epoxy paint and shall be comprise:

- Mushroom head emergency stop.
- Overload relays for motor protection.
- MCB's, HRC Fuses and Glass Fuses.
- Circuitry to operate the screen with level sensors.
- Selector switch to operate the screen on JOG mode.

1.6.11 Access

Safe access shall be provided to all screen equipment and instruments to allow for cleaning, inspection and maintenance activities.

1.6.12 Corrosion resistance

All metal parts of the screen equipment that are in contact with the sewage shall be constructed of a suitable grade of corrosion resistant stainless steel, aluminium or plastic.

1.7 Grit removing equipment

The grit chambers shall conform to the best industry practices. The material of construction of all wetted parts shall be in SS 316.

The grit removal device shall be capable of removing the following at the specified hydraulic peak flow rate, and no decrease in efficiency will be allowed at flows less than this design rate.

- 95% of the grit greater than 200 microns in size,

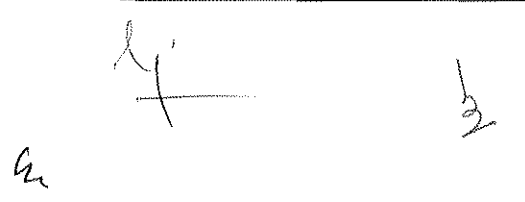
1.8 Clarifier mechanism

The clarifier mechanism shall be suitable for installation in RCC tank and circular radial flow fixed bridge with scum collector, central turn table type clarifiers shall be provided. Clarifier should be rugged and robust in design and should be provided with high capacity drive head having high torque rating, centrally located with positive sludge raking by means of two raking arms.

The mechanism shall comprise but not limited to the following main components:

Bridge superstructure spanning half the tank diameter with central maintenance platform, Drive assembly complete with drive head, chain & sprocket, geared motor etc., feed well, center cage, cone scraper, rake arms, tie rods for rake arms, plow blades & squeegees, scum blade & skimmer assembly, A-frame supports for the skimmer assembly, Scum trough and ramp with support angle, scum baffle with supports and weir plate.

Feed Well	SS 304, minimum 3 mm thick
Bridge	MS with Hot dip Galvanized (galvanizing minimum thickness shall be 80 micron) (welded/nut bolted/riveted truss in a consolidated single component and no site welding shall be allowed),grating/checkered plate 6 mm thick
Rake Arm	SS 304, minimum 3 mm thick
Center Cage	SS 304, minimum 3 mm thick
Rake Blades	SS 304, minimum 3 mm thick
V-notch weir	SS 304, minimum 6 mm thick and 300 mm wide



Squeegees	Neoprene rubber, 10 mm thick, adjustable type
Walkway	MS with Hot dip Galvanized (galvanizing minimum thickness shall be 80 micron)
Handrail (both ways in two layers minimum 1 m high)	40 NB SS Pipe 32 mm dia vertical and top rail with 25 mm dia middle level . The hand railing on clariver shall have a 6 mm toe gusard made of hot dip galvanised and be 100 mm wide x 5 mm thick .
Scum skimmer assembly	SS 304, minimum 5 mm thick and 300 mm wide
Scum Box	SS 304, minimum 3 mm thick
Scum Baffle	SS 304, minimum 3 mm thick and 400 mm wide
Fasteners – Under Water	SS-316
Fasteners – Above Water	Galvanised
Current Density baffles (like Stamford Weirs)	MS sheet 4 mm thick with 3 mm FRP voating Or Moulderd FRP / PVC

1.9 Aeration tank

1.9.1 Submersible mixers in anoxic tank / sludge storage tank

The anoxic mixers shall be of robust construction, designed for continuous operation under the most difficult operating conditions installed in three aeration basins. The anoxic mixers shall be energy efficient.

Submersible type mixer with motor housing in CI IS 210 Gr FG 250 and 3 blades propeller in SS 316 construction with suitable motor at $415 \pm 10\%$ V, 50 C/S. The submersible mixer shall be complete with lifting device comprising of MS Hot galvanized 60mm tube, MS winch and steel rope and handle with all accessories.

1.9.2 Air blowers

- 1) Blowers shall be designed to give clean, dry and oil free discharge. Each blower shall be provided with a coupling guard and motor and the whole assembly shall be mounted on a heavy duty rigid steel base-plate.
- 2) Blower/motor and variable air delivery system shall be of the automated type designed to save energy while matching air requirements in the aeration tanks at all times.
- 3) Volumetric efficiency shall not fall to a level where it adversely affects air temperature rise and overall blower efficiency.
- 4) Operating pressure shall not be greater than 85% of blower maximum continuous pressure rating. Bearing design life should be 100,000 hours.

- 5) For all blowers, standard atmospheric conditions of 20oC and 1013 mbar will be used with corrections for local ambient conditions for altitude, temperature and relative humidity.
- 6) The selection of the blowers shall include for losses for silencers, check valves and drive system, which must be included in the total power figure staged and the blower speed must be adjusted to take such losses into account.
- 7) The electric motors shall be a high efficiency type suitable for minimum 415v/3ph/50Hz and suitable for outdoor wet weather/wash down conditions, TEFC design and inverter rated.
- 8) Blowers shall have a variable flow output designed to run in concert with an automated variable air flow control system, providing air as required in the aeration tanks based on oxygen demand. The system shall include, as minimum:
 - PLC based local control panel at each blower with visual touch screen HMI including safety shut downs (i.e. motor thermister, surge control if necessary etc.);
 - PLC based master control panel with visual touch screen HMI including automated DO control and flow and pressure optimization through most-open valve algorithm;
- 9) All blower sets shall be fitted with the following ancillaries:
 - Discharge pressure relief valve – set to 10% above system operating pressure and capable of 100% blower discharge flow, with an accumulation not in excess of 10% of set pressure;
 - Discharge check valve;
 - Pressure gauge;
 - High discharge air temperature switch, to signal shut down of problem machine and auto start standby unit.
 - Anti-vibration pads and inlet/discharge flexible connections of the expandable SS corrugated/bellows type.
 - Inlet silencer – absorptive type with filter rated for 20% above design flow;
 - Discharge silencer – reactive type – for all applications and sized to ensure minimal pressure loss;
 - Blower discharge piping shall be fitted with an after cooler designed to lower the temperature of the blower discharge air to equal the approximate ambient temperature of the wastewater in the aeration process.
 - Inlet/Outlet isolation valves; and
 - For centrifugal type blowers, a vibration sensor to monitor and automatically shut down the equipment if necessary.
- 10) Standards/Norms - Compressor testing procedures, as well as the testing equipment, instrumentation, and calibration are based on national and international standards as follows:
 - ISO 5389: International standard: Turbo compressors - Performance Test Code
 - ISO 5167: International standard: Measurement of Fluid Flow.

- ISO 10816-1: Mechanical Vibration of Machines.
- ISO 3744: Determination of Sound Power Levels of Noise Sources.
- ISO 3746: If free-field conditions cannot be established ISO3746 will apply.
- API Standard
- 672/4.3.4.1: Packaged, Integrally Geared Centrifugal Air Compressors for General Refinery Service

1.9.3 Aspirator aerators

The unit supplied must be able to operate both in mixing and in aeration mode controlled completely independently of each other. Unit must have two distinct modes of operation; simultaneous aeration and mixing mode, and mixing only mode. The aerator consists of an electric motor and regenerative blower located above the water surface. The motor is connected to a hollow shaft with a protective housing positioned at a 45° angle downward into the water.

Aerators with submersible motors are not acceptable. The hollow shaft drives a mixing propeller and saturn ring-type diffuser beneath the water surface. Attached to the primary propeller is a Saturn ring diffuser, which disperses the air as fine bubbles (2.0-2.5 mm diameter) into the stream of displaced water beneath the water surface.

1.9.4 Diffuser

The aeration system may be provided to meet the aeration requirement as per the process design requirement. Sufficient design calculations are to be provided along with manufacturer standard having supplied diffuser during last five years to various waste water treatment plants.

1.9.5 Fine bubble aeration system

The membrane diffuser shall be developed specifically for releases 1~3mm fine bubble in the wastewater treatment plant. All materials have been selected for their ability to withstand the effects of the chemical, bio-chemical agents and 0~50°C used in wastewater tank. The diffuser can be placed in an evenly distributed grid system over the entire aeration tank bottom.

Diffuser grid shall be of fixed or retrievable type. Diffuser shall be Tubular/Disc type with membrane made of Polyurathene/silicon elastomer. It shall have PVC diffusers holder with retainer rings. Maximum air throughput from diffusers shall be restricted to 90 Nm³/hr/m² of membrane area. For all types of grid, supports, frames, anchors and all other steel components shall be in SS 304. The aeration system shall include air distribution purge system.

1.10 Gravity sludge thickener

Gravity sludge thickener shall be circular (radial), fixed bridge, central turn table type or central drive. Concessionaire may also provide alternatively the mechanical sludge thickener. The sludge thickener mechanism shall be suitable for installation in a circular RCC tank and shall include the following:

- Mechanism support beam spanning the diameter of the tank.
- Walkway and handrail from the edge to the centre of the tank.

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- Drive mechanism with internal gear type.
- Reduction gear box.
- Chain and sprocket with guard.
- Central shaft with scrapper arm and picket fence.
- Skimmer scum baffle and scum trough.
- Overflow weir:
- Vertical pickets.
- Torque indicating device.
- Overload alarm protection.
- Auto lifting device.

The minimum thickness of all the underwater parts shall be minimum 6mm thick excluding allowance for corrosion.

Material of Construction

Tank	:	Reinforced Cement Concrete
Feed Well	:	SS 304
Bridge	:	MS with hot dip galvanized (galvanizing minimum thickness shall be 80 micron)
Center Cage	:	Mild Steel Galvanised
V-notch weir	:	SS 304 or, minimum 6 mm thick and
Squeegees	:	Neoprene
Handrail	:	40 NB MS Pipe with Hot Dip Galvanised (radial upto centre)
Anchor Bolt & fasteners:		Stainless Steel -316
Walk way	:	MS with Hot dip Galvanized (galvanizing minimum thickness shall be 80 micron)10mm

1.11 Anaerobic digesters

Digester shall be anaerobic, mesophilic, single stage and single phase type having fixed steel cover. Bottom of the digester shall be conical.

1.12 Mixing and gas handling units

Mixing of digester contents shall be achieved either mechanical or recirculated gas methods. If gas mixing is provided working and standby compressors shall be provided for each digester.

1.13 Gas holder

The gas holder shall have a holding capacity as per CPHEEO. The gas storage shall maintain a maximum gas pressure of 250 mm WC/wg. All gas holders shall be provided with the gas safety equipment (dual pressure relief/vacuum devices) as specified herein for protection of the storage unit.

1.14 Sludge dewatering units

Sludge dewatering shall be done by mechanical sludge dewatering units such as Solid Bowl Centrifuge, Belt Filter Press. The material of construction shall be SS 316 L. The dewatering units shall include but not limited to the following equipments:

Powder or liquid polymer storage tanks/ batch tanks with mixers, polymer metering pumps, mixers and solution tanks, supply line & flush line, plant water supply pumps, sludge feeding pumps, dewatering unit, cake hopper, control valves on sludge feeding line, and on chemical feeding line, drain system.

The dewatering system should be so located that the dewatered sludge can be loaded into trolleys/ drums/ bins directly – preferably the dewatering unit shall be so located that the dewatered sludge falls into the containers/ bins without requirement of another material handling unit.

The dewatered sludge should be truck-able & be suitable for disposal by open body truck and should have a minimum solid concentration of 20% or more (measured as dry solids w/w basis).

The dewatering unit should have a 95% solid recovery. Dewatering units shall be provided in a separate sludge dewatering building. Feed pump station shall be provided at lower level/floor and dewatering units shall be provided at upper level/ floor.

1.14.1 Bio gas scrubbing system

The system shall include major equipment like Pre-Scrubber, Scrubber, wash tower, regenerator, filter press and pumps. The system should be with zero liquid discharge and no gases/ effluent emission in the process of scrubbing.

1.14.2 Gas generating set & accessories

The gas generators, if proposed and installed by the Concessionaire, shall be designed to operate at maximum gas generation to give the optimum power output.

The CH₄ (Methane) content in gas shall be in the range of 60% to 65%. The gas will also have concentration of H₂S @ 1.5% to 2.0%. This H₂S which is highly corrosive in nature has to be removed from the sewage gas before feeding the gas to the gas gen-sets. This H₂S has to be removed from this sewage gas by using chemical gas cleaning scrubbers.

The generator sets have to be designed to run on base load operation continuously during the peak gas generation; The H₂S content in the sewage gas generated shall be removed by a H₂S scrubbing system. The scrubber shall be capable to reduce the concentration below 200 ppm level.

Gas engines shall be designed for running on 100% sewage gas with a high level of fuel efficiency with lean burn combustion technology. There shall be provision of gas engine for power generation from the gas produced by proposed plant. Capacity of all gas engines shall be same & the gas gen-sets shall not be overloaded more than 100% since gas gen-sets are meant for base load operation and cannot be overloaded.

Gas engine shall be hooked to the main LT panel. Gas engines shall be running on continuous operation. It will be preferred that the gas gen-sets along with the H₂S scrubber shall be provided as a package.

The electrical efficiency of the gen-sets at the alternator terminal under site conditions and 100 % load shall not be less than 40 % (Standard tolerances shall be applicable). The engine shall be 4 stroke Otto gas V engine type.

1.14.3 Main components of gas engine

Gen-set components

Base frame, coupling, pre – lube pump, air filter, zero pressure gas control line with connection accessories, crankcase, driving gear, cylinder head, valve drive, ignition, carburetion, mixture charging, starter, lube oil system, sensor technology/actuator technology and cabling etc.

Rotary current internal pole synchronous generator

Three-phase synchronous generator, brushless, self-induced, self-adjusting, with dampening cage for 30% inclined load and parallel operation, artificial star point, protection type IP 23, with tropical atmosphere and humidity protection insulation, degree of radio shielding "N", voltage target value setting $\pm 5\%$, Insulation Class H.

Gen-Set Components

Base Frame	Steel bend torsion-resistant construction
Coupling	High stretch, axial plug in coupling for torsional elastic connection of engine and generators
Pre – Lube Pump	Electric pump
Air Filter	Paper dry type air filter
	Zero Pressure Gas Control Line with Connection Accessories
Crankcase	Alloyed special cast iron
Driving gear	Chrome molybdenum
Cylinder head	Special cast Iron
Value drive	Toothed-wheel driven cam shaft
Ignition	Microprocessor control high voltage ignition system
Carburetion	Drive type air filter
Lube oil system	Pressure lubrication gear pump

Alternator

Brushless, self-excited, self-regulated, double bearing, synchronous alternator with electronic AVR, 415 V, 1 Power Factor, 50 Hz, complete with standard accessories.

Flare system

- A Comprehensive auto flare philosophy shall be adopted along with the GAS engine power generation philosophy to complete the interlock of flaring with no power generation. Gas flow on the gas flare line shall have interlock with the flame detector to conclude the effective flaring.
- The flare unit shall be designed for biogas flow generated during average flow

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conditions. It shall be fabricated of suitable materials (carbon steel except for top portion which shall be in SS 304). The design of flare unit will be such that it shall be conveniently mounted on the steel supporting structure.

- The velocity of biogas through the flare unit should be minimal considering 100-150 mm WC pressure of biogas at flare inlet. Capacity of Gas flare system shall be provided for total gas generated from proposed plant. Gas flare system shall be one working and one standby unit along with all accessories.
- A suitable spark ignition system should be provided at a convenient location. Biogas shall be used as a pilot fuel. The pilot flame generated with the help of spark ignition systems shall propagate through the flare unit to ignite main biogas. The control system involving control panel, ignition transformer etc. shall be provided for the said purpose.
- H.T. cable shall be provided from the secondary terminal of ignition transformer up to spark ignition system. Necessary ignition electrode OR 1 number 25 KVA generator set shall be provided. The 25 KVA generator set can also be used to start the gas engine.

Moisture trap

The moisture trap shall be designed to effectively separate out moisture in the biogas such that moisture free biogas is made available at the outlet of a trap. It shall be of suitable materials of construction and be provided with suitable drain connection.

Flame trap

- The flame trap shall be of suitable size for biogas application. It shall be used primarily in pipe lines to prevent flash back during explosions.
- This device shall be installed in horizontal or vertical pipe line and hence it should be bidirectional.
- The flame arresting element shall be designed such that it results in minimal pressure loss under normal operating condition but to ensure maximum security in the event of explosion, the end connection shall be flanged.

1.15 Pumps

1.15.1 Sump Pump

- The pumps shall run smooth without undue noise and vibration.
- The power rating of the pump motor shall not be less than the maximum power required from zero discharge to zero head.
- Pump should be vertical, centrifugal, single stage, non-clog type.
- It should be suitable for handling sewage containing stringy materials.
- Plate type strainer should be provided to prevent large size solids entering into pump
- The pump shaft journal bearings shall preferably be grease lubricated. No external water will be made available for the lubrication of the bearings.
- Delivery piping with gun metal non-return valve should be supplied.
- Delivery pipe should be as per IS: 1239, medium class.

- Pump should be operated automatically by providing float operated level switch .
- The base plate shall not be directly fixed to the floor. Channels should be grouted in the floor and the base plate should be attached to the channel.
- Materials of Construction
 - a. Impeller : Stainless Steel
 - b. Casing : Cast Iron
 - c. Shaft : Stainless Steel C F 8 M
 - d. Cover plate : Steel

1.15.2 Submersible pumps

Design requirements

- a. Submersible pumps shall be submersible, vertical shaped, centrifugal, non-clog type, suitable for municipal sewage, design for continuous operation in submerged / partially submerged condition and intermittent operation complete with motor control system, guide rail, anchoring brackets, base elbow, power cable & pumping lifting cable/ SS chain with control panel and level switches suitable for solid passage of 100mm diameter and above.
- b. The efficiency of the pump shall be high at duty point and remain reasonably high during the full duty range at the pumping system.
- c. The pump shall be compatible with VFD and selected automation system.
- d. The pump should be capable of developing the required total head at rated capacity. Pumps should be suitable for single as well as parallel operation at any point.
- e. The pump should deliver at least 125% of its rated capacity at 75% of the specified total head. The H and Q curve should be continuously rising towards shut off head.
- f. Operating range – system curve
- g. The velocity of vibration should be less than 4.5mm/ sec. with noise level 85 dBA at resistance of 1.85 meter.
- h. The power rating of the pump motor should be the larger of the following:
 - i) The maximum power required by the pump from zero discharge to zero head.
 - ii) 115% of the power required at the duty point. Considering the combined efficiency (motor & pump).
 - iii) System resistance curve shall be applicable within 5% of the duty point.
- i. The combined efficiency of the pump shall not be less than 70%. The motor efficiency shall not be less than 92 % and pump efficiency shall not be less than 65-75%. The highest efficient pump set shall be considered for selection.
- j. Submission of pump data sheet shall be tagged as variable frequency drive/normal operation.
- k. The primary sludge pumps, dilution water pumps, treated effluent pumps, back wash pumps, filter feed pump should have the efficiency of 60% and motor 87%. Only energy efficient motor shall be accepted.

1. Material of Construction

Pumps

Pump casing	:	Ductile iron
Discharge cover	:	Ductile iron
Impeller	:	stainless steel SS316
Shaft	:	stainless steel SS316
Bearing Bracket	:	Grey cast iron (CI IS: 210FG260/ Ductile iron)
Motor casing	:	Grey cast iron (CI IS: 210FG260/ Ductile iron)
Bolts, nuts	:	stainless steel SS316
Shaft protective sleeve	:	stainless steel SS316
Casing wear ring	:	Grey cast iron (CI IS: 210FG260/ Ductile iron)
O-ring	:	Nitrile rubber (NBR)
Efficiency	:	Min. 75%

Shaft seal

Type of seal	:	Double mechanical seal
Arrangement	:	Tandem
Seal on medium side	:	With elastomer bellows
Mechanical seal, pump side	:	Silicon carbide
Mechanical seal, bearing side	:	Carbon/ silicon carbide

Monitoring

Thermal winding protection	:	Thermistors PT-100 in all three phase winding
Explosion proof protection	:	
Motor housing monitoring	:	By conductive moisture sensor electrode
Mechanical seal leakage detection:	:	By float switch
Bearing temp monitoring	:	Thermistors PT 100 in upper bearing

Installation

Type of installation	:	wet well installation design for automatic connection to a permanently installed discharge elbow will neoprene seal to avoid metal to metal contact
Flange dimension to	:	EN 1092-2, PN 10
Claw	:	Bolted to the pump
Installation depth	:	As per data provided
Guide system	:	Stainless Steel
Lifting device	:	Stainless steel lifting chain
Length of lifting device	:	Suitable
Lifting loops	:	suitable
Installation accessories : complete	:	Discharge elbow, fasteners, claw, bracket, lifting chain, guide bars etc.

Motor

Min. motor efficiency	:	92% and pump efficiency 65-75%
Degree of protection	:	IP 68
Insulation class	:	F0
Coolant temp	:	≤ 40 C

Starting mode	:	Direct
Rated voltage	:	3ph, 415 V
Rated freq	:	50 Hz
Nominal speed	:	Less than 1500- rpm (Synchronise)
Voltage tolerance	:	±10%
Motor casing	:	Grey cast iron
Main cable	:	complete with cable length as per requirement

1.15.3 Mixed Liquor Pumps

Type of Pump	Vertical Propeller Tube Type
Column Length & Column & Shaft Assembly	Required
Type of fabrication	Self-Water
RPM	590
Pump Efficiency	Min. 80%
Motor Efficiency	Min. 92%
Pump housing	Ductile cast iron
Impeller	EN-GJS500-7, AISI 80-55-06
Pump Shaft	Stainless Steel
Discharge Head	MS Fabricated
Motor	Cast iron, EN-JL1040, AISI A48 30
Voltage	415 ±10% 3 Phase
Frequency	50HZ

Note:

1. The Pumps will have VFD.
2. The primary and secondary scum pumps shall be submersible chopper pumps.

1.15.4 Horizontal centrifugal pumps

Design requirements:

- a. The pump should be capable of developing the required total head at rated capacity. Pumps should be suitable for single as well as parallel efficient operation at any point in between the minimum and maximum system resistance indicated in the system resistance curves.
- b. The total head capacity curve should be continuously rising towards the shut off. The pump should deliver at least 125% of its rated capacity at 75% of the specified total head.
- c. The required NPSH at duty point should be at least 1.0 M less than the available NPSH.




- d. Pumps shall run smooth without undue noise and vibration. The velocity of vibration should be within 4.5 mm/sec. The noise level should be limited to 85 dBA at a distance of 1.85 M.
- e. Operating range - system curve shall be submitted along with that of motor if the pump/s are subjected to VFD application with the data sheet tagged as VFD application
- f. The power rating of the pump motor should be the larger of the following:
 - i) The maximum power required by the pump from zero discharge to zero head.
 - ii) 115% of the power required at the duty point. Considering the combined efficiency of pump and motor with zero negative tolerance.
- g. The pump set should be suitable for starting with discharge valve open, as well as closed.

Features of construction

- a. Pump should be suitable for applications in municipal sewage handling or sludge handling as per process requirement, with back pull out design. It shall have end suction and side discharge. It should be of self-venting type.
- b. Pumps should be identical for particular application and suitable for parallel operation with equal load division. Components of identical pumps should be interchangeable.
- c. Pump casing should be of robust construction. Liquid passages should be finished smooth and designed so as to allow free passage of solids. The volute tongue should be straight across and filed to a smooth rounded edge. Casing should be provided with hardened renewable wearing ring.
- d. Impeller should be suitable for application, enclosed type with smooth blunt edges and large water ways so as to allow free passage of large size solids. It should be free from sharp corners and projections likely to catch and hold rags and stringy materials. Impellers should be provided with hardened wearing ring. Hardness of the Impeller ring should be at least 50 BHN more than that of casing ring.
- e. The first critical speed of the rotor should be 30% above the operating speed. Complete rotor should be statically and dynamically balanced.
- f. Replaceable shaft sleeves should be provided to protect the shaft where it passes through stuffing boxes. Surface hardness of shaft sleeve should be minimum 350 BHN.
- g. Pumps should be provided with anti-friction bearings. Bearings should be easily accessible for inspection and maintenance. Bearings should be grease lubricated.
- h. Stuffing box should be of such design that they can be repacked without removing any part other than gland and lantern ring. Stuffing box drain with pipe connection should be provided at the lowest point so that no leakage accumulates in it.
- i. Lantern ring should be of axially split type. Grease should be used for stuffing box sealing. Water will not be available for this purpose. Gland should be of split type.
- j. Pump should be furnished complete with flexible coupling.
- k. Coupling guard bolted to the base plate should be furnished.
- l. Base plate for pump and motor should be common. Suitable holes should be provided for grouting. Foundation bolts should be complete with nuts and washers.

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- m. Tapping should be provided at suction and discharge nozzles for pressure gauge connection.
- n. Hand holes should be provided in the casing to allow easy access to the impeller as well as to the casing throat. Casing drain connection with stainless steel collared plug should be provided.

Material of Construction

- a. Casing : CI to IS:210 GR FG 260 with 1.5 to 2% Nickel.
- b. Impeller : Stainless steel CF 8M STA STM A35/Gr.CF8M
- c. Wearing rings : SS 316 STA STM A35/Gr.CF8M
- d. Shaft : SS to AISI 431 STA STM A276 Type 410
- e. Shaft sleeves : SS to AISI 410 STA STM A276 Type 410
- f. Packing : Asbestos yarn coated with MoS2 (Molybdenum Di-Sulphide)
- g. Packing : CI/MS fabricated.CI IS210 Gr F G260
- h. Base plate : CI/MS fabricated IS 2062
- i. Gland : Cast Iron CI IS 210 Gr F G260
- j. Coupling : CI

1.15.5 Dewatering pump

- a. Pump should be suitable for handling settled sewage containing grit and suspended particles.
- b. The pump motor should be suitable for working with or without submergence in sewage. The motor rating should be more than the maximum power required by the pump.
- c. The pump set should be portable with necessary hooks.
- d. The pump should be suitable for dewatering from a pit 900mm x 900mm x 100mm deep.
- e. The pump should be vertical, centrifugal, non-clog type.
- f. The pump impeller should be mounted on the extended shaft of the motor.
- g. The pump should be provided with mechanical seal.
- h. The pump should be supplied with flexible hose pipe of 50mm, 50M length.
- i. Suitable cable of 50 M length should be supplied with the pump.
- j. Materials of Construction :
 - a) Impeller : Stainless Steel
 - b) Casing : Cast Iron
 - c) Shaft : EN8 (as per IS: 970)

1.15.6 Progressive cavity pumps

The progressive cavity pumps shall be self-priming and designed to handle abrasive, shear sensitive and viscous materials, solids in suspension and liquid/solids mixtures.

Automatic Variable stroke frequency / stroke length arrangement shall be incorporated wherever remote application with PLC/SCADA is envisaged and process demands these changes through remote, Local Control Panel shall also be envisaged with each pump with auto/manual selector switch and knob for these variations done manually.

The sludge will be a mixture of grit in the sludge that will be abrasive. The pump design shall incorporate features that prevents ragging around pump connecting rod and rotor head and include a shaft sleeve to protect the wear in these highly abrasive environments. These conditions

must be considered when selecting the pump. Pump should be screw type, slow speed maximum 200 rpm having following construction features:

Casing	:	CI IS 210-FG 260
Rotor	:	SS316 Hard Chromed plated
Base Frame	:	ISMC Fabricated Epoxy coated
Bearing Housing	:	CI IS 210-FG 260
Shaft	:	SS 316
Foundation bolt	:	HTS GALVANIZED STEEL
Stator	:	Hypalon/Equivalent lining
Coupling	:	Flexible pin bush type
Coupling guard	:	MS Fabricated

The pumps must be sourced from a supplier that is ISO 9001:2000 certified to ensure that the pump is manufactured to certified standards.

1.15.7 Polyelectrolyte solution preparation and dosing system

Polyelectrolyte solution is needed to be prepared and dosed for aiding sludge thickening and dewatering. The polyelectrolyte will be dosed online at the centrifuge inlet. Minimum dosage of polyelectrolyte shall be worked out by the Concessionaire. There shall be two poly-dosing tanks each suitable for minimum 8 hrs. of operation. Each-tank shall be equipped with slow speed mixer (100 RPM) to prepare polyelectrolyte solution. The solution will be fed using positive displacement metering type dosing pumps. There shall be dedicated dosing pumps to each centrifuge with one common standby. The pumps shall be interlocked with centrifuge so that it can only be running in auto when centrifuge is on and should shut down when centrifuge stops. The dosing system shall be housed in centrifuge house itself.

The polymer dosing required shall be as per design requirement. Polymer dosing pumps hydraulically actuated diaphragm pumps simplex and duplex type with maximum injection pressure of 5 kg/cm² complete with PP head, PP / PVC fittings, strainer, inbuilt PRV along with 415 V / 50 C / S suitable motor at 1000 RPM are required. The system will also have storage bins, polymer batch tank and polymer batch tank mixers.

1.15.8 Dosing pumps

The dosing pumps shall be selected to achieve optimum dosing technology and control safety with safety relieve valve. The pump shall have a resistant plastic enclosure that can safely be used for the selected application and shall provide soft and low-pulsation dosing.

The pump shall incorporate sensitive sensors that monitor the dosing flow and the diaphragm and provide process stability. The pumps shall be designed to have separation of hydraulics and electronics, to protected process from equipment failure.

Diaphragm Valve, Gasket	:	PTTE
Liquid End	:	Stainless Steen 316
Foundation Bolt	:	Mild Sleet Epoxy Paint

Wetted Part	:	SS 316
Base Frame	:	Carbon Steel, epoxy Painted.
Flanges	:	Carbon steel
Plunger	:	Carbon Steel
Accuracy	:	±3%
Voltage	:	415 ±10%
RPM	:	1440

1.15.9 Polyelectrolyte Dosing

Head	PP
Check Valves	PVC
Balls	Glass
Diaphragm	Teflon Faced Nitrile
Motor Details	Explosion Proof Motor

1.15.10 Sludge sump pump house and sludge dewatering

Sludge sumps shall be provided to collect sludge from PST & FST. The pump house shall be constructed above the sludge sump. Sludge transfer pumps shall be provided to feed the mechanical dewatering devices. The pump shall be screw type suitable to handle sludge of 1 – 2% solid consistency.

1.16 Pipework

1.16.1 Cast iron pipes

- The cast iron pipes shall generally conform to IS:1537/IS:1536 and pipe fittings shall conform to IS: 1538. All pipes and fittings above the ground level and inside pumping station shall be flanged.
- The material for cast iron pipes and fittings shall be of grey cast iron conforming to IS: 210, Gr FG 200.

1.16.2 Ductile iron pipes

The DI pipes conform to IS 8329 /ISO 2531/BS EN 545 & fitting conform to IS 9523/BS EN:545. These pipes can also be offered with standard thickness for smooth flow and corrosion resistance.

1.16.3 Steel pipes

All steel pipes shall conform to IS:3589.ERW steel pipes (200mm to 2000mm) for gas, water and sewage and laying should conform to IS:5822.

1.16.4 Unplasticised Polyvinyl Chloride (uPVC) pipes

The materials used in the manufacture of uPVC pipes and fittings shall comply with the physical properties indicated in relevant specification. They shall not contain any matter which could impart taste, odour, toxicity or be harmful to health or adversely affect the water conveyed.

Unless specified otherwise joints shall be of the complying with BS 4346/IS4985 having an elastometric sealing ring. Joints shall be made in accordance with the Manufacturer's instructions. Fittings shall be injection-moulded in uPVC to the requirements of BS 4346/IS4985.

1.16.5 Sluice valves

Sluice valves shall be generally conforming to IS: 14846:2000. Additionally they should meet the specific requirement given below. The valves shall be double flanged machined and drilled to IS-1538 Part IV & VI.

General

1. Sluice valve shall be conforming to IS: 14846: 2000 and with ISI marking. Additionally they should meet the specific requirement given here under.
2. Sluice valve must be from ISO-9001 certified company towards Quality Management System.
3. The valves shall be double flanged machined and drilled to IS- 1538 Part 4 & 6. The back side of the drill holes to be spot faced for proper seating of bolts & nuts. Reasonable clearance behind the rear face of the flange on body and bonnet to be kept to provide free access to use spanners for assembling & dismantling. No tap hole is acceptable.

Material of Construction

- | | | |
|----|-----------------------|--------------------------------------|
| 1. | Body | : Cast Iron to IS: 210 Gr. FG200 |
| 2. | Wedge | : Cast Iron to IS: 210 Gr. FG200 |
| 3. | Spindle | : St. Steel to IS: 6603 04Cr18Ni10 |
| 4. | Seat Rings | : SS to CF8 |
| 5. | Spindle Nut | : High Tensile Brass to IS – 320 HT2 |
| 6. | Back Seat Bush | : SS to CF8 |
| 7. | Shoe & Channel Lining | : SS to CF8 |

Shop Testing Witnessing

- | | | |
|----|------------------------------------|------------------------|
| 1. | Seat Leakage Test (2 Minutes) | : 10Kg/cm ² |
| 2. | Body Leakage Test (5 Minutes) | : 15Kg/cm ² |
| 3. | Back Seat Leakage Test (2 Minutes) | : 10Kg/cm ² |

Check valve

1. Checking valve shall be conforming to IS: 5312. Additionally they should meet the specific requirement given below.
2. The valves shall be double flanged machined and drilled to IS- 1538 Part 4 & 6. The backside of the drill holes to be spot faced for proper seating of bolts & nuts. Reasonable clearance behind the rear face of the flange on body to be kept to provide free access to use spanners for assembling & dismantling. No tap hole is acceptable.

Material of Construction

- a. Body & Cover : Cast Iron IS: 210 Gr. FG 260
- b. Door : Cast Iron IS: 210 Gr. FG 200
- c. Hinge Pin : St. Steel to AISI – 316
- d. Seat Rings : Gunmetal with 2% Nickel / IS: 318 Gr. LT B2
- e. Bearing Bush : Teflon
- f. Fastener : carbon steel

Shop Testing Witnessing

- 1. Seat Leakage Test (2 Minutes) : 10Kg/cm2
- 2. Body Leakage Test (5 Minutes) : 15Kg/cm2

1.16.6 Kinetic air valve

General

- 1. Kinetic air valves shall be conforming to IS: 14845: 2000. Additionally they should meet the specific requirement given here under.
- 2. Kinetic air valves should be from ISO – 9001 certified company
- 3. The valves shall be flanged end machined and drilled to IS – 1538 Part 4 & 6

Material of Construction

- Body, Cover, Cowl : Grey Cast Iron. IS: 210 – 1993 Gr. – 260
- Ball of small orifice : Seasoned timber ball covered with soft Vulcanite
- Ball of large orifice : Seasoned timber ball covered with soft Vulcanite
- Seat of large orifice : Neoprene Rubber
- Nipple for small orifice : LTB. : IS 318 – 1980. LTB – 2./ AISI: 410
- Isolating Gate valve : IS: 14846 (GM internals & AISI: 410 Spindle)
- Bolt & Nut : M.S

Shop testing witnessing

- Seat & body leakage test (2 Minutes) : 10Kg/cm2

Painting & coating

Pre – inspection

- 1st Step Surface preparation
Blast cleaning to near white – SA 2 ½ Gr.
- 2nd step Application of primer coating after blast cleaning
One coat of two component epoxy based primer

Post – inspection, if applicable

- 3rd Step Application of finish coat
One coat of two component solvent free amine cured epoxy coating (shade)

1.16.7 Butterfly valves

Unless otherwise specified, valve body and disc shall be of close-grained gray cast iron. Valves shall be mounted with shafts horizontal or vertical based on manufacturers design. Valves shall be fitted with indicators to show the position of the disc, clearly marked with 'open' and 'closed' positions. Valves shall not contain any brasses containing more than 5% zinc. Gunmetal conforming to BS 1400 Grade LG2, aluminum bronze, or nickel components may be used for internal components. Resilient-seated valves shall have nitrile rubber seals.

For valves of 900mm and above, retaining rings shall be provided to enable the sealing ring to be replaced without the need to remove the valve body from the pipe work. Metal seated valves of 900mm and above, shall have seat clearances adjustable to obtain as near a watertight condition as possible, without the need to remove the valve body from the pipe work.

Percentage Opening - Flow Curve shall be submitted along with data sheet mentioning area where such valves are subjected for any controlling of the fluid flow.

Component Material

1	Body Cast Iron	:	IS:210 Gr FG260
2	Inner lining Stainless steel	:	BS:970 Gr 304
3	Plate /DLSC Stainless steel	:	IS 3444 1987
4	Stem Stainless steel	:	IS 6603:1972
5	Seat ring / Boss Stainless steel	:	IS 6603:1972
6	Gland housing Cast Iron	:	IS:210 Gr FG260
7	Gland packing Teflon Impregnated with asbestos+Rubber		

1.16.8 Pressure-Relief Valves (PRV)

Pressure-relief valves shall be designed to prevent the pressure in the pipeline upstream of the valve rising above a preset level. The valve shall remain closed at lower pressures. The pressure at which the valve opens shall be adjustable. A pressure gauge shall be provided to indicate upstream pressure over the operating range of the valve. Safety valves shall comply with BS 6759: Part 1.

They shall be designed to open at the specified pressure and re-close and prevent further release of fluid after normal pressure has been restored. The pressure / temperature rating shall be in accordance with relevant standards. Flanged ends shall be Class 900, raised-face type complying with ANSI B16.25 or relevant standards.

Component material

1	Body Cast Iron	:	IS:210 Gr FG260
2	Inner lining Stainless steel	:	BS:970 Gr 304
3	Knife gate/ plate Stainless steel	:	BS:970 Gr 304
4	Stem Stainless steel	:	BS:970 Gr 304
5	Seat ring / Boss Stainless steel	:	BS:970 Gr 304
6	Gland housing Cast Iron	:	IS:210 Gr FG260
7	Gland packing Teflon Impregnated with asbestos+Rubber		

1.16.9 Ball valves

Ball valves shall conform where applicable to relevant standards. Multi-piece bodies shall be used where work on the ball and seats when installed may be needed. If valves need removal for servicing, one-piece bodies may be used. Seat materials shall be chosen for long life, with erosion and corrosion resistance. Ball supports shall be of the floating ball or trunnion type. If line pressure is too low to ensure a positive leak-free seal, built-in seat loading devices, or specially shaped seatings shall be used to ensure sealing.

Component material

1	Body Cast Iron	:	IS:210 Gr FG260
2	Inner lining Stainless steel	:	BS:970 Gr 304
3	Plate Stainless steel	:	BS:970 Gr 304
4	Stem Stainless steel	:	BS:970 Gr 304
5	Seat ring / Boss Stainless steel	:	BS:970 Gr 304
6	Gland housing Cast Iron	:	IS:210 Gr FG260
7	Gland packing Teflon Impregnated with asbestos+Rubber		

1.16.10 Knife gate valves

1. The valve shall meet standards C105/A21.5-10, C520-10, C706-10, C707-10, C713-10 and D106-10 and testing requirements of MSS SP 81.
2. Outer body may preferably be provided with inner liner in corrosion resistant stainless steel which shall extend into the gland. The body shall be devoid of any wedge/ dead pockets to avoid setting of suspended particles and solids in the service fluid.
3. The gate / plate shall be precision buffed and the edge contoured to a knife edge. The gate shall move along / be guided by the seat ring to ensure that it scrapes any deposit / scale enabling smooth uninterrupted movement.
4. Seat shall be so designed that there is no recess / relieve groove to harbour deposition that could build-up and swamp the valve. The design should also incorporate bosses that guide the gate and avoid deflection ensuring positive shut-off. The stem shall have double start threads cut in order to ensure smooth and speedy operation.
5. Gland packing shall offer minimal frictional resistance and precludes external lubrication. As positive sealing elements, the packing shall also include a resilient rubber ring. The knife edge and seat face in flow path shall be hard faced to a hardness of 400 to 450 BHN to counter erosion. In such cases, provision shall also be made to ensure the fluid contact with the seat ring is minimal.

Component Material

1	Body – Cast Iron	:	IS:210 Gr FG260
2	Knife gate/ plate – Stainless steel	:	BS:970 Gr 304
3	Stem – Stainless steel	:	BS:970 Gr 304
4	Seat ring / Boss – Stainless steel	:	BS:970 Gr 304

- 5 Gland housing – Cast Iron : IS:210 Gr FG260
- 6 Gland packing – Teflon Impregnated with asbestos + Rubber

1.16.11 CI flap valves (circular flap valves)

The flap valves with circular aperture, single door and double flanges, shall be provided. The flap valves upto 600mm dia shall have sealing faces in angular section and secured to the frame and door by a force fit. For sizes above 700 to 2000mm dia the sealing faces are of rectangular section and are secured to the frame and door using countersunk taper headed screws in the same material as the sealing face. The flap valve shall be suitable for mounting on a vertical wall or flange for static seating heads up to 6 meters.

Material of specification

Frame

Constructed in BS EN 1561 min. 250 cast iron designed for wall, thimble or pipe mounting applications.

Door

Constructed in BS EN 1561 min. 250 cast iron designed to withstand static seating heads up to 6 meters.

Sealing Faces

Copper alloy sealing faces to BS EN 1982 : 1999 are supplied as the standard material for ranges up to 600mm dia and for the ranges 700 to 2000mm dia phosphor bronze to BS EN 12167 : 1998. Sealing faces are set to 0.1mm feeler gauge non-acceptance to provide an effective seal.

Hinge Links

Manufactured in Spheroidal Graphite cast iron

Fasteners

Standard fasteners are supplied in stainless steel to BS EN 10088 : 1995 grade 1.4401 (316).

Hinge Pins

Manufactured from stainless steel to BS EN 10088 : 1995 grade 1.4401 (316).

1.17 Sluice gates

Sluice gate shall be preferably wall thimble type. The construction of sluice gates shall be in accordance specification and generally to IS:13349.

Material of Construction

The materials of construction of important components of gates will be as under:

- a. Frame & Shutter Cast Iron IS: 210 Gr. FG 200
- b. Wall Thimble Cast Iron IS: 210 Gr. FG 200
- c. Seating Faces & Counter Sunk Fixing Stainless Steel ASTM A276 type 316
- d. Wedging Device Cast Iron IS: 210 Gr. FG 200
- e. Wedge Linings Stainless Steel ASTM A276 type 316

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f. Stem & Stem Coupling	Stainless Steel ASTM A276 type 316
g. Stem Nut	Stainless Steel ASTM A743 CF8M or SS316
h. Flush Bottom Rubber Seal	EPDM ASTM D200
i. Seal retainer bar	Stainless Steel ASTM A276 type 316
j. Fasteners, Studs Anchor Bolt & Nuts	Stainless Steel ASTM A276 type 316
k. Lift Nut	Bronze IS: 318 Type LTB-2
l. Headstock, Stem Guide	Cast Iron IS: 210 Gr. FG 200
m. Hand wheel	Mild Steel IS: 2062
n. Painting	Ordinary Black Bituminous Paint

1.18 Standard painting requirements

- 1) The painting work shall conform to the following requirements:
 - The surface preparation shall be carried out generally in accordance with IS: 1477 Part I and IS: 6005.
 - After surface preparation, two coats of primer-red oxide zinc chromate with modified phenolic alkyd base conforming to IS: 2074 shall be applied. Dry film thickness of each coat shall be 25 microns.
 - For finish painting, after application of primer as in (b) above, two coats of synthetic enamel conforming to IS: 2932 shall be applied. Dry film thickness of each coat shall be 25 microns.
 - Colours shall be selected as per IS:5
- 2) The preparation, application and conditions for work shall comply with the recommendations of BS 5493 and BS 6150 or if the protection is of a special nature, in accordance with the manufacturer's directions.
- 3) Preparation for painting of Grit or Shot Blasted Parts: Grit or shot blasting shall be carried out in accordance with B.S. 7079
- 4) Chromium Plated Parts: Where chromium plating is specified or offered by the manufacturer it shall comply with the requirements of B.S. 1224.
- 5) Where hot-dip galvanizing is not practicable bolts and nuts shall be sherardised, which shall conform to BS: 4921.
- 6) Painting System Failure - The painting system shall be deemed to have failed if:-
 - After painting, damage has been caused by handling, impact, abrasion or welding;
 - Any portion of the paint film separates from any other or the parent metal;
 - After painting the total dry-film thickness is less than that specified.
 - Failure shall not include:-
 - Loss of gloss;
 - Variation of shade, not affecting the anti-corrosive properties of the system.

1.19 Electrical Overhead Traveling (EOT) crane

The capacities of various EOT's shall be decided as per recommendations of IS: 875.

The crane shall be of single / double girder type designed from lowest sump level and up to under size of the bridge.

Proper selection of reduction gears shall be done to run drive motors. Wherever required the

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motor enclosure shall afford protection to IP: 55 of IS: 4691 and have cooling facility to IC: 41 of IS: 6362. Each drive motor shall be fitted with an automatic electro-magnetic brake to stop the crane on interruption of the power supply, whether intentional or accidental power failure.

Suitable end stoppers/buffers shall be provided on the bridge girder and at each end of crane rails.

The crane and hoist shall conform to IS: 3177, IS: 3832 and IS: 3938, class 2, medium duty and meet specified operational requirements.

EOT Operations and faults shall be interfaced with respective LCP about their operations.

Lifting speed	Low	0.9 meter/minute
	High	3 meter/minute
L.T. speed	10 – 15 meter/minute	
C.T. speed	10 meter/minute (Max.)	

However illumination lights to be operated by separate switch which will not be mounted on pendant.

Other common specification:

Brakes	All brakes are electro-hydraulic thrusters/ECM brake
Operation	Through pendent push button
Gear box	Precise machine cut hardened material gear noiseless operation long life
Cable	All cables are insulated ISI Marked
Power supply	All 415:440 4 phase 50 Hz. AC supply
Control voltage	220/230 volts-50 Hz

The hoist shall comply Class II with the performance requirement IS 3177/80, IS: 3938/IS: 3832 Class 2.

The electric hoist shall be fitted with right and left handed spiral grooved cast iron drum with a rope hoist arrangement with spring loaded rope band and guards to ensure accurate rope guidance and location.

Hoist rope shall be extra flexible, improved plog plough steel rope with well lubricated hemp core and having 6 strands 37 wires per strand with an ultimate tensile strength of 160/180 kg/sq.mm. The braking load for the hoist rope shall be as per IS: 2266.

Electromagnetic brake shall be provided to hold suspended load instantly, securely and automatically in the event of the electric current being cut off whether intentionally, accidentally or due to power failure.

The lifting hooks shall be single 'C' type complying with the requirement of IS: 15560 made from grade C30/C20 carbon steel. The hook shall have a safety latch to prevent rope coming off the hook.

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1.20 Disinfection system

Chlorination if provided shall be as per IS: 10553(Part I) – 1983 and IS: 10553(Part 2) – 1983 and latest standards as applicable.

1.21 Emergency equipment (General)

1.21.1 Fire extinguishers

There should be provision of dry powder type CO₂ fire extinguishers (10 kg) for the pumping station and switchyards at the following locations:

- Outdoor switchyard
- Indoor electrical room
- Pump rooms (maintenance bay)
- Control room
- GAS handling area

Besides above, ionisation smoke, optical smoke & heat detectors shall be provided in control room with fire alarm panel having appropriate battery back-up. Fire alarm detectors shall be provided both below & above false ceiling, if any Fire alarm system and public address system shall be provided at the Varanasi STP.

All the smoke and heat sensors shall be wired up to nearest Joint Breaker (JB) and interfaced to respective PLC/DDC for alarm annunciations.

1.21.2 Spillage and leakage

Chemical preparing, dosing and transfer equipment shall be designed and arranged so that any leakage and spilling can be controlled and cannot enter ducts, channels, etc. and have a corrosive impact on pipes, cables or other equipment of the plant.

At all lubrication or greasing points grease trays or pans shall be provided to collect excessive lubricant or spillage onto the equipment or into Sewage.

1.22 Installation work

Equipment shall be installed in a neat, workman like manner so that it is level, plumb, square and properly aligned and oriented. Tolerance shall be as established in the manufactures drawing.

Manufacturer's drawings, instructions and recommendation shall be correctly followed in handling, setting, testing and commissioning of equipment.

1.23 Leveling and grouting of machinery

The pumps, motors and other equipment shall be properly and accurately leveled and aligned on the concrete plinth by means of tapered metal wedges and metal packing pieces before any grout is poured. After correct alignment and leveling the foundation bolts shall be nipped up to hold the machine firmly in position and it shall be the Concessionaire's responsibility to check that the position is maintained after the grout has been poured but before it sets. The grout, which will contain an approved expanding agent, will be mixed and poured by the Concessionaire.

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The horizontality of base plate top shall be within 0.05 mm/metre. The base plate top surface and pump motor box are to be blue matched to get a contact area of at least 80%.

After the grouting mixture has set hard the foundation bolts shall be pulled up hard and the alignment and level rechecked.

1.24 Name plates

Each main and auxiliary item to the pumping station shall have permanently attached to it, in a conspicuous position, a name plate and rating plate, each of weather-resistance and fire-resistance material. Upon these shall be engraved or stamped the manufacturer's name, type and serial number of equipment, details of the loading and duty at which designed to operate.

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Schedule 11 (Part D)
Electrical System General and Particular Specifications

1.1 Power supply information during Construction Period

The Concessionaire shall make appropriate arrangement for power supply provisions during Construction Period. All power and lighting circuits shall be constructed with due regard for personnel safety and shall comply with recognized codes of practice and local regulations. All circuits shall be fitted with earth leakage systems.

1.2 Power supply information during O&M Period

The proposed power supplies are as follows:

(i)	11 kV AC System	Voltage variation +10 to -10% Freq. Variation +5 to -5%	Three Phase, 50 Hz, effectively earthed AC System SC. Rating of 350 MVA
(ii)	415V AC System	Voltage variation +10 to -10% Freq. Variation +5 to -5%	Three Phase and neutral, 50 Hz, effectively earthed system, SC. rating of 20 MVA
(iii)	240V AC System	Voltage variation +10% to 10% Freq. Variation + 5% to - 5%	Single phase and neutral, 50 Hz, effectively earthed system
(iv)	110V DC Supply	Voltage variation +/- 15%	Unearthed two wire system

All equipment shall have rated withstand capacity based on above criteria.

1.3 Design criteria for electrical equipment/ system

a) Protections

The following protections are shall be provided for various switchboards, transformers, motors and other plant feeders.

- 1) 11 kV Switchboard
 - 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 switchboard - 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 shall 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.

b) Metering

The following metering shall be provided.

- 1) 11 kV Switchboard
Multifunction meter (for incomer) containing -
 - i) Ammeter
 - ii) Voltmeter
 - iii) kW meter
 - iv) Frequency meter
 - v) Power factor meter
 - vi) Kilowatthour meter
 - vii) kVAr meter
 - viii) kVA meter

For outgoing feeder

- i) 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 - Ammeter with ammeter selector switch. Multifunction meter shall be equipped with interfacing capability for RS-485 port.

c) Indicating lamps

The following indication shall 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 50⁰ C design ambient temperatures.

All power cables shall be sized based on continuous current capacity, permissible voltage drop and short circuit current rating. The voltage drop shall 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. shall also be considered for cable sizing.

The illumination levels proposed for various areas are as follows:

<u>Area</u>	<u>Illumination level (Lux)</u>
Pump House	300
Office/Conference Room	500
Switchboard Room	300
All other indoor areas	150
Outdoor plant area and Road	10 – 20

Component of luminaries shall be 'energy efficient low loss' type. LED type of luminaries shall be used for office/ all indoor areas except pump house area. LED luminaries shall be used for pump house area and other outdoor areas. Decorative fixtures/ receptacles shall be used for office areas and industrial type fixtures/ receptacles shall be used for remaining areas. Street/ area lighting shall be controlled by time switch/ photocell for automatic switching of luminaries. Emergency light shall be provided for safe evacuation of the people in case of fire or panic (blackout, total power failure, etc.) Emergency lighting shall be automatically switched ON when mains power supply fails.

The values of fault level for designing the electrical system shall be based on transformer capacity, its impedance and system fault level. Fault clearing time for sizing of earth conductor will be taken as one second.

The material of earthing conductor shall be hot dip Galvanized Steel. All connections between the earth conductors buried in earth/concrete and between earth conductor and earth leads shall be of welded type. While sizing the buried earth conductor, a corrosion allowance of at least 20% shall be taken. Plant earthing system shall be designed such that the overall earthing grid resistance is maximum one ohm.

Main earthing conductors outside and inside the building shall be planned in such a manner that various equipment is connected to earthing system by two connections in a reliable manner.

System description

The system description shall be as per the guideline provided as "Key Single Line Diagram" as part of Scope of Work.



Reference Standards

All equipment / systems 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.

1.4 Power Transformers

Transformers and its accessories shall comply with the following International Standards, including those referred to therein: IEC 60076, 60214, 60296 / IS 2026, IS 335 / BS 148, 171

The technical parameters of transformers shall be as below:

Description	Unit	Particulars
General		
Quantity required		2 nos
Installation (Indoor / Outdoor)		Outdoor
Ratings		
Rated power		
No load voltage Primary	kV	11
Secondary	kV	0.433
Number of phases		3
Rated frequency	Hz	50
Impedance voltage	%	As per IEC/BIS
Vector group		Dyn 11
Winding material		Electric Grade Copper
Type of cooling		ONAN
System Voltage		
Nominal system voltage Primary	kV	11
Secondary	kV	0.415
Highest system voltage - Primary	kV	12
- Secondary	kV	
Transformer Secondary Neutral Earthing		Effectively earthed
Insulation Withstand		
Rated lightning impulse withstand voltage	kV (peak)	75
- Secondary	kV (rms)	3.5
Temperature Rise		
Reference design ambient	°C	50
Temperature rise over design ambient temperature of 50 °C		

Description	Unit	Particulars
- Average winding temperature rise (by resistance measurement)	^o C	55
- Top oil temperature rise (by thermometer)	^o C	50
Tap Changing Gear		
Type of tap changer		Off Circuit tap Changer
Tapping range	%	± 10%
Tapping steps	%	2.5
Bushings		
Rated voltage – Primary	kV	12
– Secondary	kV	1.1
One minute power frequency withstand voltage (dry and wet) – Primary	kV (rms)	28
- Secondary (Line and Neutral)	kV (rms)	2.5
Rated lightning impulse withstand voltage	kV (peak)	75
Nominal creepage distance	mm/kV	31
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

Design features

Transformers will be located outdoor and shall also be rated for satisfactory operation at 50^oC design ambient temperature.

Accessories and fittings

Each main power transformer shall have the following fittings and accessories including but not limited to:

- a) A conservator of sufficient volume with
 - i. oil level gauge with potential free contacts for initiating alarm for low oil level
 - ii. weather-proof dehydrating breathers for both compartments with activated alumina or silica gel as the dehydrating breather
 - iii. shut off valves
 - iv. filling plug and drain valves

The conservator shall be designed to maintain an oil seal upto a temperature of 100^o C.
- b) Gas and oil actuated Buchholz relay with
 - i. necessary shut off valves
 - ii. test cock with pipe connections for sampling

- iii. potential free contacts for initiation of alarm in case of slow gas formation and trip in case of fast oil and gas surges
- c) Dial type thermometer with
 - i. maximum temperature indicator and its resetting device
 - ii. potential free contacts for initiating alarm on high temperature and trip on very high temperature
- d) Winding temperature indicator with
 - i. necessary sensing, compensating and calibrating devices
 - ii. potential free contacts for initiating alarm on high temperature and trip on very high temperature
 - iii. WTI transmitter for remote indication on remote tap changing panel
- f) Detachable type of radiators including but not limited to:
 - i. Shut-off valves and blanking plates on transformer tank at each point of connection of inlet and outlet header
 - ii. Top and bottom shut-off valves and blanking plate on each radiator
 - iii. Lifting lugs
 - iv. Top oil filling plug, 19 mm size
 - v. Air release plug at top
 - vi. Oil drain plug at bottom, 19 mm size
 - vii. Earthing terminals
- g) Pressure relief device for transformer tank
- h) Weather - proof marshaling box mounted on transformer tank
- i) Name plate, rating plate and Diagram plate
- j) Valves and plugs as below:
 - i. Drain valve
 - ii. Filter valve
 - iii. Oil sampling valves at top and bottom
 - iv. Valves between radiators and tank (in case of detachable radiators)
 - v. Air release plug
 - vi. Twin outlets (with plug) for applying vacuum with attachments.
- k) Earthing pads of copper or non-corrodible material for transformer tank (2 places) and radiator banks
- l) Inspection manholes as required
- m) Lifting arrangement for
 - i. fully assembled transformer
 - ii. core and coil
 - iii. tank
- n) Hauling eyes on each face of the transformer
- o) Bi-directional flanged wheels
- p) Anti-earthquake clamping devices
- q) Jacking pads

Each auxiliary transformer shall have the following fittings and accessories including, but not limited to:

- a) Conservator with oil level gauge
- b) Dehydrating silica gel breather

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- c) Oil temperature indicator
- d) Thermometer pocket
- e) Explosion vent diaphragm / pressure relief valve
- f) Sampling and drainage valves
- g) A plug or blank flange at the top for connecting valve for filtration
- h) Two earthing terminals
- i) Rating plate (Name plate and diagram plate)
- j) Lifting lugs
- k) Removable plain rollers
- l) Adequate number of air vents for relieving trapped air during oil filling and during maintenance.
- m) Accessories for clamping the wheel to the foundation channel in order to withstand earthquake forces.

1.5 Windings

The windings shall be of electrical grade copper.

Materials used in insulation and assembly shall be insoluble, non-catalytic and chemically inactive in the hot transformer oil and shall not soften or otherwise be affected under operating conditions. Windings and insulation shall be so arranged that free circulation of oil is possible between coils, between windings, and between winding and core.

Leads from winding to the terminal board and bushings shall be rigidly supported to prevent injury from vibration. Guide tubes shall be used where practicable.

Windings shall be subjected to shrinking and seasoning processes so that no further shrinkage occurs during service. Adjustable devices shall be provided to take up possible shrinkage in service. High voltage end - windings shall be suitably braced to withstand short circuit stresses.

1.6 Core

The magnetic circuit shall be constructed from high grade, cold rolled, non-ageing, grain oriented silicon steel laminations. Each sheet shall have an insulating coating resistant to the action of hot oil. Each lamination shall be coated with insulation which is unaffected by the temperature attained by the transformer during service.

The insulation structure for the core to bolts and core to clamp plates shall be such as to withstand appropriate dielectric test. All steel sections used for supporting the core shall be thoroughly shot or sand blasted after cutting, drilling and welding. Core laminations shall be annealed and burrs removed after cutting. Cut edges shall be insulated. The framework and clamping arrangements of core and coil shall be securely earthed inside the tank by a copper strap connected to the tank. The core clamping structure shall be designed to minimize eddy current loss. The core shall be provided with lugs suitable for lifting the complete core and coil assembly. The framework and clamping arrangements shall be securely earthed.

The core and coil assembly shall be dried out and impregnated under vacuum.

1.7 Tank

The transformer tank shall be made from high-grade sheet steel, suitably reinforced by stiffeners made of structural steel sections. All seams, flanges, lifting lugs, braces, and other parts attached

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to the tank shall be welded. The interior of the tank shall be cleaned by shot blasting and painted with two coats of heat resistant, oil insoluble paint. Adequately sized manholes shall be provided for ease of inspection and maintenance. Steel bolts and nuts exposed to atmosphere, shall be galvanized.

Tank together with radiators, conservator, bushings and other fittings shall be designed to withstand without permanent distortion the following conditions:

- a) Full vacuum of 760 mm of Hg for filling with oil under vacuum
- b) Internal gas pressure of 0.35 kg/cm² with oil at operating level

Tank shall be provided with a pressure release device, which shall operate at a pressure below the test pressure for the tank and radiators. The device shall be provided with a device visible from ground to indicate operation. An equalizer pipe connecting the pressure relief device to the conservator shall be supplied. The device shall be provided with potential free contacts for alarm and tripping. Alternatively, a separate pressure relay shall be provided for this purpose.

The tank cover shall be bolted type and not welded, sealed type. The tank cover shall be removable and shall be suitably sloped so that it does not retain rainwater.

1.8 Radiators

Radiators shall be designed to withstand the vacuum pressure conditions specified for the tank. They shall be so designed as to completely drain oil into the soak pit and to prevent formation of gas pockets when the tank is being filled.

Transformers of rating above 1500 kVA shall be equipped with detachable or separately mounted radiator banks. Radiators for the main transformers shall be with bolted and gasket flange connections. Transformers of rating 1500 kVA and below shall be provided with fixed type radiators. Fins of the radiators shall not have sharp edges and shall be rounded in shape.

When transformers are provided with separately mounted radiators, flexible joints shall be provided on the main oil pipes connecting the transformer tank to the radiator banks, to reduce vibration and facilitate erection and dismantling. The interconnecting pipes shall be provided with drain plug and air release vents.

Off-circuit tap changer

Off circuit tap changer shall be provided for auxiliary transformers. It shall comprise

- a) Operating handle or wheel accessible from ground level
- b) Tap position indicator
- c) Padlocking arrangement with padlock.

1.9 Marshalling box

The marshalling box shall be tank mounted, weather proof, vermin proof, dust proof, sheet steel (2 mm thick), enclosed and with hinged door having padlock. Door and gland plate shall be fitted with neoprene gaskets. Bottom shall be at least 600 mm from grade level. Top surface shall be sloped. The degree of protection shall be IP65.

Contacts / terminals of electrical devices / relays, etc. mounted on the transformer shall be wired to the marshalling box. Interconnecting wires between the marshalling box and the accessories / devices shall be either PVC insulated wires in GI conduits or PVC insulated, armoured cables together with provision of double compression type, brass cable glands at the marshalling box. The above mentioned cables as well as terminating the cables shall be the Concessionaire's responsibility.

All contacts for alarm, trip and indication circuits shall each be electrically free, designed for the auxiliary DC supply of 110 V and brought out to separate terminals in the marshalling box. Terminals shall be rated for 10 A. Disconnecting / shorting type terminal block shall be used for CT circuits.

In case of main transformers, provision for remote annunciation shall be provided with two changeover contacts for alarm condition and two changeover contacts for trip condition for each of the following conditions including but not limited to:

- a) Buchholz alarm
- b) Buchholz Trip
- c) Oil Temperature high
- d) Oil Temperature very high
- e) Oil level low
- f) Pressure relief device operated
- g) Winding temperature high
- h) Winding temperature very high
- i) Conservator oil level low

1.10 Cable terminations

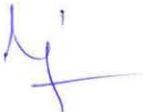
Cable boxes shall have sufficient space for segregating the cable cores and for adequate clearance in air between bare conductors at the terminals. Cable boxes shall be complete with necessary glands, lugs and armour grips.

Air filled cable boxes shall be of adequate dimensions and designed in such a manner that they can be opened for inspection without disturbing the gland plate or incoming cable. Disconnecting chamber shall be provided for disconnecting and moving away the main transformer, without removing the cables or the cable box. Provision shall be made for earthing the body of each cable box.

1.11 Tests

All tests required by the specification including repeated tests and inspection that may be necessary owing to the failure to meet any tests specified, shall be carried out at the Concessionaire's expense.

The following tests shall be carried out on the assembled transformer during inspection at the manufacturer's works.



- a) Temperature rise test on one transformer
- b) Measurement of resistance of windings at principal and extreme taps
- c) Ratio at each tap, polarity and phase relationships
- d) Measurement of impedance voltage at principal and extreme taps
- e) Measurement of no load current and no load losses at rated frequency and at both the rated voltage and 110 % rated voltage
- f) Measurement of efficiency and regulation at ½, ¾ and full load
- g) Measurement of insulation resistance
- h) Induced over voltage withstand test
- i) Separate source voltage withstand test
- j) Magnetic balance test
- k) Test on OLTC

Type test certificates shall be provided for verification. Whenever two nos. or more identical transformers are being offered, type tests on one of them shall be carried out, including heat run test. At the time of submission of the data sheet for transformer, based on the Jal Nigam's concurrence, the Concessionaire can submit old type test certificates provided that it is not older than 3 years at the time of dispatch and 5 years at COD.

All auxiliaries and accessories such as temperature indicators, Buchholz and pressure relays shall be tested as per the applicable standards.

1.12 MV Indoor Switchboard

MV indoor VCB switchboard shall comply with the following Standards, including those referred to therein: IEC 61869, 60265, 60282, 62271, 60529, 60694, 60787, 62271 IEC/TR2 61211 and IS 9046, 9920, 9921, 13118, 3427, 4237, 2156, 2705, 3156, 10118, 722, 13118.

The technical parameters of HV switchboards shall be as below:

HV switchboard

Description	Unit	Particulars
General		
Type		Metal enclosed, compartmentalized, draw-out type
Rated voltage, no. of phases and rated frequency	kV / - / Hz	12 kV, 3 Phase, 50Hz
System neutral earthing		Effectively Earthed
Rated Insulation Levels		
- Rated short duration power frequency	kV (rms)	70

Description	Unit	Particulars
withstand voltage		
- Rated lightning impulse withstand voltage	kV (peak)	170
Rated normal current of bus bars under design ambient temperature of 50°C and material of busbar	A / -	(*),Aluminium - suitable for 100% load including future loads
Rated short-time withstand current and time	kA (rms) / sec	16 kA for 1 sec
Dynamic rating	kA (peak)	40
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
Color finish shade		
- Interior		Glossy White
- Exterior		Light Grey Semi Glossy
Cable connection		Bottom entry and exit
Circuit Breakers		
Type		Vacuum/ SF6
Rated current inside the cubicle under design ambient temperature at 50°C	A	(*) – (Breakers shall be rated for final ratings of motors in STP)
Rated operating sequence		O–3 Min–CO-3 Min–CO
Rated short time breaking current	kA (rms)	16
Rated short time making current	kA (peak)	40
Rated short-time withstand current and time	kA (rms) / sec	16 kA for 1 sec
Rated peak withstand current	kA (peak)	40
Min. no. of auxiliary contacts		6 NO + 6 NC 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	110V DC
- Space heater and lighting	V	230V AC
Earthing switch		Required
Current and Voltage Transformers		
Details of ratio, taps, burden, accuracy		As per Single Line Diagram (*)
Protective Relays		

Description	Unit	Particulars
Type		Numerical (Microprocessor based)
Auxiliary supply	V	110V DC
Details of protective relays		As per Single Line Diagram
Switch-Disconnecter		
Rated current under design ambient temperature of 50°C	A	(*)
Rated making current	kA (peak)	40
Rated peak withstand capacity	kA (peak)	40
Rated short-time withstand current and time	kA (rms) / sec	16 kA for 1 sec
Insulation levels		
Rated lightning impulse withstand voltage		
- Across the isolating distance	kV (peak)	70
- Phase to phase, between phases and across open switching devices	kV (peak)	60
Rated short duration power frequency withstand voltage		
- Across the isolating distance	kV(rms)	23
- Phase to phase, between phases and across open switching devices	kV(rms)	20
Operating mechanism		
- Closing and opening		Spring charged
- Control voltage	V	110V DC
Earthing switch		Required
HV Fuses		
Application		Indoor
Type		HRC
Rated current	A	(*)
Rated voltage	kV	36
Rated breaking capacity	kA (rms)	16

(*) Value to be as per the approved Design & Drawings.

1.13 Circuit Breaker

Circuit breakers shall preferably vacuum type. Circuit breaker along with its operating mechanism shall be mounted on a wheeled carriage moving on guides, designed to align correctly and allow easy movement. Plugs and sockets for power circuits shall be silver faced and shall be insulated with suitable insulating material shrouds. All corresponding components of circuit breaker cubicles of same rating shall be interchangeable with one another.

There shall be 'service', 'Test' 'Fully withdrawn' positions for the breakers. In the 'Test' position the circuit breaker shall be capable of being tested for operation without energizing the power circuits, i.e. the control circuits shall remain undisturbed while the power contacts shall remain

disconnected. Separate limit switches, each having a minimum of 2 'NO' + 2 'NC' contacts, shall be provided for both 'Service' and 'Test' positions of the circuit breakers for future SCADA.

Electrical tripping shall be performed by shunt trip coils. "Local / Remote" selector switch lockable in "Local" position shall be provided on the cubicle door. 'Red' and 'Green' indicating lamps shall be provided on cubicle door to indicate breaker close and open positions. Breaker "Service" and "Test" positions shall be indicated by separate indicating lamps on the cubicle door, in case mechanical indication of "Service" and "Test" positions are not available on the cubicle door.

Connection of the control / interlocking circuits between the fixed portion of the cubicle and the breaker carriage shall be preferably by means of plug socket arrangement.

Operating mechanism control

- a) Circuit breakers shall be operated by a motor spring charging type of mechanism. The mechanism shall be complete with motor, opening spring, closing spring and all accessories to make the mechanism a complete operating unit
- b) Operating mechanism shall normally be operated from the breaker cubicle itself.
- c) The tripping spring shall be charged by the closing action, to enable quick tripping. Closing of the circuit breaker shall automatically initiate recharging of the springs to enable the mechanism to be ready for the next closing stroke. Charging time for the springs shall not exceed 30 seconds. It shall be possible to manually charge the springs in an emergency. Transfer from motor to manual charging shall automatically disconnect the charging motor. All operating mechanisms shall be provided with "ON" - "OFF" mechanical indication. The charging mechanism shall be provided with mechanical indicators to show "charged" and "discharged" conditions of the spring. Failure of any spring, vibration or mechanical shock shall not cause tripping or closing of the circuit breaker.
- d) Only one closing operation of the circuit breaker shall result from each closing impulse (manual or electrical), even if the breaker trips while the control device (manual or electrical) is being held in the "close" position.
- e) The circuit breaker mechanism shall make one complete closing operation, once the push button (PB) or control switch has been operated and the first device in the control scheme has responded, even though the PB or control switch is released before the closing operation is complete, subject to the condition that there is no counter- impulse for tripping.
- f) Means shall be provided to manually open and close the breakers slowly, when the operating power is not available, for maintenance and adjustments. A local manual trip device shall also be provided on the operating mechanism.
- g) Circuit breaker control shall be on 110 V DC. Closing coils and other auxiliary devices shall operate satisfactorily at all voltages between 85-110 % of the control voltage. Trip coils shall operate satisfactorily between 70 -110 % the rated control voltage.

h) Provision for remote control shall be provided for SCADA.

1.14 Safety interlocks and features

- a) Withdrawal or engagement of a circuit breaker / switch disconnecter shall not be possible unless it is in the open position.
- b) Operation of a circuit breaker / switch disconnecter shall not be possible unless it is in service position, withdrawn to test position or fully drawn out. It shall not be possible to close the circuit breaker electrically in the service position, without completing the auxiliary circuit between the fixed and moving portions.
- c) Circuit breaker / switch disconnecter cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker / switch disconnecter carriage to cover the stationary isolated contacts when the breaker / switch disconnecter is withdrawn. Padlocking facilities shall be provided for locking the shutters positively in the closed position. It shall, however, be possible to open the shutters intentionally against spring pressure for testing purposes.
- d) The circuit breaker / switch disconnecter carriage shall be earthed before the circuit breaker / switch disconnecter reaches the test position from fully withdrawn position. In case of breakers / switch disconnecter with automatic disconnecting type of auxiliary disconnects, the carriage shall be earthed before the auxiliary disconnects are made and the carriage earthing shall break only after the auxiliary disconnects break.
- e) Caution nameplate, "Caution Live Terminals" shall be provided at all points where the terminals are likely to remain live and isolation is possible only at remote end, i.e. incomer to the switchboard. Suitable interlock shall be wired for the purpose.

1.15 Current and voltage transformers

Current Transformer (CTs) and Voltage Transformers (VTs) shall have polarity marks indelibly marked on each transformer and at the associated terminal block. Facility shall be provided for short-circuiting and earthing the CT secondary at the terminal blocks.

CT shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit current. Core laminations shall be of high grade silicon steel.

VTs shall be of the single phase type and mounted on a draw out trolley. VTs shall be protected on their primary and secondary sides by current limiting fuses with interrupting ratings corresponding to breaker rating. It shall be possible to replace the secondary fuses safely when the switchboard is energized. Alternatively, MCB having auxiliary contact shall be provided. Primary side fuses shall be replaceable only in the de-energized position.

Secondary winding of voltage transformer (VT) shall be rated for a three phase line to line voltage of 110 V.

Identification labels giving type, ratio, output and serial numbers shall be provided for CTs and VTs.

1.16 Relays

Protection relays shall be numerical (microprocessor based) type. Relays shall have interfacing facilities to communicate data to SCADA system.

All relays shall be enclosed in rectangular shaped, dustproof cases and shall be suitable for flush mounting.

All relays shall be accessible from the front for setting and resetting. Access to setting devices shall be possible only after the front covers of the relays are removed.

All protective relays shall be of the draw-out type and shall be provided with operation indicators visible from the front.

Over current / earth fault protection

- a) This relay shall be of the multi-characteristics type which has a flexible mode selection facility so that it is possible to select one mode for the over current elements and another for the earth fault element.
- b) Phase current range shall cover at least 50-300% of 'In' in steps of not more than 10% while the earth current range shall cover at least 5-100% of 'In' in steps of not more than 5%.
- c) The time setting range of the definite time mode shall not be less than 5 seconds in steps of 0.1 second each.
- d) The time multiplier setting for the inverse time-current characteristic modes shall have a range not less than 0.05- 1.6 in steps of 0.05.
- e) Over current and earth fault relays shall have separate timers and operation indicators.
- f) The high set element shall have a range of 2 - 15 times the nominal current in steps of 'In' and shall be of low transient overreach, with a tripping time of less than 25 ms and possible to be selected on "blocked" position. Reset time shall be not more than 50 ms for both elements.
- g) The relays that are installed on the transformer neutral side shall be of single phase version, but they shall have the same characteristics as the phase side relays.

Restricted earth fault protection

- a) The restricted earth fault relay shall be operated from a completely separate core of line and neutral current transformers. The dedicated CTs shall be of class PS and have the same magnetization characteristics with a knee 'emf' value higher than the highest possible setting of the relay. Intermediate CTs for ratio correction are not acceptable. CT sizing shall be matched with the requirements of the relay.
- b) For this protection, 1-phase high impedance relay shall be provided and all the aspects regarding stability of the protection, dimensioning of current transformer, considering the peak short circuit current, etc. and all the auxiliary equipment such as non-linear VDR resistor for voltage limiting, filter for harmonics and DC component suppression and variable shunt resistor for sensitivity adjustment, if required, shall be provided. The total fault clearing time shall not exceed 20 m sec. at $3 \times I_n$.

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- c) The stability of this protection against out-zone faults shall be confirmed. A calculation to show the proper selection of the relay up to the maximum short circuit of the switchboard shall be submitted.

Under voltage relays

- a) Suitable voltage operated relays for sensing loss of voltage shall be provided. The relay shall have a drop off to pick up ratio of the order 90%. The relays shall be fast operating type and shall be fitted with operation indication. The indication shall come on drop off or loss of voltage.
- b) Additional potential free contacts for all the relay outputs i.e. trip as well as alarm signals shall be provided for connection to future SCADA.

Motor protection relay

- a) It shall be designed to protect the motor against thermal overload, locked rotor, over current and earth fault protection, under voltage, over voltage, phase reversal and negative sequence.
- b) Thermal setting range shall cover at least 50% to 200% of 'In' in steps of not more than 5 % of 'In'.
- c) Phase current range shall cover at least 5-200% of 'In' in steps of not more than 1% while the earth current range shall cover at least 1-100% of 'In' in steps of not more than 5%.

Auxiliary relays and timers

- a) Following auxiliary relays shall be provided on each breaker cubicle:
- i. Trip circuit supervision relay
 - ii. Anti- pumping relay
- b) Hand reset type lockout (tripping) relays and timers shall be provided as required in addition to the protection relays given in the single line diagram.
- c) Auxiliary relays and timers shall be rated to operate satisfactorily between 70 % and 110 % of the rated voltage.
- d) Voltage operated relays with sufficient contacts to initiate tripping, alarm, annunciation for various trip functions like Buchholz relay operation. Each relay shall have four (4) pairs of self-reset contacts except for Buchholz and "PRD" trip which shall have hand-reset contact. The relays shall have hand-reset operation indicators.
- e) Voltage operated relays with sufficient contacts to initiate alarm and data logging for various alarm functions for transformers, etc. shall be provided. Each relay shall have four (4) normally open self reset contacts. The auxiliary relay for Buchholz alarm shall be slugged to have delay on drop off at 100 ms. The relays shall have hand reset operation indicator.

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1.17 Switch disconnectors and fuses

Switch disconnectors when switched, shall be of the load break, fault make, grouping operated type. For use on 3-phase systems, the switches shall be of the triple pole type with a link for neutral connection.

Switch disconnectors shall be of the heavy duty, quick make and quick break type. It shall be electrically and manually operated. Their contacts shall be silver plated, and contact springs shall be of stainless steel. Their handles shall have provision for locking in both fully open and fully closed positions. Mechanical 'ON-OFF' indication shall be provided.

For combination units of switch disconnector and fuses, the following interlocks shall be incorporated:

- a) The fuses should not be accessible unless the switch disconnector is in fully open condition.
- b) It should not be possible to close the switch disconnector when the fuse cover is open, but an authorized person may override the interlock and operate the switch disconnector. After such an operation, the cover shall be prevented from closing if the switch disconnector is left in the "ON" position.

All fuses shall be of the HRC cartridge type in accordance with IEC 60269 mounted on plug-in type of fuse bases. Fuses shall be provided with Visible indicators to show that they have operated.

Fuses and links functionally associated with the same circuit shall be mounted side by side.

An adequate number of spare fuse cartridges of each rating shall be supplied and fitted in clips inside the panel.

1.18 Constructional Features of Switchboard

Switchboard design shall comprise metal enclosed, fully compartmental and draw out execution having separate sections for each circuit. Compartments with doors for access to operating mechanism shall be so arranged as not to expose high Voltage circuits. Switchboard cubicle shall be provided with hinged door on the front with facility for locking door handle.

- a. Switchboard shall be dust and vermin-proof and shall have a degree of protection of enclosure of IP 5X.
- b. All removable covers shall be gasketed all around with neoprene or superior gaskets.
- c. Instruments, relays and control devices shall be flush-mounted on hinged door of the metering compartment located in the front portion of cubicle. The metering compartment shall be properly shielded to prevent mal-operation of electronic equipment such as numerical / static relays due to electro-magnetic fields. Separate signal earth shall be provided for such devices, if necessary.
- d. Each switchboard cubicle shall be fitted with a label on the front and rear of the cubicle. Each switchboard shall also be fitted with label indicating the switchboard designation, rating and duty. Each relay, instrument, switch, fuse and other devices shall be provided with separate label.
- e. Sheet steel used for fabrication of switchboards, control cabinets, marshalling boxes, etc. shall be cold rolled.
- f. All panels, cabinets, kiosks and boards shall comprise rigid welded structural frames made of structural steel sections or of pressed and formed cold rolled sheet steel of thickness not less than

- 2 mm. The frames shall be enclosed by sheet steel of at least 2 mm thickness. Stiffeners shall be provided wherever necessary.
- g. All doors, removable covers, gland plates, etc. shall be of at least 2 mm thickness and shall be gasketed all round the perimeter.
 - h. All doors shall be supported by strong hinges of the disappearing or internal type and braced in such a manner as to ensure freedom from sagging, bending and general distortion of panel or hinged parts.
 - i. All floor mounted panels / boards shall be provided with a channel base frame.
 - j. It shall be possible to extend the switchboard on both sides.
 - k. The fully draw-out modules shall have all the circuit components mounted on withdrawable type steel chassis. All power and control connections shall be of the draw out type. It shall be possible to withdraw the chassis mounted circuit components without disconnecting any connections. All draw-out contacts shall be of silver plated copper.
 - l. In case of circuit breaker compartments, suitable barriers shall be provided between breaker and all control, protective and indication circuit equipment including instrument transformers such that no live parts are accessible. External cable connections shall be through separate cable compartments for power and control cables.
 - m. One metal sheet shall be provided between two adjacent vertical sections running to the full height of the switchboard except for the horizontal busbar compartment. However, each shipping section shall have metal sheets at both ends.
 - n. After isolation of the power and control connections of a circuit, it shall be possible to carry out maintenance in a compartment safely, with the bus bars and adjacent circuits alive.

1.19 Earthing

- a. A copper earthing bus shall be provided and extended throughout the length of the switchboard. It shall be bolted to the framework of each unit and brazed to each breaker earthing contact bar. It shall be located at the bottom of the board.
- b. The earth bus shall have sufficient cross section to carry the momentary short circuit and short time fault current for at least 1 second or higher as specified, without exceeding maximum allowable temperature rise. The earth bus shall be properly supported to withstand stresses induced by the momentary short circuit current.
- c. Suitable clamp type terminals at each end of the earth bus shall be provided to suit the size of the earthing conductors.
- d. Bolted joints, slices, tap, etc. to the earth bus shall be made with at least two bolts.
- e. Positive earthing of circuit breaker frame shall be maintained when it is in the connected position and in all other positions whilst the auxiliary circuits are not totally disconnected.
- f. Hinged doors shall be earthed through flexible earthing braid of adequate cross section.
- g. All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus.
- h. Positive connection of the frames of all the equipment mounted in the switchboard to the earth busbar shall be maintained through insulated conductors of size equal to the earth busbar or the load current carrying conductor, whichever is smaller.
- i. All instrument and relay cases shall be connected to earth busbar by means of 1100V grade, green colored, PVC insulated, stranded, tinned copper, 2.5 sq. mm conductor looped through each of the earth terminals.

1.20 Circuit / busbar earthing facility

- a. It shall be possible to connect each circuit or set of 3 phase bus bars of the switchboard to earth through earthing switches.
- b. Earthing switches / earthing devices shall be mechanically interlocked with the associated breakers / switch disconnectors to prevent accidental earthing of live circuit or bus bars.
- c. In case the earthing facility comprises earthing trucks to be inserted in place of circuit breakers, separate earthing trucks shall be supplied for each type / size of breaker.
- d. Auxiliary contacts (min. 2 NO + 2 NC) shall be provided on each earth switch / earthing device and shall be wired to the terminal block for interlocking purpose.

1.21 Annunciators

- a. Annunciators shall be of facia type with translucent plastic window for each alarm point. Annunciator facia plates shall be engraved in block lettering with respective alarm inscriptions. The inscriptions shall be clearly readable and visible when the respective facia light is lighted.
- b. Each annunciation window shall be provided with two lamps to provide redundancy against lamp failure. Lamps shall be replaceable from the front. Lamps shall be of clustered LED type.
- c. All facia annunciator points shall be suitable to accept external contacts of either 'NO' or 'NC' self or hand reset type for initiating the annunciation sequence. Annunciators shall be suitable for accepting fleeting faults of duration as less as 15 millisecond.
- d. For static annunciator schemes, special precaution shall be taken by the Concessionaire to ensure that spurious alarm conditions do not appear due to influence of external magnetic fields on the annunciator wiring and switching disturbances from the neighboring circuits within the panels / desks.
- e. A "Lamp Test" push button shall be provided for each individual panel's group of annunciators to limit the sudden drain on the battery.
- f. Provision of testing facilities for flasher and audible alarm circuits of annunciators is desirable. The Concessionaire shall give the details of the offered scheme.
- g. Annunciators shall have following features:
 - o Suitable for annunciating subsequent faults immediately after the sound cancel of the previous fault.
 - o During lamp test, if a fault occurs, the corresponding lamp circuit shall be automatically disconnected from the "lamp test" circuit and shall start flashing.
 - o Designed to prevent mal-operation of the scheme or sequence when the push buttons are pressed incorrectly or in the wrong order.
 - o "Alarm Supply Failure" Alarm scheme similar to the normal annunciation sequence, but shall operate on a different DC supply or on AC auxiliary supply.

1.22 Instruments

All electrical instruments and meters shall comply with IEC 60051, 61010 and IS 722, 1248. All indicating and recording instruments shall be flush mounted in dust proof cases complying with IEC 60068 and dimensions to IEC 61554. All digital instruments shall have interface facilities to communicate data to SCADA system.

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Indicating instruments

- a) Electrical indicating instruments shall be 96 or 110 mm square with 2400 scale. Taut band type of instruments is preferred. Taut band moving coil instruments for use on AC systems shall incorporate built-in transducers.
- b) Instrument dials shall be white with black numbers and lettering. A red line shall be drawn on each scale to represent rated conditions.
- c) Normal maximum meter reading shall be of the order of 60 % normal full scale deflection. Ammeters for motor feeders shall have suppressed scale to show current from full load up to six times the full load current.
- d) Instruments shall have accuracy class of 1.0 or better. The design of the scales shall be such that it can read to a resolution corresponding to 50% of the accuracy class index.
- e) Ammeters and current coils of Watt meters and Voltmeters shall continuously withstand 120% of rated current and 10 times the rated current for 0.5 sec., without loss of accuracy. Voltmeters and potential coils of Watt meters and Voltmeters shall withstand 120% of rated voltage continuously and twice the rated voltage for 0.5 sec. without loss of accuracy.
- f) Alternatively, instruments can be electronic / digital type with LCD display. These instruments should have high performance ratio and can be equipped with digital output (for alarms) or with interfacing facilities for communication and remote reading of parameters.

Metering instruments

- a) Watt-hour meters shall be of the induction type and shall be provided with reverse running stops.
- b) Watt-hour and Varhour meters shall be of the three phase two element type of accuracy class 1.0, suitable for measurement of unbalanced loads in three phase three wire circuits.
- c) Watt-hour and Varhour meters shall be suitable for operation from the secondary of CTs and VTs. They shall be provided with a separate 3 phase 4 wire type test blocks for the testing of the meters without disturbing the CT and VT secondary connections.
- d) Meters shall have digital or cyclometer type of registers. They shall read kWh, kVARh or MWh, MVARh as the case may be without the use of additional multiplying factors. Multiplying factors if unavoidable shall be multiples of 10 (ten). Number of digits provided shall be adequate to cover at least 1000 hrs. of operation.
- g) Alternatively, instruments can be electronic / digital type with LCD display. These instruments should have high performance ratio and can be equipped with digital output (for alarms) or with interfacing facilities for communication and remote reading of parameters.

1.23 Control and selector switches

Control and instrument switches shall be rotary type, provided with escutcheon plates clearly marked to show operating position and suitable for semi-flush mounting with only the switch front plate and operating handle projecting out. The connections shall be from the back. The contact assembly at the back of the switch shall be enclosed in dust tight removable covers.

The control switches shall be 3 position, spring return to neutral type. They shall be provided with contacts to close in 'normal after close' and 'normal after trip' position. Each switch shall have external red and green indicating lamps, (except when discrepancy type switches are called for). In addition, a semaphore indicator shall be provided for earthing switch.

Contacts of the switches shall be spring assisted and contact faces shall be of silver / silver alloy. Springs shall not be used as current carrying parts. Contact rating and configurations of the switches shall be adequate for the functions desired.

Instrument selector switches shall be of the maintained (stay-put) type. Ammeter selector switches shall have make-before-break type contacts so as to prevent open circuiting of CT secondary when changing the position of the switch.

Lockable type switches, which can be locked in a particular position, shall be provided, if required.

Emergency stop buttons, if any, shall incorporate 'stay-put' features with independent reset facilities.

1.24 Indicating lamps / pilot lights

Indicating lamp shall be of the double contact, bayonet cap type rated for operation at either 230 V AC or at the specified DC system voltage as applicable. Lamps shall be provided with translucent lamp covers.

Clustered LED type lamps shall be provided Lenses shall be glass or plastic in standard colors, red, green, blue, white and amber, in accordance with IEC 60073.

Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panel. Tools, if any, which are required for replacing the bulbs and lenses, shall also be included in the scope of supply.

Miniature pilot lamps may be provided with plastic marking plate contained inside square (or rectangular) front lens to provide indication of legend or symbols engraved on the marking plate.

The basis of colors shall be as follows:

- Red : Flow of energy.
- Green : No flow of energy.
- White : Supervision of power available, relay coil healthy, etc.
- Amber : Disagreement with original condition, 'abnormal' condition or 'sequence-on' condition.

1.25 Push buttons

Push buttons shall be of momentary contact type with rear terminal connections. The color of the push button actuator shall be red for 'OPEN / STOP' and green for 'CLOSE / START' and for other applications shall be as per specified requirements. The push button knob shall be suitably shrouded to prevent inadvertent operation. The push buttons shall be provided with integral inscription plates engraved with their designation.

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All push buttons shall have independent, potential free, 2NO + 2NC contacts. The contact faces shall be of silver / silver alloy. The contacts shall be rated 10A and capable of breaking inductive load of 1A at 110V DC and 5A at 110V AC.

1.26 Space heaters

Adequately rated anti-condensation space heaters shall be provided for each switchboard / cubicle.

Space heater shall be of the industrial strip continuous duty type, rated for operation on a 230 V, 1 phase, 50 Hz, AC system.

Space heater shall be provided with a single pole MCB with overload and short circuit release, a neutral link and a thermostat to cut off the heaters at 35^o C.

1.27 Cubicle lighting / receptacle

Each cubicle shall be provided with interior lighting by means of 18 W fluorescent tube lighting fixture. An MCB shall be provided for the lighting circuit. The lighting fixture shall be suitable for operation from a 230 V, 1 ph, 50 Hz, AC supply.

A 230 V, 1 phase, AC receptacle (socket) plug point shall be provided in the interior of each panel with an MCB.

1.28 Power and control cable terminations

Terminals for power connections shall be complete with adequate phase segregating insulating barriers, shrouds and suitable crimping type of lugs for terminating the cables.

Double compression type glands with armour and bonding clamps for the termination of all solid dielectric multicore cables shall be provided. They shall be designed to secure the armour wires to provide electrical continuity between the armour and the threaded fixing component of the gland and to provide watertight seals between the cable outer sheath and gland and between the inner sheath and threaded fixing component. The gland shall preferably project above the gland plate to avoid entry of moisture.

Earthing connectors between cable armour and earth shall be routed outside the cable gland in an approved manner. Gland insulation shall be capable of withstanding test for appropriate high Voltage for one minute.

Cable terminations for HV / MV cables shall be heat / cold shrinkable type. Adequately sized shrouds/ bolts shall be provided at connections to completely cover the terminations.

Where core-balance type current transformers are provided on the feeder cables for earth fault protection, glands for cables shall be insulated from earth in an approved manner.

1.29 Wiring for control and protective circuits

All low voltage wiring for control, protection and indication circuits shall be carried out with 1100 V grade, PVC insulated cable with stranded, tinned copper conductor of minimum 1.5 sq. mm size. The size of conductor for CT circuits shall be minimum 2.5 sq. mm.

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All wiring shall be run on the sides of panels and shall be neatly bunched and cleated without affecting access to equipment mounted in the panel.

The wiring shall be bound and supported by clamping, roughing or lacing. Spiral wrapping will not be accepted. Wireways shall not be more than 50% full. Adequate slack wire shall be provided to allow for one restripping and reconnection at the end of each wire. When screened cables or wires are necessary, an insulating sheath shall be included.

Wiring and supports shall be of fire resistant material.

Wiring shall only be jointed or teed at terminals. Terminals of the clamp type shall not have more than two wires connected.

1.30 Terminations and ferrules

Engraved core identification ferrules, marked to correspond with the wiring diagram, shall be fitted to each wire and each core of multicore cables terminated on the panels.

Moisture and oil resisting insulating material shall be used. The ferrules shall be of the interlocking type and shall grip the insulation firmly without falling off when the wire is removed.

All wires forming part of a tripping circuit shall be distinctively marked.

Spare auxiliary contacts of electrical equipment shall be wired to terminal blocks.

1.31 Control wiring terminal blocks

Terminal blocks shall be of 1000 V grade and stud type. Brass stud of at least 6 mm dia. with fine threads shall be used and securely locked within the mounting base to prevent turning. Each terminal shall comprise two threaded studs, with a link between them, washers, and matching nuts and locknuts for each stud. Connections to the terminals shall be at the front.

Terminals shall be numbered for identification, grouped according to function. Engraved 'black on-white' labels shall be provided on the terminal blocks describing the function of the circuit.

Terminals for circuits with voltage exceeding 110 V shall be shrouded. Terminal blocks at different voltages shall be segregated into groups and distinctively labeled.

Terminals used for connecting current transformer secondary leads shall be 'disconnecting and shorting' type with a facility for earthing the secondary.

Terminal blocks shall be arranged with 100 mm clearance, between any two sets.

Separate terminal stems shall be provided for internal and external wiring respectively.

All wiring shall be terminated on terminal blocks, using crimping type lugs or claw type of terminations.

1.32 Electronic equipment

Electronic equipment shall be capable of withstanding randomly phased transient over voltages of either polarity on the power supply or interruptions of the power supply without damage or impairment to the equipment's subsequent performance. In the case of controls, no mal-operation shall occur.

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Where manufacturers require that electronic equipment supplied under this Concession Agreement should not be subjected to insulation resistance tests ('Meggering'), suitable warning notices shall be provided and installed in appropriate locations. When specified by manufacturers, separate shield / signal earthing shall be provided.

It shall be possible to remove / replace cards from / to electronic equipment without damage and without interfering with the operation of the rest of the equipment or system. If necessary, consideration should be given to switching off the supplies locally to a card to prevent inadvertent interference to the equipment or system during removing / replacing a card.

Local internal batteries shall be of the totally sealed, leak proof type.

Interference

a) Self-generated interference

Equipment shall not generate any type of interference at a level, which could be detrimental to the performance of any other equipment / component or which could cause annoyance or discomfort to personnel.

The earthing and cabling arrangements shall be such that detrimental interference is not generated.

b) External interference

In the presence of interference expected in substation environments, the design of the equipment shall be such that no damage occurs and performance is maintained to the requirements of the individual specifications.

c) Spark quenching

Spark quenching devices shall be fitted wherever necessary to ensure continued satisfactory operation of contacts and prevent mal-operation of electronic devices.

d) Noise and vibration

The acoustical noise levels and / or vibration produced by the equipment in operation shall be as low as is reasonably practicable for the type of equipment concerned.

Setting-up and maintenance facilities

All equipment shall be provided with sufficient easily accessible test points to facilitate setting-up and fault location together with maintenance aids such as extension boards, jumper leads and special maintenance tools.

Pin or terminal numbering of all cards in all crates shall be consistently uniform throughout. Power supplies shall use the same pin positions on all cards in an equipment or system.

Loose equipment

Special connecting leads, extension boards and any special item required for calibration or maintenance purposes, together with the mating half of all necessary connectors shall be supplied.

Printed circuit boards

Printed circuit boards shall be epoxy glass fabric boards to comply with IEC - 60321 suitable for use in hot humid climates. Printed circuit boards may be single-sided, double-sided or multi-layer.

Printed boards shall, in general, comply with IEC 60326. They shall not bow perceptibly when they are mounted in their shelves or racks. Means shall be provided to prevent boards being plugged into the wrong sockets and the plugging in / out action shall be arranged in a positive manner.

An approved protective coat shall be applied to the printed circuit side of the board to protect against tracking, tarnishing and general deterioration due to moisture and deposition of dust. The coating shall not have any adverse reaction with any other material or components used and shall be suitable for use under tropical conditions. When boards are repaired in the field it shall be possible to apply (or 'touch up') such a finish by simple convenient means.

Component identification

- a) A component reference number shall be marked adjacent to each component. Where this is impossible, components shall be identifiable from the layout drawings provided.
- b) The following shall be marked in all instances:
 - i. Fuses
The rating and the circuit identification of each fuse shall be marked adjacent to the fuse base.
 - ii. Control, protection and indication devices
The function of each control, protection and indication device shall be marked.
 - iii. Preset controls
The circuit reference and if possible, the function shall be marked adjacent to each preset control in a position where it will be clearly visible while the adjustment is being made.
 - iv. Connectors
The diagram reference number shall be marked on or adjacent to each connector.
- c) Test points shall be individually marked with the diagram reference number.
- d) The polarity of any polarized devices (e.g. diodes) shall be marked.

1.33 Test terminal blocks

Test terminal blocks, if any, shall be provided for secondary injection and testing of relays. A suitable metering block shall be provided where specified for the connection of a portable precision instrument to be operated when required for specific plant testing purposes.

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A blue checkmark-like symbol in the center.
A blue checkmark-like symbol on the right.

1.34 Tests

The following routine tests shall be carried out on the assembled switchboard / panel during inspection at the manufacturer's works in addition to other tests as per applicable standards.

- (i) Primary injection tests to ensure correct ratios and polarity of current and voltage transformers and of the current operated protection relays and direct acting coils, over their full range of settings.
- (ii) Balance earth fault stability test by primary current injection. Care must be taken to reproduce accurately the burdens of interconnecting cables. A further test to ensure correct polarity must be made after assembly.
- (iii) Tests on auxiliary relays at normal operating voltages by operation of associated remote relays.
- (iv) Correct operation of sequencing and control circuits at normal operating voltages by operation of local control switches, and simulation of operation from remote control positions.
- (v) Carry out functionality tests, check interfacing status contacts and instrumentation.
- (vi) Checking of Differential protection relay.
- (vii) One minute power-frequency voltage dry withstand tests on the main circuits
- (viii) One minute power-frequency voltage dry withstand tests on auxiliary circuits
- (ix) Insulation resistance tests

All circuit breakers shall be subject to the following tests:

- (i) Routine tests including HV pressure test, millivolt drop tests and mechanical tests.
- (ii) To ensure the operation of the dc closing coil and satisfactory closing of the circuit breaker with the voltage of the coil down to 80% of its rated voltage, and that mal-operation does not occur with a voltage on the coil of 120% of its rated voltage.
- (iii) Interchangeability of withdraw able identically equipped circuit breakers, and checking of all mechanical and electrical interlocks.

Type test figures for heat test runs performed on identical panel types shall be made available.

1.35 Motors

- a. All motors shall be energy efficient with rating of IE 3 and comply with IEC 60034-30:2008 and IS 12615:2011, IEC 60072/ IS 325, 4691, 6362,4029,12065, 12075, including standards referred to therein:
- b. The technical parameters of motors shall be as below :

Description	Unit	Particulars
Type		Squirrel cage Induction motor (TEFC)
Rating	kW	(*)
Rated voltage	kV	0.415
Type of mounting		Vertical / Horizontal (As required)

Description	Unit	Particulars
Duty type		Continuous (S1)
Method of starting		By variable speed drive (For Blower/compressor motors) Direct on line- for motors upto 3.7kW Star-Delta (Close transition type) – For motors above 3.7kW and upto 75kW Soft Starter – For motors above 75kW
Type of system earthing		Effectively earthed
Class of insulation		F
Design ambient temperature	°C	50
Limits of temperature rise of winding		
- Determination by resistance method	°C	70
- Determination by ETD method	°C	80
Location		Indoor
Degree of Protection		IP55
Cooling designation		IC411
External cable details		0.4 / 1 kV, 3C x (*) Aluminum, XLPE, armoured
Space heater for motor		Required for rating 30kW and above

(*) Value to be identified in line with the approved Design and Drawings.

- c. The LV motors shall be of the totally enclosed fan cooled type, with degree of protection for enclosure of IP 55 and shall be suitable for continuous operation and direct-on-line starting, unless otherwise specified.
- d. They shall be suitable in all respects for service in extreme climatic conditions. Main conductor and slot insulation shall be non-hygroscopic and in accordance with Class F of IEC 60085.
- e. Motors shall be capable of operating continuously at rated output at any frequency between 49 and 51 Hz and at any voltage within + 10% of the nominal value. Motors shall be designed to be operated for a period of not less than five minutes at a voltage of 20% below the nominal value and at normal frequency without injurious overheating.
- f. The starting current at rated voltage when started direct-on-line shall not exceed 6 times the rated full load current. When started with soft starter it should be 2.5 to 3 times the rated full load current. The motor characteristics shall be co-ordinated with soft starter manufacturer.
- g. All bearings shall be fitted with oil or grease lubricators. Vertical shaft motors shall have thrust bearings.
- h. All terminals shall be of the stud type of adequate size for the particular duty, marked in accordance with an approved standard and enclosed in a weatherproof box.
- i. All terminal boxes shall be fitted with an approved sealing chamber, conduit entry or adapter plate, as required, together with the necessary fittings to suit the type of cable specified.
- j. The power rating of the motors shall be larger of the following: 115% of the power input to the pump at duty point at a speed corresponding to a frequency of 50 Hz.
- k. Motors shall be capable of starting and accelerating the load with the applicable method of

starting, without exceeding permissible winding temperatures, when the supply voltage is 80% of the rated voltage.

- l. Motors shall be capable of satisfactory operation at a supply voltage of 80% of the rated voltage for 5 minutes, commencing from hot condition.
- m. The locked rotor withstand time under hot conditions at 110% rated voltage shall be more than the starting time at minimum permissible voltage by at least two seconds or 15% of the accelerating time, whichever is greater. The locked rotor current of motors shall not exceed 600% of full load current of motor, which is inclusive of 20% tolerance.
- n. Motors when started with the drive imposing its full starting torque under the specified supply voltage variations shall be capable of withstanding at least two successive starts from cold conditions and one start from hot condition without injurious heating of windings. The motors shall also be suitable for three equally spread starts per hour under the above referred supply conditions.
- o. In case of motors started by soft starters, the three phases shall be segregated by metal barriers within both line and neutral side terminal boxes. The two terminal boxes shall be on opposite sides.
- p. The earthing pad shall be of non-corrodible metal, welded / brazed at two locations on opposite sides. The pad size shall be 75x65x25 mm with two holes drilled at 40mm centers, tapped and provided with suitable bolts and washers for connecting the earthing strip.
- q. Motors shall have space heaters suitable for 230 V, single phase 50 Hz AC supply. These shall be placed in easily accessible positions in the lower part of motor frame. Provision shall be made to measure temperature of bearing by inserting hand held temperature measuring device.
- r. Motors shall have drain plugs so located that they will drain water, resulting from condensation or other causes from all pockets in the motor casing.
- s. Pockets shall be provided in the motor bearing housings for insertion of portable instrument probes for measuring bearing temperature. One portable hand held instrument per pumping station shall be provided for measuring motor bearing temperature. The same instrument shall also be used to measure the pump bearing temperature.

1.36 Insulation

Any joints in the motor insulation such as at coil connections or between slot and winding sections, shall have strength equivalent to that of slot sections of the coil. The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in extreme climate. The motors shall be provided with class F insulation with temperature rise limited to that of class B insulation.

1.37 Constructional features

The motor construction shall be suitable for easy disassembly and re-assembly. The enclosure shall be sturdy and shall permit easy removal of any part of the motor for inspection and repair.

Motors weighing more than 25 kg shall be provided with eyebolts, lugs or other means to facilitate safe lifting.

The rotor bars shall not be insulated in the slot portion between the inner core laminations for squirrel cage motors.

1.38 Terminal box

Terminal boxes shall be of weather proof construction designed for outdoor service. To eliminate entry of dust and water, gaskets of neoprene or equivalent approved shall be provided at cover joints and between box and motor frame. It shall be suitable for bottom entry of cables. It shall be suitable of being turned through 3600 in steps of 900.

The terminals shall be of stud type with necessary plain washers, spring washers and check nuts. They shall be designed for rated current carrying capacity and shall ensure ample phase to phase and phase to earth clearances. Suitable cable glands and lugs shall be supplied to match specified cables.

1.39 Accessories

Two independent earthing points shall be provided on opposite sides of the motor for bolted connections. These earthing points shall be in addition to earthing stud provided in the terminal box.

1.40 Tests

Motors shall be subject to routine tests which shall also include the following:

- insulation resistance
- Measurement of winding resistance
- high voltage test
- no load / full load tests to determine efficiency, power-factor and slip
- momentary overload test
- test for noise levels of motor
- test for vibration severity of motor
- overspeed test
- locked rotor reading of voltage, current and power input at a reduced voltage.

Type test certificates for test runs performed on identical motors (below 11 kW rating) shall be made available. Whenever two nos. or more identical motors (above 11 kW rating) are being offered, type tests on one of them shall be carried out, including heat run test. At the time of submission of the data sheet for motors, based on the Jal Nigam's concurrence, the Concessionaire can submit old type test certificates provided that it is not older than 3 years at the time of dispatch and 5 years at COD.

1.41 Soft starters for LV motors

The soft starters shall comply with the requirements of IEC 60034, 60947 and IS 325 including those standards referred to therein.

1.42 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) bus bars
- 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.

Necessary wiring diagram shall be provided considering starting interlock, trip circuit, starting and running mode signal.

It shall be possible to manually start the motor locally from the starter panel or in Auto mode through PLC.

1.43 Bus bars

- Bus bars shall be fully insulated by encapsulation in epoxy resin /shrinkable PVC sleeve, with moulded caps protecting all joints. Bus bars shall be supported on insulators capable of withstanding dynamic stresses due to short circuit. Bus bars shall be of Copper or Aluminium conductor (Only Copper is in HT switchgear panel.)
- Coating on the bus bar must ensure following
 - Improved Conductivity
 - Corrosion Protection
 - Electrical Shock Protection
 - High Voltage Arcing Protection
 - Current-Induced Magnetic Field Protection
 - Harsh Environment Conditions and Outdoor Elements Protection

1.44 Earthing

A copper earthing bus shall be provided at the bottom and extended throughout the length of the panel. It shall be bolted / welded to the framework. All non-current carrying metal work of the panel shall be effectively bonded to the earth bus. Hinged doors shall be earthed through flexible earthing braid.

1.45 Panel accessories and wiring

- a. Panel shall be supplied completely wired internally upto equipment and terminal blocks and ready for the external cable connections at the terminal blocks. Inter panel wiring between compartment of the same panel shall be provided.
- b. All auxiliary wiring shall be carried out with 1100 volts grade, single core, stranded copper conductor with PVC insulation. The sizes of wire shall be not less than 1.5 sq. mm.
- c. Terminal blocks shall be of stud type, 10 A rated, complete with insulated barriers. Terminal blocks for CTs shall be provided with test links and isolating facilities.
- d. All spare contacts and terminals of cubicle mounted equipment and devices shall be wired to terminal blocks.
- e. Accuracy class for indicating instruments shall be 1.0 or better. Instruments shall be 110 mm square, 240s scale for flush mounting with only flanges projecting.
- f. Push buttons shall be provided with inscription plates engraved with their functions.
- g. Indicating lamps shall be of clustered LED type.
- h. Space heaters of adequate capacity shall be provided inside each panel. They shall be suitable for 230 V, 1 ph, 50 Hz supply. They shall be complete with MCB and thermostat.
- i. Each panel shall be provided with 230 Volts, 1 phase, 50 Hz, 5 A, 3 pin receptacle with MCB located in a convenient position. An interior illuminating lamp together with the operating door switch and protective MCBs shall be provided.
- j. The DC and AC auxiliary supply shall be distributed inside the panel with necessary isolating arrangements at the point of entry and with sub-circuit MCBs as required.

1.46 Capacitors and 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:

LV Capacitors and Control Panel

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	°C	50
Type of switching		Automatic
Control supply		230 VAC from UPS of PLC system

Description	Unit	Particulars
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 0.99 lag) with plc interface through RS485 communication to PLC

(*) Value to be identified as per the approved Designs and Drawings.

MV capacitors shall be provided for connection across MV motor terminals while LV capacitors with APFC relay and a panel shall be provided for connection to LV switchboard bus, where specified.

Design criteria

- MV capacitors – Capacitor rating shall be such that capacitor current is less than 90% of the magnetizing current of the motor or for improvement of rated motor power factor to 0.98, whichever is lesser.
- LV capacitors – Rated for improvement of power factor on LV side to 0.98

General

The capacitor bank shall be complete with all parts that are necessary or essential for efficient operation. Such parts shall be deemed to be within the scope of supply whether specifically mentioned or not. It shall be complete with the required capacitors along with the supporting post insulators, steel rack assembly, aluminium bus bars, copper connecting strips, foundation channels, fuses, fuse clips, etc. The steel rack assembly shall be hot dip galvanized.

The capacitor bank shall comprise of suitable number of single phase units in series parallel combination. However, the number of parallel units in each of the series racks shall be such that failure of one unit shall not create an over voltage on the units in parallel with it, which will result in the failure of the parallel units. The assembly of the banks shall be such that it provides sufficient ventilation for each unit.

Each capacitor case and the cubicle shall be earthed to a separate earth bus.

Capacitors shall be of polypropylene type. Each unit shall satisfactorily operate at 135% of rated kVAR including factors of over voltage, harmonic currents and manufacturing tolerance. The units shall be capable of continuously withstanding satisfactorily any over voltage up to a maximum of 10 % above the rated voltage, excluding transients.

Each capacitor unit / bank shall be fitted with a directly connected, continuously rated, low loss discharge device, if required, to discharge the capacitors to reduce the voltage to 50 volts within one minute upon disconnection.

Unit protection

Each capacitor unit shall be individually protected by a HRC fuse suitably rated for load current and interrupting capacity, so that only the faulty capacitor unit will be disconnected without causing the bank to be disconnected. An operated fuse shall give visual indication so that it may be detected during periodic inspection. The fuse breaking time shall co-ordinate with the pressure built up within the unit to avoid explosion. Mounting of the individual fuse should be internal to the capacitor case.

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.). The panel shall be of indoor type and shall consist of:

- a) Isolating MCCB
- b) Contactors with overload element
- c) Relays responsive to current / voltage / kVAR / pf for automatic switching
- d) Sequencing devices, timers and auxiliary relays for automatic sequential switching of capacitor units in and out of circuit
- e) Auto-manual selector switch
- f) Microprocessor based Automatic Power Factor Correction (APFC) Relay
- g) Push button for opening and closing the power circuit
- h) Red and Green lamps for capacitors ON / OFF indication
- i) Protective relays to protect the healthy capacitor units when one unit fails in a series connection
- j) Space heater and cubicle lighting

1.47 MV and LV Cables

MV / LV Cables shall comply with the following International Standards, including those referred to therein: IEC 60183, 60228, 60502, 60884 and IS 7098, 5831, 8130, 1554, 10810. The technical parameters of cables shall be as given below:

Description	Unit	Particulars
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Description	Unit	Particulars
MV XLPE Power Cables		
Rated voltage U / U _o (U _m)	kV	6.35/11(12)kV & 3.6/7.2 kV
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 U / U _o (U _m)	kV	0.6 / 1 (1.2)
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 Steel (Aluminum for single core cable)
Cable Protection		Compound of outer sheath of all HV/MV/LV cables shall contain suitable chemicals for preventing attack by rodents.

(*) Value to be identified as per the approved Design & Drawings.

Installation

Cable installation shall be as per IS 1255/IEC standard

- 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 layer 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.

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Tests

All HV, and LV cables shall be subject to routine tests in accordance with the relevant Indian Standard Specifications.

Test certificates shall be provided against each drum and/or cable length.

The tests carried out on every cable length and / or drum at manufacturer's premises shall include following tests as applicable but not limited to:

- High Voltage DC insulation pressure test, between cores, each core to earth, metallic sheath or armour as applicable;
- insulation resistance test;
- core continuity and identification;
- conductor resistance test
- Elongation test
- Smoke density test
- HCl gas generation test
- Anti rodent test (Presence of lead)

1.48 LV Indoor Switchboard

LV indoor switchboard and its components shall comply with the following International Standards, including those referred to therein: IEC 60269, 60947, 60529 and IS 4237, 8623, 1248, 722, 2705, 3156, 10118, 11353, 13947. The technical parameters of LV switchboard shall be as given below:

Description	Unit	Particulars
General		
Rated voltage, no. of phases and rated frequency	V / - / Hz	415V, 3, 50Hz
System neutral earthing		Effectively Earthed
Rated short duration power frequency withstand voltage		
- Power circuit	kV (rms)	3.5
- Control circuit	kV (rms)	1.5
Rated normal current of bus bars under design ambient temperature of 50°C and material of busbar	A / -	(*), Aluminum
Rated short-time withstand current and time	kA (rms) / sec	25 kA for 1 sec
Constructional Requirements		
Thickness of sheet steel in mm Cold rolled (Frame/Enclosure/Covers)	mm	Frame – 2.5 Doors/Covers – 2.0
Degree of protection of enclosure		IP-5X, Form-4 enclosure

Description	Unit	Particulars
Color finish shade		
- Interior		Glossy White
- Exterior		Light Grey
Cable connection		Bottom entry and exit
Circuit Breakers		
Type		Air
Rated current inside the cubicle under design ambient temperature at 50°C	A	(*)
Rated operating sequence		O-3 Min-CO-3 Min-CO
Rated short-time withstand current and time	kA (rms)/ sec	25(*)
Min. no. of auxiliary contacts		6 NO + 6 NC 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 only for incomer for Outgoing feeders 230 VAC
- Spring charging motor	V	230 VAC
- Space heater and lighting	V	230V AC
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	110V DC
Details of protective relays		As per Single Line Diagram
Moulded Case Circuit Breakers		
Type		Moulded Case (microprocessor based)
Rated current when installed within cubicle under design ambient temperature of 50°C	A	As required (*)
Rated short-time withstand current	kA (rms)	25 kA
Miniature Circuit Breakers		
Type		Miniature
Rated current when installed within cubicle under design ambient temperature of 50°C	A	(*)
Rated short-time withstand current	kA (rms)	10
Motor Starters and Contactors		
Type		Variable Frequency Drive/ Star-Delta / Direct-on line
Rated current	A	(*)

Description	Unit	Particulars
Rated voltage of coil	V	230V AC / 110V DC
Utilization category		AC-3

(*) Value to be identified as per the approved Design & Drawings .

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 5X.

The board shall be provided with circuits as required, ammeter with ammeter selector switch and voltmeter with Voltmeter selector switch.

Incoming and outgoing circuit shall be protected by suitably rated ACBs/Moulded Case Circuit Breaker (MCCBs).

The switchboard and its components shall be subjected to tests as per the applicable standards.

The current rating of outgoing feeders of any switchboard shall not be less than 10% of that of the incoming feeder.

1.49 Moulded Case Circuit Breaker (MCCB)

MCCBs shall be of the air break, quick make, quick break and trip free type and shall be totally enclosed in a heat resistant, moulded, insulating material housing.

MCCBs shall have an ultimate short circuit capacity not less than the prospective short circuit current at the point of installation.

MCCBs shall have a service short circuit breaking capacity equal to the ultimate short-circuit capacity.

Each pole of MCCB shall be fitted with microprocessor based protection for over current, earth fault and short circuit (L-S-I-G). Such a protection system shall be fully self-contained, needing no separate power supply. The elements shall be adjustable. Adjustments shall be made simultaneously on all poles from a common facility. MCCB shall be suitable for remote On-Off-Trip operation. Necessary spare auxiliary contacts (minimum 2NO+2NC) shall be provided for future use.

Motor protection circuit breaker (MPCB) shall be used for motor feeder instead of MCCBs.

1.50 Miniature Circuit Breaker (MCB)

Miniature circuit breakers shall be of the thermal and magnetic tripping type, and comply with IEC 60898 and IEC 60947-2.

MCB shall be hand operated, air break, quick make, quick break type.

Operating mechanisms shall be mechanically trip-free from the operating knob to prevent the contacts being held closed under overload or short-circuit conditions.

Each pole shall be fitted with a bi-metallic element for overload protection and a magnetic element for short-circuit protection. Multiple pole MCBs shall be mechanically linked such that

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tripping of one pole simultaneously trips all the other poles. For motor feeders, MCB shall have type C characteristics.

The short circuit rating shall be not less than that of the system to which they are connected with a minimum of 10 kA.

1.51 Contactors and Starters

- a. The power contactors used in the switchboard shall be of air break, single throw, triple pole, and electromagnetic type. Contactors shall be suitable for uninterrupted duty and rated for Class AC3 duty in accordance with IEC 60947-4.
- b. Operating coils of all contactors shall be suitable for operation on 230 V, single phase, 50 Hz supply.
- c. Contactors shall be provided with at least two pairs of NO and NC auxiliary contacts.
- d. Contactors shall not drop out at voltages down to 70 % of coil rated voltage. All motor contactors and their associated apparatus must be designed to operate for a period of not less than 5 minutes at a voltage of 20% below the nominal value and at normal frequency without injurious overheating.
- e. Contactors shall be provided with a three element, positive acting, ambient temperature compensated, time lagged, hand reset type thermal overload relay with adjustable settings. The hand reset button shall be flush with the front door of the control module, and shall be suitable for resetting the overload relay with the module door closed. Relays shall be either direct connected or CT operated. Overload relay and reset button shall be independent of the "Start" and "Stop" push buttons. All contactors shall all be provided with single phasing preventer (SPP).
- f. Motor starters shall be complete with auxiliary relays, timers and necessary indications.
- g. Starters shall be of the electrically held-in type with integral "start" and "stop" push buttons mounted externally on the door, with integral interlocked isolators. Where required, auxiliary switches shall be included for the operation of "red" and "green" indicating lights in remote instrument panels.
- h. For details of other equipment/ accessories of LV switchboard (e.g. circuit breaker, current and voltage transformer, relay, constructional features of switchboard, earthing, annunciator, indicating and measuring instrument, control and selector switch, indicating lamp, push button, space heater, cubicle lighting/ receptacles, power and control cable termination, wiring, terminal blocks, etc), refer specification of HV switchboard.

1.52 DC Equipment

DC equipment shall comply with IEC 60896 including those standards referred to therein.

Requirements

Following items shall be covered in Concession Agreement:

- a) One no. 110 V Nickel Cadmium type Battery (Minimum capacity of Battery – 200AH)
- b) Two nos. Float-cum-boost chargers for 110 V battery
- c) DC distribution board.

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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. Aqueous solution of Potassium hydroxide with small quantities of lithium hydroxide shall be used as electrolyte. It shall be used only for ion transfer and shall not chemically changed during charging/ discharging.

The containers shall be transparent and preferably be made of toughened glass or plastic and provided with acid level indicator.

The battery shall be rated on 5-hour basis and for the specified ambient temperature. The battery shall have maximum recharge time of 8 hours. The batteries shall be sized for a backup of 8 hours, in case of power failure. The ampere-hour capacity shall be selected to cater to all the emergency loads, operation of control gear, indication lamps, annunciation panels, emergency lighting, incoming breaker(s) spring charging currents, short time loads etc. A margin of about 25% shall be taken to cater to the contingencies.

Terminal posts shall be designed to accommodate external bolted connection conveniently and positively. Each terminal post shall have two bolt holes of the same diameter, preferably at right angles to each other. The bottom hole shall be used to terminate the inter-cell connection. The top hole shall be left for external terminal connections. Bolts, heads and nuts, except seal nuts, shall be hexagonal and shall be lead covered. The junction between terminal posts and cover, and between cover and container shall be so sealed as to prevent any seepage of electrolyte.

Required quantity of electrolyte for first filling with 10% extra shall be supplied in non-returnable containers.

Each battery shall be complete with following accessories, as applicable, that include, but are not limited to:

- a) Battery racks
- b) Porcelain insulators, rubber pads, etc.
- c) Set of inter-cell, inter-tier and inter-bank connectors as required for the complete installation.
- d) Electrolyte for first filling + 10% extra.

Accessories for testing and maintenance

- i. One - -3, 0, +3 volts DC voltmeter with built-in discharging resistor and suitable leads for measuring cell voltage.
- ii. One - Filler hole thermometer fitted with plug and cap and having specific gravity correction scale.
- iii. Three - Pocket thermometers
- iv. Two - Cell lifting straps
- v. One set - Terminals and cable boxes with glands for connecting cable as required.
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Spare connectors
Spare vent plugs
Spare nuts and bolts
Suitable set of spanners

Each battery shall be mounted in a manner that permits easy accessibility to any cell. The racks shall be suitable for fixing on flat concrete floor. The complete racks shall be suitable for bolting end to end.

It shall be the responsibility of the Concessionaire to provide batteries of adequate capacities to meet specified requirements pertaining to control, indication, annunciation, etc. and emergency lighting. For computing battery capacity, it shall be assumed that the battery is fully charged at the beginning of loading cycle and is discharged to a voltage of 1.2 volts per cell at the end of the loading cycle.

The battery shall have minimal difference (approx. 0.3 V per cell) between float and boost charging voltages.

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.

The rectifier transformer shall be dry type and double wound with required number of taps.

The DC output voltage during float charging shall be stabilized within + 1% of the set DC bus voltage for AC input voltage variation of +10%, frequency variation of + 5% and DC load variation from 0 - 100%. The voltage regulation shall be achieved by a constant voltage regulator having fast response SCR control. The ripple content shall be within 1% of DC output nominal voltage with battery disconnected and shall be designed to have voltage regulation of 1%. Also in any mode of operation, the maximum harmonics in the charger output shall not exceed 5%. The setting of the output DC bus voltage shall be adjustable between + 10% of nominal rated voltage. There shall be provision for manual control if automode fails. Line surge suppressers shall be provided.

For boost charging the discharged battery after a mains failure, the rectifier shall charge the battery at high rate limited to the maximum boost charging voltage. The boost charging shall come on only when selected for boost mode manually. In auto control, the DC output current shall be stabilized within +2% for AC input voltage and frequency variation of + 10% and + 5% respectively. There shall be provision for manual control if auto-mode fails. Boost charging time for charging the battery to full capacity from fully discharged condition shall not exceed 8 hours.

In the float charging mode, the charger shall be designed for supplying:

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- a) The DC loads of control, indication and annunciation circuits that remain energized during normal operation and the momentary closing and trip coil loads of circuit breakers, vacuum contactors; and
- b) The float charging current of the battery.
- c) 25% margin over the above load

Battery charging equipment complete with all accessories shall be housed in a free standing sheet steel cubicle having degree of protection of IP 4X. Sheet steel used for construction shall be 1.6 or 2 mm thick. The units shall be wired using 1100 V grade, PVC insulated, stranded copper conductor cables.

Each battery charger shall be provided with accessories that include, but not limited to the following:

- a) Silicon controlled rectifiers connected in full wave bridge circuit with ripple control devices and transient suppression network.
- b) Double wound dry type transformer with taps
- c) Automatic voltage regulator unit with manual / auto control switch
- d) Coarse and fine control potentiometers for manual control
- e) Selector switch for mode of charging i.e. float charging / boost charging
- f) Off-load tap changing switch for changing the taps of the transformer
- g) DC voltmeter with fuses and a three position selector switch
- h) DC ammeter with shunt
- i) AC ammeter with selector switch for incoming AC power
- j) AC voltmeter with selector switch for incoming AC power
- k) MCB for incoming AC supply along with surge suppressers
- l) Switch-fuse / MCB on DC output side with kick fuses and alarm contacts
- m) Voltage dropping diodes in load circuit during boost charging mode
- n) DC under voltage relay and earth fault relay
- o) AC / DC switching relays for alarm and indication circuits including buzzer
- p) Cubicle space heater suitable for 230 V AC, 1 ph, 50 Hz supply, with MCB and thermostat
- q) 230 V AC compact fluorescent lamp fixture for internal lighting with MCB

Each battery charger shall be provided with the following alarms / indications:

- a) AC and DC supply 'ON'
- b) AC and DC supply fail
- c) Modes of charging
- d) Over voltage
- e) Under voltage on DC side
- f) Earth fault on DC side
- g) AC / DC MCB trip

110 V DC Distribution Board (DB)

The distribution board shall be of floor mounting design. Entry for incoming and outgoing cables shall be from the bottom. Bus bars shall be of aluminium or copper.

Incomers, bus coupler and outgoing circuits shall be controlled by suitably rated double pole MCBs type suitable for DC application.

Constructional features, pre-treatment, painting and other aspects shall comply with the specifications for LV switchboard.

Aluminium earth busbar of suitable size shall be provided along the length of the DB at the bottom. Two nos. earthing terminals shall be provided on the external face of the board for connection to the earthing grid.

1.53 Variable Frequency Drives (VFD)

The Frequency drives shall be of Current Source Inverter Pulse Width Modulated (CSIPWM) with GTO/IGBT/IGCT/SGCT/DTC technologies or later version, which performs precise speed and torque control of standard squirrel cage motors with optimum efficiency. Each drive must have a soft starting feature and a by pass arrangement for DOL starting of motors. All frequency drives shall be suitable for data connectivity with PLC/SCADA system and shall have Ethernet TCP/IP communication port and protocol. The drives must be easily programmable. The drives shall be provided with surge protection, programmable lockable code. The Frequency drive shall have following characteristics:

- Accurate open loop torque control
- Torque step rise time typically less than 5 ms
- Speed control inaccuracy typically 0.1% to 0.5% of nominal speed
- 150% overload capacity for 60 second

Total Harmonic distortion shall comply with the provisions of IEEE 519. Necessary metering, self-diagnostic arrangement (including display and alarm facilities) shall be provided for local/remote monitoring.

Technical Parameters

Main connection

Voltage	: 3 phase, 415 +/- 10 % permitted tolerance
Frequency	: 45 to 65 Hz, maximum rate of change 17%/s
Imbalance	: Max. +/- 3% of nominal phase to phase input voltage
Fundamental Power factor	: 0.97 (at nominal load)

Motor connection

Voltage	: 3 phase, from 0 to applied incoming supply voltage, 3-phase symmetrical
Output Frequency	: 0 to 250 Hz
Frequency Resolution	: 0.01 Hz
Continuous Current	: 1.0 * I2N(normal use)
Short Term Overload	: I2max = 1.1 * I2N
Capacity (1min./10min)	
Field Weakening point	: 8 to 300 Hz
Acceleration Time	: 0 to 1800 sec
Deceleration Time	: 0 to 1800 sec
Efficiency	: Min. 97% at nominal power level

Environment limits
Ambient temperature : 0 to 45 deg. Cent.

General Standard Control Connections or as per Process Requirement

- 3 programmable differential analogue inputs (1 voltage signal, 2 current signals)
- 7 programmable digital inputs
- 2 programmables analogues outputs (current signal)
- 3 programmable digital outputs (from C relays)
- Power Torque Speed value must be configurable to the ethernet tcp/ip port for their remote data acquisition in PLC/ SCADA.

Protection

- Over current
- Short circuit at start-up
- Input phase loss
- Output phase loss
- Motor overload
- Earth fault
- Overvoltage
- Undervoltage
- Over temperature
- Motor stall

Application macros

The features a selection of built-in, pre-programmed application macros for configuration of inputs, outputs, signal processing and other parameters. It shall have interfacing facilities to communicate data to SCADA system. These include:

- FACTORY SETTING for basic industrial applications
- HAND/AUTO CONTROL for local and remote operation
- PID CONTROL for closed loop processes
- TORQUE CONTROL for process where torque control is required.
- SEQUENTIAL CONTROL for processes where torque control is required.
- USER MACRO 1 and 2 for user's own parameter setting
- Comprehensive testing and diagnostic function

Tests

Each unit of Variable frequency drive shall be tested at the manufacturer's work with the motor they have been assigned to work for at the STP. Test result must satisfy the efficiencies on various loads and at different frequency levels against their quoted values.

1.54 Lighting System Equipment

Lighting system shall comply with the following International Standards, including IEC 60083, 60598, 60669, 60884, 60906 and 60947



General Requirements

Lighting system equipment shall cover lighting panels, lighting fixtures, switches, receptacles with switches, for outdoor lighting - lighting masts, street lighting poles, etc.

Normal and emergency lighting for indoor and outdoor areas shall be provided.

The Concessionaire shall provide emergency lighting in the vital installation including pump house, switchboard room, office building, administration areas, etc. 10% of the total normal lighting shall be emergency type.

Galvanized conduits shall be used for all exposed wiring and PVC conduit for concealed wiring conforming to CPWD standard "General Specifications for electrical works , part 1 Internal – revision 2013". Minimum size of conduit shall be 20 mm / 25mm for exposed / concealed conduits respectively. Wiring inside the pump house, switchboard room and other areas shall be concealed type.

Wires used for conduit wiring of lighting fixtures / ceiling fans and receptacles shall be 250/440V grade, PVC insulated, single core, stranded copper conductor wires of sizes not less than 2.5 sq. mm and 4 sq. mm respectively. Wires shall conform to IS standards. Three individual wires with proper color coding (P-N-E) shall be used for wiring and no joint in wires between conduit is allowed. 3 core x 2.5 sq. mm. copper cable shall be used for circuiting of peripheral lighting.

Lighting panels

Lighting panels shall be of wall mounting type and fabricated out of 1.6 mm. thick cold rolled sheet steel. Incomer circuit shall be controlled by a switch disconnecter with a link in the neutral circuit. Outgoing circuits shall be controlled by single pole MCBs of minimum 10A rating and a link in the neutral circuit. TPN MCB shall be provided for street lighting/ area lighting purposes. Breaking capacity of MCBs shall not be less than 10 kA. Residual circuit breakers (RCCBs) shall be used on all lighting and receptacle circuits.

It shall be possible to terminate incoming and outgoing circuits from top and bottom. Knock-out for cable / conduit entries for all the circuits shall be provided. Separate circuits shall be provided for control of lighting fixtures and receptacles. Each phase shall have at least one spare circuit.

The panel shall be provided with 3 phase and neutral copper busbar adequately rated to cater to the requirement of all the outgoing circuits. Two earthing terminals shall be provided external to the panels for terminating the external earthing conductor.

The panel shall be internally wired using color coded, stranded copper conductor, PVC insulated wires of 1100 V grade.

The panels shall have hinged door, gasketed all round and provided with handle lock. Operation of incomer switch or MCBs shall be possible without opening the door.

Detailed specification of lighting panel and its accessories (e.g. busbar, MCB, indicating instrument, indicating lamp, etc.) are described at MV and LV switchboard.

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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 IP66. The fixtures shall be suitable for operation on a nominal supply of 240 V, single phase, 50 Hz, AC with a voltage variation of + 3 %.

Fixtures shall be complete with internal wiring, lamp, holder, ballast, reflector, louvres / perspex, etc. as required for their satisfactory operation. Fixtures shall be energy efficient and ballast shall be electronic low loss type. All indoor lighting fixture for office and control room shall be decorative type and for remaining areas it shall be industrial type.

The power factor of the luminaries shall be maintained at 0.95.

LED lamp shall be 'Tri-band' color temperature of the luminaire shall be in the range of 5000 k – 6000k (CCT as per BIS).

Lighting fixture reflectors shall generally be manufactured from steel or aluminum sheet of not less than 20 SWG thickness. Each fixture shall be complete with a four-way terminal block for connection and looping of incoming and outgoing cables. Each terminal shall be able to accept two 2.5 mm² copper stranded conductors. Each lighting fixture shall be provided with an earthing terminal suitable for connecting 16 SWG copper stranded conductor. All metal or metal enclosed parts of the housing shall be bonded and connected to the earth terminal to ensure satisfactory earthing continuity throughout the fixture. All reflectors and louvers shall be finished to the same standard as the fixture housing.

The enamel finish shall have a minimum thickness of 2 mils for outside surface and 1.5 mils for inside surfaces. The finish shall be non-porous and free from blemishes, blisters, and fading.

Size of wire chosen shall be such as to limit the voltage drop to within 3 %. Minimum area of conductor shall be 1.5 sq mm stranded copper for lighting and 2.5 sq mm / 4 sq mm for 5A / 15A receptacle circuits respectively, and current density shall not exceed 2.5 A/sq mm. Generally, not more than 8 to 10 lighting points shall be wired in one circuit. For calculating connected loads of various circuits, a multiplying factor of 1.25 shall be assumed on the rated lamp wattage for sodium vapour and fluorescent lamp fixtures to take into account the losses in the ballast. A loading of 100 watts and 500 watts shall be assumed for each, single-phase 5 amps and 15 amps receptacles respectively. Wires belonging to different phases shall not be run in the same conduit. However, more than one circuit on the same phase can be run in the same conduit. For every phase wire, a separate neutral wire shall be run. Neutral wire for different phases shall not be looped.

The following types of fixtures shall be considered for various areas. The construction features are indicative. Equivalent or superior feature is acceptable.

General purpose flood lighting fixtures - Housing with integral control gear from die-cast aluminum alloy, vitreous enameled, and with electrochemically brightened anodized aluminum

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reflector, clear, heat resistant glass with rubber gasket secured to housing by a ring, cast iron base and MS cradle for turning in horizontal and vertical planes and lockable in desired position, suitable for max. 3000 W LED lamp. These fixtures shall be used for illumination of outdoor area for providing general illumination.

Gate post lights - Top canopy spun from aluminum sheet and vitreous enameled. Spigot shall be made of die-cast aluminum and vitreous enameled. Fixture shall be suitable for 70 W HPSV/MH lamp.

Fluorescent tube fixtures - Housing made from mild steel sheet and stove enameled white. Reflector assembly made from electrochemically brightened anodized aluminum sheets secured to housing with spring loaded triggers and suitable for 2/3 nos. 36 watt triphosphor coated tubes. These fixtures shall be used in switchboard room and other areas. Where false ceiling is provided, fixtures shall be suitable for recessed mounting. For non-false ceiling office areas, decorative type fixtures shall be used.

Street lighting fixtures for the approach road shall be weather-proof, suitable for 70 W / 150 W LED lamp and shall be cut-off type. The fixtures shall be of die-cast aluminum with electrochemically brightened anodized aluminum reflector and with transparent polycarbonate cover. The degree of protection shall be IP66. Street lighting control (switching ON and OFF automatically) shall be done by photo-electric sensor or by timer.

Lighting fixture used for pump house and other areas with high ceiling shall be medium/high bay type suitable for 150/250/400 W LED lamps. These shall have housing with integral control gear of from die-cast aluminum alloy, electrochemically brightened anodized aluminum reflector, etc.

1200mm sweep ceiling fans shall be provided in areas such as offices, etc. as per design requirement. Adequate ventilation arrangements shall be made for enclosed areas where ceiling fans are not proposed to be installed or cannot be provided. Power supply for the ceiling fans shall be derived from lighting circuits. Ceiling fans shall be complete with all accessories. Regulators shall be electronic (triac) type.

The work shall comprise wiring in heavy gauge (minimum 16 SWG) GI conduits, fixed and supported at intervals of 300 mm on walls, ceiling etc.; installation of light control switches and receptacles housed in GS boxes; earthing with 16 SWG copper wire run along the conduit and clamped to it at every 300 mm; and termination of cables/wires at lighting panels, light control switches, receptacles, lighting fixtures etc., as required. The minimum size of conduit shall be 20 mm. Space factor (ratio of total wire area to internal conduit area) shall be 40 %. Concealed conduiting shall be provided to all building / office areas. For pump house area, the Concessionaire shall adopt surface conduiting also.

Receptacles and Switches – It shall be weather-proof for outdoor application. For Pump-house area and Switchgear room, industrial type receptacles with switch shall be provided. For Office areas, it shall be decorative type. 3 phase welding receptacles shall also be provided as per requirement.

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The lighting poles for streetlights shall be of tubular / swaged type steel poles, circular in construction. The steel poles shall be coated with bituminous preservative paint on the inside as well as embedded outside surface. Exposed outside surface of the steel poles shall be painted with one coat of red lead oxide primer. After completion of installation, two coats of aluminum paint shall be applied. The supply of poles shall be complete with fixing bracket, necessary pipe reducer for fixing the fitting and also include the necessary associated pole mounted junction boxes. 2 nos. studs shall be provided on the pole for earthing. The lighting poles shall have an end cap with brackets for mounting HPSV/MH lamps (of suitable wattage) in weatherproof fittings, cut-off type or semi- cut off type luminaries. The brackets shall be welded to the pole and shall ensure an suitable overhang depending on height of the pole.

Junction boxes with terminals shall be supplied for branching and terminating the lighting cables, weatherproof and suitable for usage in outdoor areas. The junction boxes shall be dust and vermin proof and shall be fabricated from 2 mm CRCA sheet steel and shall be complete with removable cover plate with gaskets, two earthing terminals each with nut, bolt and washer. The Concessionaire shall provide support arrangement (through 25 x 4 mm GI flat U clamp) for proper fixing of the junction box to the pole.

The boxes shall be hot dipped galvanized / painted with on shop coat of red oxide zinc chromate primer followed by a finishing coat of paint. Suitable rubber gaskets shall be provided on the doors of the junction boxes. The junction boxes shall have a locking facility, suitable to be opened by a common panel key for all the junction boxes. The boxes shall have provision for mounting on the poles. Suitable knockouts for the entry for cable / conduit entry shall be provided with terminal blocks, HRC fuses etc.

The terminal blocks shall be mounted securely on brackets welded to the back sheet of the box. The terminals shall be 1.1kV grade, one piece construction complete with barriers, galvanized nuts, bolts, washers and provided with identification strips of PVC. The terminals shall be made of copper alloy and shall be of box clamp type. Double compression brass glands shall be provided for entry / exit of the cables into the junction box.

Illumination Levels

Lighting system shall be designed to achieve the average maintained levels of illumination as indicated below. The Concessionaire shall be required to measure the actual levels and carry out necessary modifications to accomplish specified levels. It is to be noted that the values measured after installation will exceed those specified due to inclusion of light loss factor in the calculation. Measurement shall be carried out after 100 burning hours.

The illumination system shall be so designed that the uniformity factor is of acceptable level and that the glare is within limits. The ratio of maximum to minimum illumination levels shall not exceed 20 in outdoor area.

The following values of 'light loss factor' shall be considered for design:

- | | | | |
|----|-----------------------------|---|------|
| a) | Indoor air-conditioned area | : | 0.85 |
| b) | Other indoor areas | : | 0.85 |
| c) | Outdoor area | : | 0.85 |

The Concessionaire shall furnish detailed design calculations, uniformity factors, ratio of maximum to minimum illumination levels, ratio of average to minimum illumination levels, glare values, etc. for approval. Detailed characteristics of various types of fixtures including photometric curves and tables shall also be furnished for review.

1.55 Receptacles with switches

Adequate number of receptacles of 6A, 16A and 32A rating with MCBs suitable for operation on 230 V AC, 1 phase, 50 Hz supply shall be provided as detailed below:

- a) Decorative and industrial type shall be proposed in relevant areas.
- b) Receptacles proposed for outdoor installation shall be of weatherproof design of degree of protection IP65.
- c) Single phase receptacle shall be provided with a switch / MCB of the same current rating, housed in the same enclosure. Three phase receptacles shall be associated with a MCB of the same rating, housed in the same enclosure.

1.56 Water Coolers

General

Water cooler shall conform to IS 1475/78 with latest amendment suitable for operation on 230 volts $\pm 10\%$, 50 cycle's single phase AC supply. It shall be supplied with hermetically sealed type suction cooled compressor with overload protection conforming to IS 10167. It shall have cooling capacity of 40 liters per hour with storage capacity as 80 liters. The other technical parameters are as under:

Sr. No.	Particulars	Parameter
1	Overall Dimensions of	
	Unit	
	Width	590 mm
	Depth	735 mm
	Height	1555 mm
	Tank	
	Width	485 mm
	Depth	455 mm
	Height	485 mm
2	Details of Cabinet	
	Material of Construction	CRCA Sheet/Coated GI
	Thickness	1 mm
	Surface Treatment	Powder Coated
	Type of finish	Structural

Sr. No.	Particulars	Parameter
	Dimensions of SS front panel below water outlets	410mm X 465 mm
3	Details of pedestal	
	Material of construction	Stainless steel
	SS conforming	AISI 304
	Thickness	2.65 mm
	Method of securing to the cabinet	SS bolts washer and nuts
5	Rated voltage of water cooler	230 ±10 % volts
6	Details of compressor	
	Capacity of compressor	900 Kcal per hour
	Max output of compressor motors	0.25 KW
	Rated	
	Current	3.1 (nominal) Amps
	Speed	2850 RPM
	Voltage	230±10 % volts
	Maximum full current of compressor	3.4 Amps
	Class of insulation	B
	Power consumption (max) during operation under capacity rating test condition	575 watts

1.57 Cabling system installation

General

In order to avoid hazards to personnel moving around the equipment, which is kept charged after installation before commissioning, such equipment shall be cordoned off by suitable barriers to prevent accidental injury.

Switchboard shall be installed on finished surfaces. Proper aligning, joining of various vertical shipping sections, busbar connections, inter panel wiring, etc. will be the responsibility of the Concessionaire.

The Concessionaire shall take utmost care in handling instruments, relays and other delicate mechanisms. Wherever the instruments and relays are supplied separately, they shall be installed only after the erection of switchboards is complete.

Cabling System

All apparatus, connections and cable work shall be designed and arranged to minimize risk of fire and any damage, which might be caused in the event of a fire.

Cables shall be laid directly buried in earth, on cable trays in built-up trenches, in conduits / pipes along walls / structures / foundations / ceilings, etc. The Concessionaire's scope of work includes unloading, excavation, laying, backfilling, fixing, bending and terminating the cables. The Concessionaire shall supply the necessary material and accessories required for installation and

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termination of the cables which shall include but not be limited to items such as glands, lugs, terminating accessories, hardware, consumables, saddles / spacers, GI conduits / pipes, cable identification tags, protective bricks, civil materials, etc.

Buried cables

Cable installation in outdoor areas shall be carried out in directly buried cable trenches. Stabilized thermal backfilling shall be used for directly buried cables. Cabling from trenches up to junction box / equipment, etc. shall be carried out in GI conduit / pipes of class B. Provision of GI pipe sleeves in trench wall shall be the Concessionaire's responsibility. Where cables cross roads or water / sewage pipes, the Concessionaire shall provide rows of 150 mm diameter GI pipes in a concrete block for passage of cables. Concessionaire shall also lay spare pipes for future use. Alternatively, Concessionaire shall provide concrete cable duct for road crossing. LV cables shall be buried at a depth of minimum 750 mm while HV and MV cables shall be buried at a depth of minimum 1000 mm. For road crossings, the pipe for the cables shall be buried at not less than one-meter depth.

Directly buried cables shall be laid on a 75 mm thick riddled and compacted earth bed. The cables shall then be covered on top and at their side with riddled earth to a depth of about 150mm. This shall then be gently pulled down to a depth of about 100 mm above the top of uppermost cable to provide bedding for the protective concrete cable covers, which shall be placed centrally over the cables. The protective cable covers shall be of reinforced concrete. The RCC covers shall have one hole at each end to tie them to each other with GI wires to prevent displacement. The trench should be then backfilled with the excavated soil and well rammed in successive layers of not more than 300 mm thick, with the trenches being watered to improve consolidation, wherever necessary. To allow for subsidence, a crown of earth not less than 50 mm in the center and tapering towards the sides of the trench should be provided.

All cables to be routed along any particular route shall be laid at one time to avoid repeated excavation, etc. Each cable shall be tagged with numbers. The tag shall be of aluminum with the number punched on it and securely attached to the cable / conduits by not less than two turns of 20 SWG GI wire. Cable tags shall be of rectangular shape for power cables and of circular shape for control cables. Cables tags shall be provided on all cables at each end, on both sides of wall / floor crossings, on each duct / conduit entry, at each bend/ corner and at every thirty (30) meters in cables trench / tray racks on straight run.

Where groups of HV, LV and control cables are to be laid along the same route, suitable metallic barriers to segregate them shall be provided. When power cables are laid in the proximity of communication cables, minimum horizontal and vertical separation of 300 mm shall be maintained. Power and communication cables shall, as far as possible, cross at right angles to each other.

Cables in trays

Cables in trays shall be cleated individually or in a group using GI saddles. Interval for cleating shall not exceed 1500 mm.



In case of laying on cable trays / racks, power and control cables shall be laid in separate cable trays, the order of laying of various cables being as given below:

- a) HV cables on top tiers
- b) LV cables on subsequent tiers
- c) Control, instrumentation and other service cables in bottom-most cable tier.

Ladder type GI cable trays and painted rack support shall be installed in cable trenches for power cables. Perforated trays shall be used for control and instrumentation cables. Embedded flats for fixing cable tray supports shall be provided in cable trenches to support the cable trays during civil works. Where such flats cannot be used, the fixing of cable trays shall be done using anchor fasteners. All cable trays shall be earthed at a regular interval.

The cable trays shall be complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories and hardware. Cable trays and accessories such as tees, elbows, reducer, etc. shall be fabricated out of minimum 2 mm thick sheet of hot dip galvanized sheet except for trays of width 300 mm and lower for which 16 G GS sheet is acceptable. Bends, tees, etc. shall be supplied or fabricated at site, as required. Cable tray supports such as angles, channels, etc. shall be of galvanized steel. Galvanizing thickness shall be not less than 85 micron.


Cable pulling

The cables shall be laid in built-up trenches, directly buried in ground, or on cable trays, vertical raceways, clamped on structures / walls / ceiling, pulled through pipes and conduits, etc. The scope of cable installation shall include excavation and backfilling (in case of buried cable trench), laying, pulling of cables, proper dressing of cables on cable trays, racks, vertical raceways and supply and installation of cable tags, saddles, spacers and nylon chord for tying as required. The cost of supplying covers for cable route / joint markers, supply of sand and cover plates are included in the scope of the Concessionaire.

Standard cable grips and reels shall be utilized for cable pulling. The maximum pull tension shall not exceed the recommended value for the cable measured by the tension dynamometer. In general, any lubricant that does not injure the overall covering and does not set up undesirable conditions of electrostatic stress or electrostatic charge may be used to assist in the pulling of insulated cables in conduit / pipes and ducts.

After pulling the cable, the Concessionaire shall record cable identification with date pulled neatly with waterproof ink in linen tags / aluminum tag and shall securely attach such identification tags. Identification tags shall be attached to each end of each cable with non-corrosive wire. The wire must be non-ferrous material on single conductor power cable. Tags would further be required at intervals on long runs of cables on cable trays and in pull boxes. Cable and joint markers and RCC warning covers shall be provided wherever required.

Each cable shall be pulled into the particular conduit / pipe and shall be taken from the particular reel designated for the run. In hand holes, pull boxes or junction boxes having any dimension over 1000 mm, all conductors shall be cabled and / or racked in an approved manner. Care shall be taken to avoid sharp bending or kinking cables, damaging insulation or stressing cable beyond manufacturer's recommendations in pulling. Cable shall be protected at all times from mechanical

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injury and from absorption of moisture at unprotected ends. The bending radii for various types of cables shall not be less than 12/15 times the overall diameter of the cable for armoured cables and 15/20 times the overall diameter of the cable for unarmoured cables.

Cables on cable racks and in conduits / pipes shall be formed to avoid bearing against edges of trays, racks, conduit / pipes or their supports upon entering or leaving racks or conduit / pipes.

Splices shall be made by Concessionaire for each type of wire or cable in accordance with the instructions issued by cable manufacturers. Before splicing, insulated cables shall have conductor insulation stepped and bound or penciled for recommended distance back from splices to provide a long leakage path. After splicing, insulation equal to that on the spliced conductors shall be applied at each splice.

At cable terminal points, where the conductor and cable insulation will be terminated, terminations shall be made in a neat, skillful and approved manner by specially trained staff. Terminations shall be made by the Concessionaire for each type of wire or cable in accordance with instructions issued by cable manufacturers.

Control cable termination shall be made in accordance with wiring diagrams, using proper color codes for the various control circuit.

When control cables are to be fanned out and corded together with a cord, the Concessionaire shall make connections to terminal blocks, and test the equipment for proper operation before cables are corded together. If there is any doubt about correctness of connection, the Concessionaire shall make a temporary connection with sufficient length of cable so that the cable can be switched to another terminal without splicing. After correct connections are established, cables shall be cut to their correct lengths, connected to terminals in the specified manner, and corded together where necessary to hold them in place in a skillful manner. Jointing of cables shall be in accordance with relevant Standards and manufacturer's instructions. Materials and tools required for cable jointing work shall be supplied by the Concessionaire. Cables shall be firmly clamped on either side of a 'straight through joint' at a distance of not more than 300 mm away from the joints. Identification tags shall be provided at each joint at all cable terminations.

Where cables pass through floor or wall openings or other partitions, suitable bushes / pipe sleeves of GI shall be provided by the Concessionaire. The Concessionaire shall seal the cables at the bushes / pipe sleeves using fire resistant material.

Cable seals shall be examined to ascertain if they are intact and that cable ends are not damaged. . Before joining is commenced, insulation resistance of both sections of cables to be jointed shall be checked by megger.

In case of motor cables, after installation and alignment of motors, the Concessionaire shall complete the conduit / pipe installation, including a section of flexible conduit / pipe between motor terminal box and trench / tray, if necessary. The Concessionaire shall install and connect the power, control and heater supply cables as per equipment manufacturer's drawings /

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instructions. The Concessionaire shall be responsible for correct phasing of the motor power connection and shall interchange connections at the motor terminal box, if necessary, after each motor is test run.

Connections to recording instruments float switches, level electrodes, limit switches, pressure switches, thermocouples, thermostats and other miscellaneous equipment shall be done as per manufacturer's drawings and instructions.

In each cable run, some extra length shall be kept at a suitable point to enable one or two straight-through joints to be made, should the cable develop fault at a later date.

1.58 Conduits / pipes

Where cable trench is not available, cables shall be laid in GI conduits / pipes routed along walls / columns / beams / steel structures or buried in concrete slabs, etc. to suit site conditions. GI conduits shall be Class C type. Supply and installation of GI conduits / pipes, their accessories such as bends, tees, couplers, etc., saddles, spacers, junction / marshalling boxes and GI hardware required for installation shall be included in the Concessionaire's scope. Interval between supports shall not exceed 500mm. For multiple cables, maximum utilization factor (ratio of total wire area to internal conduit area) shall be 50% of the conduit area.

Non-metallic conduits / pipes shall be used for single core cables of a 3 phase circuits.

1.59 Junction boxes / Marshalling boxes

Junction boxes / marshalling boxes shall be hot-dip galvanized, weather proof with IP 55 degree of protection and shall be provided with cable glands for incoming and outgoing cables. The boxes shall be fabricated from 1.6 mm thick sheet steel and galvanized. The boxes shall be suitable for mounting on walls / columns / steel structures, etc. and shall be supplied with mounting accessories. The front covers of the boxes shall be removable and provided with gaskets. All the terminals shall be complete with insulated barriers, terminal studs, washers, nuts, etc. The boxes shall be effectively earthed.

1.60 Fire Proof Sealing (FPS) System

Fire proof sealing system shall be provided and shall consist of

- a) Fire-stops / fire-seals for sealing of cable / cable tray and conduit / pipe penetrations, both horizontal and vertical, through brick or RCC walls / floors, to prevent the spread of fire from one area to other areas by fire-resistant barriers.

The FPS system shall also include all the necessary accessories and equipment required for supporting, holding in position, fixing and installation of the fire-stop.

The FPS system shall comply in all respects with the requirements of the codes and standards mentioned herein IEC-111 and IEC-112.

Fire stop / seal

The FPS system adopted for cables or cable trays penetrating through walls and floor openings, or cables passing through embedded conduits / pipes / pipe-sleeves, constitutes a 'fire stop / seal', which is meant to prevent spreading of fire between areas separated by fire-resistant barriers.

Performance requirements

Requirement of fire stops

- i. The material, design and construction of the fire stops shall be such as to provide a fire-rating of 120 minutes for a fire on any side and meet all requirements listed in this specification and the relevant codes and standards.
- ii. The materials used in the fire stops shall be non-hygroscopic, compatible with the type of cables.
- iii. The fire stops shall be suitable for retrofitting of cables through the penetration seal without disturbing the sealing of the cables already existing.

Application of fire proof sealing system

a) Fire stops

Fire stops shall be provided for cable penetration openings listed below

- i. The passage of cables / cable trays pipe sleeves / embedded conduits through walls / floors.
- ii. Vertical raceways, if any, which carry cables between successive floors, through openings provided in the RCC floor slab, shall be sealed by fire stops at each floor level.
- iii. Cable entry through openings in floor slabs.

Performance Tests:

- a) The fire stops shall be subjected to the following type tests:
 - i. Fire Rating Test
 - ii. Hose Stream Test
- b) Type tests shall be conducted on different fire stop test specimens described above as per IEEE-634. The sizes of the fire stop test specimens shall be similar to the largest of the sizes being used in the plant.
- c) Preconditioning of fire stop test specimens
Before conducting the Fire Rating and Hose Stream tests, each test specimen shall be preconditioned for thermal ageing, water immersion and vibration.
- d) Test on Fire Stops
During the Fire Rating test, the transmission of heat through the cable penetration fire stop shall not raise the temperature on its unexposed surface above the self ignition temperature of the outer cable covering, the cable penetration fire stop material, or material in contact with the cable penetration fire stop, with a maximum temperature limit on the unexposed surface of 200°C.

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1.61 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 and 142, IEC 61024 and IEC-62305, 3043.

Designing the earthing and lightning protection systems as per the applicable standards and specific design basis listed below:

- a) Average value of soil resistivity as measured for different electrode spacing, at site. (from 2 to 100 Meter or more in steps of 5, 10 Meter. At least 20 nos. readings shall be taken over the plant area, each in two different directions)
- b) Permissible values of step and touch potentials based on weight of human being as 70 kg and Earth fault current of 40 kA for 1 seconds
- c) Gravel with surface resistivity of 3000 ohm-m
- d) Depth of burial of earth conductors of 600 mm below ground level
- e) Ground resistance with only electrodes of maximum 1 ohm.
- f) Ground resistance of earthing grid of maximum 1 ohm
- g) Corrosion allowance of at least 20 %
- h) Earthing conductor material shall be minimum 20 mm diameter and 3 m long GI Pipe.

Earthing and lightning protection system shall be provided to ensure equipment safety, personnel safety and to facilitate designed operation of protective devices during earth fault conditions in the associated system.

The Concessionaire shall install bare earth conductors as required for the system and individual equipment earthing. All the work such as cutting, bending, supporting, drilling, brazing / soldering/welding, clamping, bolting and connections to structures, equipment frames, terminals or other devices shall be in the Concessionaire's scope. All hardware and consumables such as fixing cleats / clamps, anchor fasteners, lugs, bolts, nuts, washers, brazing electrodes, flux, bituminous compound, anti-corrosive paint, etc. as required for the complete work shall be included by the Concessionaire.

Tap connections (earthing leads) of more than 500 mm long, from main earthing grid to equipment shall be embedded in the floor by the Concessionaire together with associated civil work such as chipping / chasing, concreting and surfacing, etc. The concrete cover over the conductor shall not be less than 50 mm.

The scope of installation of earth conductors in outdoor areas, buried in ground shall include excavation in earth up to 600 mm depth and 400mm width, laying of conductor at 600 mm depth, brazing as required of main grid conductor joints as well as riser's up to 500 mm above ground at required locations and backfilling. Backfilling material to be placed over buried conductor shall be free from stones and other mixtures. Backfill shall be placed in layers of 150 mm, uniformly spread along the trench and compacted. If the excavated soil is found unsuitable for backfilling, the Concessionaire shall arrange for suitable material from outside. Earthing conductors in outdoor areas shall be laid 1500mm away from buildings. The scope of installation of earth

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conductors in outdoor areas buried in ground, shall include excavation of earth up to 600 mm depth, brazing / welding of main grid conductor, joints as well as risers of length 500 mm above ground at required locations and then backfilling.

Wherever earthing conductor crosses underground service duct and pipes, it shall be laid 300 mm below them. If the distance is less than 300 mm, the earthing conductor shall be bonded to such service ducts / pipes.

The scope of installation of electrodes shall include installation of electrodes in constructed earth pits, and connecting to main buried earth grids. The scope of work shall include excavation, construction of the earth pits including all materials required for treatment (salt, charcoal, chemicals, etc.), placing the electrode and connecting to main earth grid conductors.

The work of embedment of earthing conductor in RCC floors / walls along with provision of earth plate inserts / pads / earth risers shall be done by the Concessionaire preferably before the floors / columns / walls are cast. The embedded conductors shall be connected to reinforcing rods wherever necessary.

The scope of installation of earthing leads to the equipment and risers on steel structures / walls shall include laying the conductors, brazing / cleating at specified intervals, brazing to the main earth grids, risers, bolting at equipment terminals and coating brazed joints by bituminous paint.

Earthing and lightning protection system conductors along their run on walls / columns, etc. shall be cleated at an interval of 750 mm.

Main earthing conductor shall be buried below the trench at crossing points.

Metallic frames of all electrical equipment shall be earthed by two separate and distinct leads and then connected with earthing system.

Neutral of a transformer shall be earthed to two separate earth electrode pit by two separate earth leads.

Crane rails shall be connected to the earthing system.

An earthing mat shall be provided under the operating handle of the disconnector. Operating handle of the disconnector and the supporting structure shall be bonded together by a flexible connection and connected to earth grid.

Metal pipes and cable conduits shall be effectively bonded and earthed by earthing clamps efficiently fastened to the conduit at both ends.

Neutral connection shall never be used for equipment earthing.

A separate earth electrode shall be provided for each lightning arrester and for each lightning conductor down comer.

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Cable sheaths and screen shall be bonded to the earthing system.

Armour of multicore cables shall be bonded to earthing system at both ends, while that of single core cables shall be earthed at source end only. The size of conductor for bonding shall be appropriate with the system fault current.

Conduits, fixtures, junction boxes, etc. shall be bonded to the earthing system by 16 SWG diameter copper wire looped from lighting panel earth bus onwards. Outdoor lighting poles, junction boxes, etc. shall be earthed by 12 SWG copper wires.

Street light pole and junction box shall be earthed with 12 SWG tapped off from the 25x3 mm GI earthing conductor to be laid along the street lighting cable.

All metallic parts such as transformer, fence, gate, etc. shall be properly earthed.

Wherever earthing conductor passes through walls, galvanized steel pipe sleeves shall be provided for the passage of earthing conductor. The pipe ends shall be sealed by the Concessionaire, by suitable water-proof compound. Water stops shall be provided wherever earthing conductor enters the building from outside below ground level.

All connections in the main earth conductors buried in earth / concrete shall be brazed type. Connections between main earthing conductor and earth leads shall also be of brazed type. Connection between earth leads and equipment shall be by two bolts.

Installation of lightning conductors on the roof of buildings shall include laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods wherever necessary, laying, fastening / cleating / brazing of the down comers on the walls / columns of the building and connection to the test links to be provided above ground level.

Lightning protection system down-conductors shall not be connected to the conductors of safety earthing system above ground level. The lightning protection system for the structures shall be installed by forming a grid of exposed continuous earth conductors and taking down-comers along the walls/supports of the structure and terminating the same at earth pits. A separate earth electrode shall be provided for each lightning arrester and for each lightning conductor downcomer. The lightning protection system earth pits shall be inter-connected to form the safety earthing grid provided for the building / structure. The safety earthing grid shall be connected to the mains grid of the switch yard.

The lightning protection air termination rods and / or horizontal air termination conductors shall be fixed in a firm manner. The necessary accessories such as cleats, clamps, brazing materials, bolts, nuts, shall be supplied by Concessionaire.

Air termination systems shall be connected to earthing system by down conductors. There shall not be any sharp bends, turns and kinks in the down conductors.

All joints in the down conductors shall be of brazed type. All metallic structure within 1 meter of down conductors shall be bonded to lightning protection system.

Every down conductor shall be provided with a 'test link' mounted on wall / column at about 1000 mm above ground level housed in a 16 SWG GS enclosure. The test joint shall be directly connected to the earth electrode.

The lightning protection system shall not be in direct contact with underground metallic service ducts, cables, cable conduits and metal enclosures of electrical equipment. However, all metal projections, railings, vents, tanks, etc. above the roof shall be bonded together to form a part of roof grid.

Lightning protection system down conductors shall not be connected to other earthing conductors above ground level. In addition, no intermediate earthing connection shall be made to lightning arresters and transformer, whose earthing leads shall be directly connected to electrode pit.

1.62 Earth electrodes and pit

Treated earth pits shall comprise of treatment material such as salt and charcoal or any other conductivity enhancing compound. Treatment material placed around the electrode shall be finely graded, free from stones and other harmful mixtures. Backfill shall be placed in 150 mm thick uniformly spread and compacted layers. If excavated soil is found unsuitable for backfilling, the Concessionaire shall arrange for a suitable soil from outside.

Earth electrodes shall be fabricated from minimum 20 mm diameter, 3m long, copper rod or 40 mm diameter, 3m long GI pipe. The minimum spacing between adjacent electrodes shall be 6 m.

Electrodes shall, as far as practicable, be embedded below permanent moisture level.

Test pits with concrete covers shall be provided for periodic testing of earth resistance. Installation of electrodes in test pits shall be suitable for watering. The necessary materials required for installation of test pits shall be supplied and installed by Concessionaire. The installation work shall also include civil works such as excavation / drilling and connection to main earth grid. Earth electrode pit marker shall be provided.

Treated earth pits shall be treated with suitable treatment material mentioned above, if average electrical resistivity of soil is more than 20 ohm meter.

Conductor size for connections to various equipments shall be as per the table as follows:

Equipment		Conductor Size
Motors	Up to 11 kW	8 SWG GI wire
	11 kW up to 22 kW	4 SWG GI wire
	22 kW up to 37.5 kW	25 x 3 mm GI flat
	37.5 kW to 90 kW	25 x 6 mm GI flat
	90 kW to 200 kW	40 x 6 mm GI flat
	Above 200 kW	50 x 10 mm GI flat

Equipment		Conductor Size
PCC		50 x 6 mm GI flat
PDB		50 x 6 mm GI flat
DG and other panel		50 x 6 mm GI flat
Local control station, street light pole and its junction box		8 SWG GI wire
All switchyard equipment		50 x 6 mm GI flat
Main earth grid		50 x 6 mm GI flat
Lighting Panel		25 x 3 mm GI flat
Indoor fixtures		14 SWG GI wire

All paint, scale etc. shall be removed before earthing connections are made.

Anchor bolts or fixing bolts shall not be used for earthing connections.

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Schedule 11 (Part E)
Instrumentation Works

1.1 General

The Concessionaire is required to adopt the latest technology with compatible automation system having fully automatic process control,

The "Plant Control Configuration" attached to the Scope of Works gives basic and minimum requirement of Instrumentation and Control Automation with electrical interface.

ON LINE to monitor and control the plant from a single location. The plant data collected through online monitoring of water quality and flow shall be made available via the internet to various statutory bodies.

1.1.1 General requirements

This part covers the general requirements for the design, supply, installation, inspection and testing of the instrumentation and automation solution proposed for flow measurement, monitoring of water quality and control of plant.

1.1.2 Reference Standards

Unless otherwise approved, instrumentation shall comply with relevant quality standards test procedures and codes of practice collectively referred to as Reference Standards including those listed below in accordance with the requirements detailed elsewhere in this specification. IEC 60381-1:1982 Analogue signals for process control systems.

ISA Water/Wastewater and Automatic Controls (WWAC) Proceedings in 2016 can be referred for advances in instrumentation, SCADA (supervisory control and data acquisition), and automatic control applications can improve the treatment and distribution of water, as well as the collection and treatment of wastewater. Other topics covered include:

- Cybersecurity
- Wireless communications
- DNP 3.0 protocol
- Smart water
- Alarm management
- Optimizing process controls

Specification for direct current signals:

- IS 15953 : 2011
- ISA-5.1-2009
- IEC 62443
- IEC 61346
- IEC 60870-6- all parts
- IEC 61131-3 industrial control programming standard advancements
- IEC 61850 all parts ranging from 1 - 10
- IEC 61850-10:2012 - Conformance testing

- IEC TR 61850-90-3:2016 - Using IEC 61850 for condition monitoring diagnosis and analysis + IEC TR 61850-90 all parts
- IEC 60947-4-2:1999 Specification for low-voltage switchgear and Control Gear. Contactors and motor-starters. A.C. semiconductor motor controllers and starters.
- IEC 60947-4-3:1999 Specification for low-voltage switchgear and Control Gear. Contactors and motor-starters. Contactors and motor-starters. AC semiconductor controllers and contactors for non-motor loads.
- IEC 60770-1:1999 Transmitters for use in industrial-process control systems. Methods for performance evaluation.
- BS ISO 1217:1996 Displacement compressors. Acceptance tests.
- ISO 2112:1990 Specification for aminoplastic moulding materials.
- ISO 6817:1997 Measurement of conductive liquid flow in closed conduits. Method using electromagnetic flow meters.
- BS EN 837-1:1998 Pressure gauges. Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing.
- BS EN 1057:1996 Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications.
- BS EN 1092-1:2002 Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges.
- BS EN 1563:1997 Founding. Spheroidal graphite cast iron.
- BS EN 60529:1992 Specification for degrees of protection provided by enclosures (IP code).
- BS EN 60534-1:1993 Industrial-process control valves. Industrial-process control valves. Control valve terminology and general considerations.
- BS EN 60546-1:1993 Controllers with analogue signals for use in industrial-process control systems. Controllers with analogue signals for use in industrial-process control systems. Methods for evaluating performance.
- BS EN 60584-2:1993 Thermocouples. Tolerances.
- BS EN 60654:1998 Operating conditions for industrial-process measurement and control equipment. All relevant parts.
- BS EN 60751:1996 Industrial platinum resistance thermometer sensors.
- BS EN 60873:1993 Methods of evaluating the performance of electrical and pneumatic analogue chart recorders for use in industrial-process control systems.
- BS EN 61000-6:2001 Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments.
- BS 89:1990 Direct acting indicating analogue electrical measuring instruments and their accessories. All parts.
- BS 90:1975 Specification for direct-acting electrical recording instruments and their accessories.
- BS 476 Fire tests on building materials and structures. All parts.
- BS 1042-1.4:1992 Measurement of fluid flow in closed conduits. Pressure differential devices. Guide to the use of devices specified in Sections 1.1 and 1.2.
- BS 1041-2.1:1985 Code for temperature measurement. Expansion thermometers. Guide to selection and use of liquid-in-glass thermometers.
- BS 1041-2.2:1989 Code for temperature measurement. Expansion thermometers. Guide to

selection and use of dial-type expansion thermometers.

- BS 1041-3:1989 Temperature measurement. Guide to selection and use of industrial resistance thermometers.
- BS 1041-4:1992 Temperature measurement. Guide to the selection and use of thermocouples.
- BS 1042-1.4:1992 Measurement of fluid flow in closed conduits. Pressure differential devices. Guide to the use of devices specified in Sections 1.1 and 1.2.
- BS 1123-1:1987 Safety valves, gauges and fusible plugs for compressed air or inert gas installations. Code of practice for installation.
- BS 1203:2001 Hot-setting phenolic and aminoplastic wood adhesives. Classification and test method.
- BS 1553-1:1977 Specification for graphical symbols for general engineering. Piping systems and plant.
- BS 1571-2:1975 Specification for testing of positive displacement compressors and exhausters. Methods for simplified acceptance testing for air compressors and exhausters.
- BS 1646-1:1979 Symbolic representation for process measurement control functions and instrumentation. Basic requirements.
- BS 1646-2:1983 Symbolic representation for process measurement control functions and instrumentation. Specification for additional basic requirements.
- BS 1646-3:1984 Symbolic representation for process measurement control functions and instrumentation. Specification for detailed symbols for instrument interconnection diagrams.
- BS 1646-4:1984 Symbolic representation for process measurement control functions and instrumentation. Specification for basic symbols for process computer, interface and shared display/control functions.
- BS 1794:1952 Specification for chart ranges for temperature recording instruments.
- BS 2765:1969 Specification for dimensions of temperature detecting elements and corresponding pockets.
- BS 3680 Measurement of liquid flow in open channels. All relevant parts.
- BS 3693:1992 Recommendations for design of scales and indexes on analogue indicating instruments.
- BS 4675-2:1978 Mechanical vibration in rotating machinery. Requirements for instruments for measuring vibration severity.
- BS 4999-142:1987 General requirements for rotating electrical machines. Specification for mechanical performance: vibration.
- BS 5169:1992 Specification for fusion welded steel air receivers.
- BS 5728-3:1997 Measurement of flow of cold potable water in closed conduits. Methods for determining principal characteristics of single mechanical water meters (including test equipment).
- BS 6004:2000 Electric cables. PVC insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring.
- BS 6739:1986 Code of practice for instrumentation in process control systems: installation design and practice.
- BS 7671:2001 Requirements for electrical installations. IEE Wiring Regulations. Sixteenth edition. Instrument Society of American Standards and Recommended Practices:
- S 5.1 Instrumentation symbols and identification

- S 5.4 Instrument loop diagrams
- S 7.3 Quality standard for instrument air
- RP 16.1 Terminology, dimensions and safety practices for indicating variable 2, 3 area meters
- RP 16.4 Nomenclature and terminology for extension-type variable-area meters (rotameters)
- RP 16.5 Installation, operation, maintenance instructions for glass tube variable area meters (rotameters)
- RP 16.6 Methods and equipment for calibration of variable area meters (rotameters)
- RP 18.1 Specifications and guides for the use of general purpose enunciators
- S 26 Dynamic response testing of process control instrumentation
- RP 31.1 Specification, installation and calibration of turbine flow meters
- S 37.1 Electrical transducer nomenclature and terminology
- S 37.3 Specifications and tests for strain gauge pressure transducers
- S 50.1 Compatibility of analog signals for electronic industrial process instruments
- S 51.1 Process instrumentation terminology
- RP 60.08 Electrical Guide for Control Centers

Installation works shall comply with all relevant local Indian Regulations including the Code of Practice for Electrical Wiring Installations – IS 732.

1.2 Basic Features

Each instrumentation system shall be designed, manufactured and installed to achieve the following basic requirements:

Basic Requirements

- To maintain the highest standards of availability, reliability and accuracy and to give clear warnings of any deterioration in performance
- To suit the abilities of the staff who will:
 - (i) Use the systems
 - (ii) Service the systems
- To measure, indicate, process, store and control the relevant parameters, as specified
- To give clear warnings of dangerous and other abnormal conditions and to initiate plant safety procedures, shutdowns and corrective measures as specified to assure the safety of 'operations and maintenance' personnel and that of the plant and to store and collate the data, as required
- To derive, present and utilize, as required, such additional data to facilitate:
 - (i) The most efficient operation of the plant
 - (ii) The routine maintenance of the plant

1.3 Design requirements for instrumentation and control systems (I&C)

The instrumentation, control and automation installations shall fully comply with design standards, regulations and the material and workmanship requirements of the Specification. The instrumentation control and automation systems shall comply with the relevant Indian Standards

being practiced as per the industry norms. All consumable items and spare parts shall be readily available within India.

All equipment and materials incorporated in the system shall be selected, designed and rated to operate under the defined performance duties and specified site conditions and to maintain a high level of operational reliability. The instrumentation control and monitoring system equipment and materials shall have an operational life of not less than 15 years.

Unless otherwise specified, all functions shall be transmitted electrically and all analogue signal-transmission systems shall be in accordance with IEC 60381-1:1982 or equivalent and shall use a signal of 4mA to 20mA dc. Where possible, measuring systems shall be designed so that any necessary power supply is taken from the appropriate instrument panel. Transmitting devices shall have integral indicators to monitor the output signal or connections suitable for use with a portable test meter, and shall be capable of meeting the requirements specified in the appropriate part of IEC 60770-1:1999 or equivalent. Equipment mounted in enclosures shall be suitable for continuous operation at the maximum internal temperature possible in service, due account being taken of internally-generated heat and heat dissipated by other plant. All components shall be rated adequately and circuits shall be designed so that change of component characteristics within the manufacturers' tolerances shall not affect the performance of plant. All equipment shall be designed to operate without forced (or fan) cooling.

All measuring instruments shall have zero and span adjustment. Instruments not mounted in panels shall be supplied complete with all brackets, stands, supporting steelwork and weatherproof enclosures (separate from the instrument cases) necessary for securing them in their working positions and affording complete protection at all times including periods of servicing, adjustment, calibration and maintenance. The installation arrangements for meters measuring conductivity, pH, dissolved oxygen, chlorine residual and ionic concentration shall include a sample bench and other facilities for operating portable test meters. Each installation shall incorporate a valve and pipework for obtaining a sample representative of the fluid at the position of the permanent meter, tundish and drain. If the measuring and sampling points are remote from each other, the test and sample facilities shall be provided at both points. Sample transport times shall be minimized by provision of a bypass and drain with control and isolating valves and a local flow meter to enable the correct sample flow to be adjusted. An automatic portable sampler shall be provided for collecting and transporting the samples from the sampling locations to the laboratory.

1.3.1 Instrument Design Criteria

The design criteria to be applied to instrumentation system shall be as follows:

- Instrumentation & Control (I&C) systems shall be selected, designed, manufactured, installed, tested and rated to operate under the defined performance duties and specified site conditions and to maintain a high level of operational reliability. Instruments mounted in field and on panels shall be suitable for continuous real time operation. All electronic components shall be adequately rated and circuits shall be designed so that change of component characteristics shall not affect the plant operation.

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- No custom made hybrid type integrated circuits shall be used in any circuit in instrumentation and control equipment.
- Instruments and loggers provided shall be able to carry out continuous real time monitoring and logging of selected water quality parameters.
- All instrumentation shall be suitable for continuous real time operation and be powered through the UPS.
- As far as possible and depending upon the location and availability of wireless services, all transmitting instruments and data loggers shall be of wireless type (GPRS / GSM based). In case of non-feasibility, the output of the transmitting instruments shall be 4-20 mA / 0-10V DC linear having two wire system.
- After a power failure, when power supply resumes, the instruments and associated equipment shall start working automatically.
- Unless otherwise specified, the normal working range of all indicating instruments shall be between 25% and 80% of the full scale range.
- The field instruments i.e. the instruments mounted outside the control panel shall be mounted at a convenient height of approximately 1.2 m above grade platform.
- Unless otherwise stated, field mounted electrical and electronic instruments shall be weatherproof to IP-65 or better.
- The instruments shall be designed to work at the ambient conditions of temperature, humidity, and contamination that may prevail at site. The instruments shall be given enough protection against corrosion. All wetted parts of instrument sensors shall be non – corrosive and suitable for use within sewerage environment.
- The performance of all instruments shall be unaffected for the $\pm 10\%$ variation in supply voltage and $\pm 5\%$ variation in frequency simultaneously.
- Unless otherwise specified, double compression glands shall be used for glanding the cable in field instruments and instrument control panel.
- All digital outputs shall be volt free.
- All probe type analyzers should be IP68 rated.
- All displays shall be of the digital type with no moving parts and should utilize back lit liquid crystal diode LCD/ LED technology.
- Instrumentation shall utilize solid state electronic technology and avoid the use where practical of any moving parts.
- Minimum maintenance requirements. The instruments selected shall be rugged and not require any consumables / filling solutions. Systems should be able to work with minimum power requirements.
- Lockable enclosure shall be provided for all the field mounted instruments.
- All the instruments and cabinets shall have tag plates / name plates permanently attached to them.
- All instruments to be used or installed within a corrosive sewerage environment shall be explosion proof and intrinsically safe.
- The data obtained from the online quality monitoring system shall be conveyed back via suitable communications protocol, to web servers hosted by a service provider. The service provider shall have the data storage capacity for next 15 years.
- Unless otherwise specified, all continuous online monitoring instruments shall be plug and play type.

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Instrumentation system shall be provided to monitor the following parameters

- Online Continuous Dissolved Oxygen Measuring System
- Ultrasonic Level Measurement
- Ultrasonic Differential Level Measurement
- Flow Measurement Instrument at Parshall Flume
- Gas Flowmeter (Thermal Mass Flow Measurement System)
- Pressure Transmitter
- Continuous Online Total Suspended Solids Analyzer
- Continuous Online pH Measuring System
- Online Residual Chlorine Measuring System
- Conductivity Meter
- Ammonia Analyzer
- Alkalinity Analyzer
- Total Nitrogen Analyzer
- Indicative BOD Analyzer
- Indicative COD Analyzer
- Indicative TOC Analyzer
- Measurement of CO₂, CH₄ and H₂S Gas Concentration
- Electro-Magnetic Flow Meter
- Online Gas Calorific Value Measurement
- Total Phosphorus
- Nitrate Analyzer

1.4 Instrumentation

1.4.1 Online Instruments

The online measurement at Inlet and outlet for continuous monitoring of the raw and treated sewage characteristics are specified below. However Concessionaire shall provide additional instruments to support their design.

At the Inlet Point and the Outlet Point

- Electro-Magnetic Flow Meter/ Ultrasonic Open Channel Flow Measurement
- Total Phosphorus Analyzer
- Conductivity Meter
- Continuous Online pH Measuring System
- Continuous Online Total Suspended Solids Analyzer
- Indicative BOD Analyzer
- Indicative COD Analyzer
- Online Residual Chlorine Measuring System
- Total Nitrogen Analyzer

Online instrument system shall have the ranges *in accordance with CPCB "Guidelines for*

continuous monitoring for Effluents” and CPHEEO.

1.5 Laboratory – Laboratory instruments and sampling system

The laboratory shall be housed within the administrative building and shall be equipped with instruments, equipment, chemicals and other infrastructure that is necessary to perform the routine analysis for the parameters as detailed in “Table 2”. The equipment shall be supplied with all the accessories that are necessary to make the equipment functional for analyzing parameters and generating daily reports. In addition to these, Concessionaire shall also provide necessary chemicals, glassware and reagents required for sample testing in the laboratory along with calibration standards / solutions for calibrating the instruments.

The quality of the sewage entering, passing and leaving the treatment plant shall be monitored via online monitoring equipment as well as manual sampling systems and tested daily, at least from the following parameters:

Table 2 – Parameters to be monitored

Sl. No.	Parameter
1.	BOD ₅ or BOD ₃
2.	pH
3.	SS
4.	Temp.
5.	COD
6.	TOC
7.	Ammonia
8.	Total Phosphorous
9.	Acidity, Alkalinity
10.	Ammonical Nitrogen
11.	Total Nitrogen
12.	MLSS/MLVSS
13.	Dissolved Oxygen
14.	SVI
15.	Total Hardness, Calcium Hardness
16.	Gas Analysis
17.	Calorific Value Monitoring
18.	Volatile Suspended Solids
19.	Total Solids
20.	Specific Gravity
21.	Moisture Content
22.	Total Coliform
23.	Faecal Coliform
24.	Total Dissolved Solids
25.	Bacteria, Escherichia Coli

Two portable samplers shall be provided to collect composite samples for monitoring from -

- Inlet chamber for raw Sewage
- At the outlet of Varanasi STP

The laboratory shall have the equipment, storage space and chemicals for all the chemical and bacteriological routine analyses. The area of laboratory shall be sufficient with sufficient length of working platforms and adequate no. of sinks. Area of laboratory shall be defined by Concessionaire as per the requirement of the Concession Agreement. At least the following equipment and all required laboratory chemicals / reagents given in Table 3 are to be provided by the Concessionaire within the scope of work and have to be replenished by him till the end of the O&M Period.

All lab based test instruments results shall be stored automatically and transferred to the PLC as well as web servers on real time basis for control and report applications.

Table 3: Lab Instruments

Sl. No.	Description
1.	Comparator test set for residual chlorine or chloroscope
2.	Single / Multi parameter meter for pH, Conductivity, DO, Ammonia and Phosphate
3.	Mains operated pH meter completed with one calomel electrode and glass electrode
4.	Turbidity meter - Bench Model
5.	Turbidity meter - Hand held (Portable)
6.	UV / VIS Spectrophotometer
7.	Water bath with 6 to 8 concentric holes and discs, electrically heated
8.	Hot plates – 25cm
9.	Ultrapure Water Plant
10.	Conductivity with TDS meter
11.	Refrigerator (280 litres capacity) double door / cooling cabinet for sample preservation
12.	Muffle furnace
13.	Electronic Burettes and Dispensers
14.	Magnetic stirrer
15.	Analytical balance (Electronic) with weight box – Resolution up to 4 decimal places
16.	Jar-Test apparatus – 6 Stirrers
17.	Centrifuge
18.	Flame photometer with gas cylinder
19.	Fume cupboard
20.	Field Test kit for cations and anions
21.	Depth Sampler
22.	Total Organic Carbon Analyser
23.	Sieve shaker with standard sieves and two pan balance weighing up to 200gm samples
24.	Hot Air Oven
25.	Autoclave
26.	Binocular microscope

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Sl. No.	Description
27.	Automatic Portable Sampler
28.	Pipette Box (Stainless Steel)
20.	Wooden Racks/Aluminium Racks
30.	Wire Baskets
31.	Cotton/ Aluminium Foils
32.	Burners (Bunsen) With Pilot Lamp
33.	Suction Flask (1 Litre Cap)
34.	Suction Pump
35.	Sampling Bottles
36.	Measuring Cylinders (1000 MI, 500 MI, 200 MI, 100 MI, 50 MI, 25 MI)
37.	Vacuum pump
38.	Soxhlet extraction unit
39.	Kjeldhal digestion unit
40.	Weighing Balance (max 10kg)
41.	Laminar Air Flow chamber
42.	M. Endo Broth (dehydrated)
43.	Lactose or Lauryl Tryptose broth
44.	Mac Conkey broth
45.	Brilliant Green Bile Lactose Broth
46.	Total Plate Count Agar
47.	Peptone / Tryptone Water
48.	BOD Analysis: Incubator, Reagents, etc.
49.	COD Analysis: COD Reactor – 15 Vials, Reagents, etc.
50.	Filtration assembly for suspended solids
51.	Incubator 44°C (Water/Air-Jacketed)

1.6 Online Instruments Specifications

1.6.1 Flow measuring system

1.6.1.1 Electromagnetic flowmeter

Flow meters shall operate on the electromagnetic induction principle and shall consist of a measuring sensor and measuring transmitter complying with ISO 6817:1997. Measuring sensors shall have a full bore stainless steel metering tube and non-conductive, abrasion-resistant lining to suit the fluid being metered. The lining of material can be of polyurethane. No rubber lining will be allowed. The flow meter shall have flanged connection. Measuring sensors shall have factory-sealed power and signal cables. Unless otherwise specified, the cable lengths shall be sufficient to permit termination external to the chamber, either at a junction box or at the measuring transmitter. Remote flow indicator cum integrator shall be provided on the control panel.

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Measuring sensors installed within a chamber shall be suitable for indefinite submersion under a head of water equal to the chamber depth or 3 meters whichever is the greater. Measuring sensors shall be installed on a steel cradle or concrete plinth with upstream and downstream straight pipe lengths not less than those recommended by the manufacturer. When fitted in lined non-metallic or internally-coated pipe work, measuring sensors shall have an earthing electrode or corrosion-resistant earthing rings. To ensure full electromagnetic compatibility the flow tube flanges and transmitter housing shall be connected earth.

Measuring sensors shall be bonded by tinned copper braid links at each end to the adjacent pipe work to ensure a good connection between the body and the metered liquid. Measuring sensors installed in a cathodic protected pipeline shall have isolation and bonding in accordance with the recommendations of the manufacturer. The measuring transmitter shall provide a precise current input to the field winding of the measuring sensor and shall convert the resultant signal from the electrodes to analogue and pulse outputs in accordance with IEC 60381-1:1982. The signal processing facilities of the converter shall ensure that the output signals are unaffected by interfering voltages, stratified flow, changes in fluid electrical conductivity within the limit stated, non-homogeneity of the fluid and the presence of ferrous particles. The zero and output signals shall be unaffected by partly-fouled electrodes.

The following measuring transmitter features shall be provided as a minimum:

Measuring transmitter features:

- Pulsed D.C. field excitation
- Scaled pulse output for integration counter drive
- Capability of bi-directional measurement with differing forward and reverse ranges and with local and remote indication of flow reversal
- Contact operation at a programmable measured value
- Integral display of flow and integrated quantity
- Galvanic isolation between each output circuit and between the electrode circuit and output circuit
- Output circuit isolation from earth within the instrument but suitable for earthing at any point in the external circuit
- Key entry for basic parameters
- Commissioning and re-scaling to require no special programming knowledge
- Adjustable low flow cut-off

Self-diagnosis

- Continuously adjustable velocity and flow range settings
- Terminals accommodated in a compartment separate from electronic components
- Outputs including: analogue - 4-20mA
- Pulse - two programmable outputs
- Alarms - two outputs programmable for high/low
- Flow, polarity, forward/reverse, instrument fault, liquid sensing fault condition including

partially empty pipe

Technical specifications

Measuring Principal	:	Electromagnetic
Type	:	Pulsed DC
Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Metering Tube	:	SS 304
Sensor Housing	:	SS 304 fully welded
Connection / Junction Box	:	SS 304
Lining Material	:	PTFE/Polyurethane
Range	:	As per site requirement
Accuracy	:	± 0.5% of flow rate at maximum mean velocity of 1.5 to 3.0 m/sec
Electrode Type	:	Flush or bullet nose as recommended by the Manufacturer
Earthing Ring/Electrode Material:	:	Type 316 stainless steel
Protection Category	:	
a.) Sensor	:	IP-68
b.) Transmitter / Controller	:	IP-65
Transmitter / Controller Type	:	Microprocessor Based
Display	:	Indicating and totalizing
a.) Indicator	:	Digital 16-character display
b.) Totalizer	:	Digital 16-character display
Mounting	:	Pipe, wall, panel
Diagnostic	:	Inbuilt
Power Supply	:	230 V AC ± 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA / 0-10VDC output based on the flow rate
Zero & Span	:	Field Adjustable
Turndown Ratio	:	Minimum of 10 to 1 when flow velocity at minimum flow is at least 0.3 metres per second
Zero Stability Feature	:	Required to eliminate the need to stop flow to check zero alignment
Pressure Loss	:	Very Low
Removable Electrodes	:	Required
Flange Material	:	Carbon steel, Epoxy Coated
Empty Pipe Detection	:	Inbuilt
Operating Temperature	:	0 to 50°C
Temperature Compensation	:	Inbuilt temperature sensors for automatic compensation for changes in air temperature
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.

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1.6.1.2 Level measuring system

Ultrasonic level meters

Ultrasonic level measuring devices applied for liquid level measurement shall comprise of level sensor / transducer, level transmitter, digital level indicator / remote indicator, control unit and any other items required to complete the level measuring system.

The transducer shall be suitable for flange or bracket mounting as required. To reduce the effect of sewage turbulence in wet wells / tanks, averaging facility should be provided in the transmitter unit for providing steady readings.

The design and application of the ultrasonic level measuring system shall take into account the vessel / sump / wet well / channel construction, the material, size, shape, environment, process fluid or material, the presence of foam, granules, size etc.

In case of ultrasonic level sensor, the installation shall avoid any degradation of instrument performance due to spurious reflections, absorption, sound velocity variations, sensor detection area, temperature fluctuations, specific gravity changes and condensation. For applications where spurious reflections are unavoidable the control unit shall be provided with facilities for spurious reflection rejection. If turbulence exists, shielding, stilling tubes or other measures shall be provided to avoid effects on the measurement.

Technical specifications

Measuring Principal	:	Ultrasonic
Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Range	:	As required at site
Accuracy	:	± 0.25% of measured value or better
Resolution	:	2mm or 0.2 percent of range, whichever is greater
Blanking Distance	:	As short as 0.3 meters
Beam Angle	:	12 degrees or less
Temperature compensation	:	Integral
Mounting		
a.) Sensor	:	Flange or bracket
b.) Transmitter / Controller	:	Wall, Panel, Pole
Protection Category		
a.) Sensor	:	IP-68
b.) Transmitter / Controller	:	IP-66 (NEMA 4X)
Transmitter / Controller Type	:	Microprocessor Based
Diagnostic	:	Inbuilt
Display	:	LCD with LED backlighting
Power Supply	:	230 V AC ± 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA
Relay Contacts	:	Minimum of 3 SPDT contacts
Zero & Span	:	Field Adjustable

Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	:	Integral to sensor
Cable Length	:	As per site requirement

1.6.1.3 Ultrasonic differential level measurement

The ultrasonic type differential level measuring system shall consist of ultrasonic type level sensors on upstream and downstream of screens, differential level computer / transmitter and indicator. The flow computer / transmitter shall be microprocessor based and shall have facility for programming (i.e. adjustment of set points) while the sensor shall be capable of adjustable datum setting facilities.

The differential level control shall be done by two ultrasonic sensors, one before and one after the screen to sense the differential level through the screen and give a signal to the control to start the screens operation as soon as a preset differential level is reached. After receiving the level signal the control shall start and operate the screen as long as the preset level difference appears.

Technical specifications

Measuring Principal	:	Ultrasonic
Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Range	:	As required at site
Accuracy	:	± 0.25% of measured value or better
Resolution	:	2mm or 0.2 percent of range, whichever is greater
Blanking Distance	:	As short as 0.3 meters
Beam Angle	:	12 degrees or less
Temperature compensation	:	Inbuilt
Mounting		
a.) Sensor	:	Flange or bracket
b.) Transmitter / Controller	:	Wall, Panel, Pole
Protection Category		
a.) Sensor	:	IP-68
b.) Transmitter / Controller	:	IP-66 (NEMA 4X)
Transmitter / Controller Type	:	Microprocessor Based
Diagnostic	:	Inbuilt
Display	:	LCD with LED backlighting
Power Supply	:	230 V AC ± 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA
Relay Contacts	:	Minimum of 3 SPDT contacts
Zero & Span	:	Field Adjustable
Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	:	Integral to sensor
Cable Length	:	As per site requirement

1.6.1.4 Pressure measuring system – pressure transmitter

Pressure measuring system shall measure pressure and transmit signal proportional to pressure. The system shall consist of a combined pressure transducer and transmitter, digital panel indicator, connecting pipe work, diaphragm seal and valves. Pressure measuring system shall be rugged in construction and shall be capable for with standing surge pressures likely to occur in the monitored system. Pressure transmitters shall have over range protection up to 1.5 times the maximum line pressure and shall be capable of withstanding full line pressure on any side with the other side vented to atmosphere without damage or effect on the calibration. No plastic material shall be used in their construction. Internal parts shall be of stainless steel, bronze or approved corrosion-resistant material. Where necessary, a special diaphragm shall be used to segregate the corrosive fluid media. In ammonia applications, the diaphragm shall be in stainless steel. In chlorine applications, the diaphragm shall be in silver or tantalum. In Sulphur dioxide applications, the diaphragm shall be in tantalum.

The zero and span of a pressure transmitter shall not change by more than $\pm 0.1\%$ of the span per $^{\circ}\text{C}$ change in ambient temperature. After application for 10 minutes of pressure at 130% of maximum pressure, the change in zero and span shall not exceed $\pm 0.1\%$ of the span. Pressure transmitters shall be protected to BS EN 60529:1992, IP 65 standard or higher. For transmitters installed in locations liable to flooding or underwater applications, they shall be to IP 68 standard and shall operate up to a maximum submergence of 20 meters of water.

Technical specifications

Parts	:	Transmitter and communicator
Type	:	Electronic variable capacitance; two-wire transmitter
Application	:	H2S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Range	:	As required at site
Accuracy	:	$\pm 0.25\%$ of span or better
Humidity	:	0 to 100% relative humidity
Damping	:	Fluid or electronic type with adjustment
Indicator	:	LCD with LED backlighting
Materials	:	Wetted parts including process flanges and drain / vent valves, Type 316 stainless steel otherwise specified
Wetted O-Rings	:	Glass filled TFE, graphite filled PTFE, or Viton, unless otherwise specified
Fill Fluid	:	Silicone
Output	:	4 – 20mA DC output proportional to the pressure range
Mounting	:	Pipe or wall as specified. Provide stainless steel brackets with stainless steel bolts
Housing	:	Modular with separate compartments for electronics and field wiring termination. Epoxy

		coated aluminium, unless otherwise specified
Power Supply	:	230 V AC \pm 10%, 50 Hz
Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.

1.6.1.5 Dissolved oxygen measuring system - DO analyzer

DO analyzers shall be installed to continually record the dissolved oxygen level at every grid within each aeration basin. The primary sensing device used for the dissolved oxygen level measurement, shall be a sensing probe mounted within the aeration basin and connected to a controller for displaying and transmitting the results

Technical specifications

Measuring Principal	:	Optical
Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Range	:	0 to 20.0 ppm, 0 to 20.0 mg/L
Accuracy	:	\pm 0.5% or better
Repeatability	:	\pm 0.5% of span
Sensitivity	:	\pm 0.5% of span
Pressure Limit	:	4 - 6 bar
Temperature Indication	:	Inbuilt
Calibration Method	:	Air Calibration: One point, 100% water saturated air; Sample Calibration: Comparison to standard instrument, or comparison to Winkler Titration method
Cleaning	:	Air Blast Unit. Probe should be able to function with cleaning unit attached to it
Mounting		
a.) Sensor	:	Inside aeration basin at each grid
b.) Transmitter / Controller	:	Wall, Panel, Pole
Protection Category		
a.) Sensor	:	IP-68 for Sensor
b.) Transmitter / Controller	:	IP-66 (NEMA 4X)
Transmitter / Controller Type	:	Microprocessor Based
Diagnostic	:	Inbuilt
Display	:	LCD with LED backlighting
Power Supply	:	230 V AC \pm 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA
Relay Contacts	:	Minimum of 2 SPDT contacts
Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	:	Integral to sensor
Cable Length	:	As per site requirement

1.6.1.6 Total Suspended Solids Measuring System - TSS Analyzer

Technical specifications

Measuring Principal	:	Optical
Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Range	:	0 – 50 mg/l, 0 - 1000 mg/l, 0 – 5000 mg/l
Accuracy	:	<5% of reading or better
Pressure Limit	:	6 bar
Flow Rate	:	Maximum 3m per second
Temperature Indication	:	Inbuilt
Calibration Method	:	Single point or two point
Cleaning	:	Inbuilt
Mounting		
a.) Sensor	:	Inside pipe / channel / tank
b.) Transmitter / Controller	:	Wall, Panel, Pole
Protection Category		
a.) Sensor	:	IP-68 for Sensor
b.) Transmitter / Controller	:	IP-66 (NEMA 4X)
Transmitter / Controller Type	:	Microprocessor Based
Diagnostic	:	Inbuilt
Display	:	LCD with LED backlighting
Power Supply	:	230 V AC ± 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA
Relay Contacts	:	Minimum of 2 SPDT contacts
Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	:	Integral to sensor
Cable Length	:	As per site requirement

1.6.1.7 pH Measuring System – pH Analyzer

Technical specifications

Measuring Principal	:	Combination / Differential Electrode
Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Range	:	0 - 12 pH
Accuracy	:	±0.02 pH or better
Repeatability	:	±0.05 pH
Sensitivity	:	±0.01 pH

Pressure Limit	:	4 - 6 bar
Flow Rate	:	Maximum 3m per second
Temperature Indication	:	Inbuilt
Temperature Compensation	:	Inbuilt automatic temperature compensation
Temperature Accuracy	:	±0.5 °C
Calibration Method	:	Two point automatic, one point automatic, two point manual, one point manual
Mounting		
a.) Sensor	:	Inside pipe / channel / tank
b.) Transmitter / Controller	:	Wall, Panel, Pole
Protection Category		
For Transmitter / Controller	:	IP-66 (NEMA 4X)
Transmitter / Controller Type	:	Microprocessor Based
Diagnostic	:	Inbuilt
Display	:	LCD with LED backlighting
Power Supply	:	230 V AC ± 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA
Relay Contacts	:	Minimum of 2 SPDT contacts
Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	:	Integral to sensor
Cable Length	:	As per site requirement

1.6.1.8 Residual Chlorine Measuring System – Residual Chlorine Analyzer

Technical specifications

Measuring Principal	:	Amperometric or DPD Colorimetric
Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Range	:	0 – 10 ppm
Accuracy	:	±3% of the reference test or better
Resolution	:	0.001 ppm
Repeatability	:	30 ppb or 3%, whichever is greater
pH	:	Automatic
Temperature Compensation	:	Inbuilt temperature sensor
Temperature Indication	:	Inbuilt
Pressure Limit	:	0.5 bar
Flow Rate	:	Maximum 50 L/hour
Calibration Method	:	1-point or 2-point calibration
Mounting		
Protection Category	:	Wall, Panel
a.) Sensor	:	IP-65
b.) Transmitter / Controller	:	IP-66 (NEMA 4X)
Transmitter / Controller Type	:	Microprocessor Based

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Diagnostic	:	Inbuilt
Display	:	LCD with LED backlighting
Power Supply	:	230 V AC \pm 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA
Relay Contacts	:	Minimum of 2 SPDT contacts
Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	:	Integral to sensor
Cable Length	:	As per site requirement

1.6.1.9 Conductivity Measurement – Conductivity Analyzer

Technical specifications

Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Range	:	0 - 1000 μ S/cm
Accuracy	:	\pm 0.5% or better
Temperature Compensation	:	Inbuilt
Temperature Indication	:	Inbuilt
Pressure Limit	:	6.9 bar
Flow Rate	:	Maximum 3m per second
Mounting		
a.) Sensor	:	Inside pipe / channel / tank
b.) Transmitter / Controller	:	Wall, Panel, Pole
Protection Category		
For Transmitter / Controller	:	IP-66 (NEMA 4X)
Transmitter / Controller Type	:	Microprocessor Based
Diagnostic	:	Inbuilt
Display	:	LCD with LED backlighting
Power Supply	:	230 V AC \pm 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA
Relay Contacts	:	Minimum of 2 SPDT contacts
Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	:	Integral to sensor
Cable Length	:	As per site requirement

1.6.1.10 Ammonia Measurement – Ammonia Analyzer

Technical specifications

Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
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Safety	:	Explosion Proof or Intrinsically Safe
Range	:	0 – 5 mg/l, 0 - 50 mg/l
Accuracy	:	3% ±1 mg/l or better
Repeatability	:	2% ±1 mg/l or better
Flow Rate	:	Maximum 20 L/h
Cleaning	:	Automatic
Mounting		
a.) Analyzer	:	Wall, Panel
b.) Transmitter / Controller	:	Wall, Panel, Pole
Protection Category		
a.) Analyzer	:	IP-55 or better
b.) Transmitter / Controller	:	IP-66 or better
Transmitter / Controller Type	:	Microprocessor Based
Diagnostic	:	Inbuilt
Display	:	LCD with LED backlighting
Power Supply	:	230 V AC ± 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA
Relay Contacts	:	Minimum of 2 SPDT contacts
Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.
Cable Length	:	As per site requirement

1.6.1.11 Alkalinity Measurement – Alkalinity Analyzer

Technical specifications

Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Range	:	0 – 500 mg/l
Accuracy	:	±5% of reading or ±1.0 mg/L, whichever is greater
Repeatability	:	±3% of reading or ±0.6 mg/L, whichever is greater
Pressure Limit	:	2 bar
Flow Rate	:	Maximum 2 L/m
Mounting	:	Wall, Panel
Protection Category	:	IP-66 (NEMA 4X)
Power Supply	:	230 V AC ± 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA
Relay Contacts	:	Minimum of 2 SPDT contacts
Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.

1.6.1.12 Total Nitrogen Measurement – Total Nitrogen Analyzer

Technical specifications

Measuring Principle	:	UV Absorption
Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Range	:	0 – 30 mg/l, 0 - 80 mg/l
Accuracy	:	± 3% of mean + 0.5 mg/l
Resolution	:	0.1 mg/L
Pressure Limit	:	0.5 bar
Cleaning	:	Automatic
Mounting		
a.) Sensor	:	Inside pipe / channel / tank
b.) Transmitter / Controller	:	Wall, Panel, Pole
Protection Category		
a.) Sensor	:	IP-68
b.) Transmitter / Controller	:	IP-66 (NEMA 4X)
Transmitter / Controller Type	:	Microprocessor Based
Diagnostic	:	Inbuilt
Display	:	LCD with LED backlighting
Power Supply	:	230 V AC ± 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA
Relay Contacts	:	Minimum of 2 SPDT contacts
Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	:	Integral to sensor
Cable Length	:	As per site requirement

1.6.1.13 BOD Measurement – Indicative BOD Analyzer

Technical specifications

Measuring Principle	:	UV Absorption
Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Range	:	0 – 50 mg/l, 0 - 500 mg/l
Accuracy	:	± 5% or better
Compensation	:	550 nm
Sample pH	:	4.5 to 9 pH
Pressure Limit	:	0.5 bar
Cleaning	:	Automatic
Mounting		
a.) Sensor	:	Inside pipe / channel / tank
b.) Transmitter / Controller	:	Wall, Panel, Pole
Protection Category		
a.) Sensor	:	IP-68
b.) Transmitter / Controller	:	IP-66 (NEMA 4X)

Transmitter / Controller Type	:	Microprocessor Based
Diagnostic	:	Inbuilt
Display	:	LCD with LED backlighting
Power Supply	:	230 V AC \pm 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA
Relay Contacts	:	Minimum of 2 SPDT contacts
Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	:	Integral to sensor
Cable Length	:	As per site requirement

1.6.1.14 COD Measurement – Indicative COD Analyzer

Technical specifications

Measuring Principle	:	UV Absorption
Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Range	:	0 – 250 mg/l, 0 - 1000 mg/l
Accuracy	:	\pm 5% or better
Compensation	:	550 nm
Sample pH	:	4.5 to 9 pH
Pressure Limit	:	0.5 bar
Cleaning	:	Automatic
Mounting		
a.) Sensor	:	Inside pipe / channel / tank
b.) Transmitter / Controller	:	Wall, Panel, Pole
Protection Category		
a.) Sensor	:	IP-55 or better
b.) Transmitter / Controller	:	IP-55 or better
Transmitter / Controller Type	:	Microprocessor Based
Diagnostic	:	Inbuilt
Display	:	LCD with LED backlighting
Power Supply	:	230 V AC \pm 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA
Relay Contacts	:	Minimum of 2 SPDT contacts
Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	:	Integral to sensor
Cable Length	:	As per site requirement

1.6.1.15 TOC Measurement – Indicative TOC Analyzer

Technical specifications

Measuring Principle	:	UV Absorption / UV Persulphate
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Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Range	:	0 - 1000 mg/l
Accuracy	:	± 5% or better
Compensation	:	550 nm
Sample pH	:	4.5 to 9 pH
Pressure Limit	:	0.5 bar
Mounting		
a.) Sensor	:	Inside pipe / channel / tank
b.) Transmitter / Controller	:	Wall, Panel, Pole
Protection Category		
a.) Sensor	:	IP-55 or better
b.) Transmitter / Controller	:	IP-55 or better
Transmitter / Controller Type	:	Microprocessor Based
Diagnostic	:	Inbuilt
Display	:	LCD with LED backlighting
Power Supply	:	230 V AC ± 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA
Relay Contacts	:	Minimum of 2 SPDT contacts
Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	:	Integral to sensor
Cable Length	:	As per site requirement

1.6.1.16 Total Phosphorus Measurement – Phosphorus Analyzer

Technical specifications

Measuring Principle	:	Photometric
Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Range	:	0 - 10 mg/l
Accuracy	:	2% of the measured value + 0.05 mg/L or better
Repeatability	:	2% of the measured value + 0.05 mg/L
Flow Rate	:	Maximum 20 L/h
Sample pH	:	5 to 9 pH
Pressure Limit	:	0.05 bar
Mounting		
a.) Analyzer	:	Wall, Panel
b.) Transmitter / Controller	:	Wall, Panel, Pole
Protection Category		
a.) Analyzer	:	IP-55 or better
b.) Transmitter / Controller	:	IP-55 or better
Transmitter / Controller Type	:	Microprocessor Based
Diagnostic	:	Inbuilt

Display	:	LCD with LED backlighting
Power Supply	:	230 V AC \pm 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA
Relay Contacts	:	Minimum of 2 SPDT contacts
Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.
Cable Length	:	As per site requirement

1.6.1.17 Nitrate Measurement – Nitrate Analyzer

Technical specifications

Measuring Principle	:	UV Absorption
Application	:	H ₂ S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	:	Explosion Proof or Intrinsically Safe
Range	:	0 – 30 mg/l, 0 - 80 mg/l
Accuracy	:	\pm 5% or better
Resolution	:	0.1 mg/L
Pressure Limit	:	0.5 bar
Mounting		
a.) Sensor	:	Inside pipe / channel / tank
b.) Transmitter / Controller	:	Wall, Panel, Pole
Protection Category		
a.) Sensor	:	IP-68
b.) Transmitter / Controller	:	IP-66 (NEMA 4X)
Transmitter / Controller Type	:	Microprocessor Based
Diagnostic	:	Inbuilt
Display	:	LCD with LED backlighting
Power Supply	:	230 V AC \pm 10%, 50 Hz
Analog Output	:	Isolated 4 – 20mA
Relay Contacts	:	Minimum of 2 SPDT contacts
Operating Temperature	:	0 to 50°C
Communication Protocol	:	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	:	Integral to sensor
Cable Length	:	As per site requirement

1.7 Surge Protection Devices

Surge protection devices (SPDs) shall be suitable for withstanding the surge arising out of high energy static discharge / lightning strikes and protect the instrument to which it is connected against damage. SPDs shall provide protection through the use of quick acting semiconductors like Tranzorb, zener diodes, varistors and an automatic disconnect and reset circuit. SPDs shall be passive and shall require negligible power for operation. During the occurrence of a surge it shall clamp on the allowable voltage and pass the excess voltage to the ground. The SPD shall be self-resetting to minimize the down time of the measurement loop.

SPDs shall be provided to protect devices transmitting and receiving analogue and digital signals derived from field devices located outdoors.

The surge protection device shall be rated for surge rating of 10kA.

1.8 Cabinets for field instruments

Wall mounted cabinets shall be provided for enclosing transducer unit and associated accessories which are mounted outside the main control panel. The cabinet shall be of die-cast aluminium; field provided not less than IP-65 protection and shall be lockable. The cabinet shall have facilities for earthing. A steel plate shall be provided inside the cabinet for mounting instrument and accessories.

1.9 Panel Details

1.9.1 Cabinet / Enclosure for Instruments

Enclosures shall be any form of board, cabinet, panel, desk, box or case used to protect, contain or group instrumentation, telemetry or control equipment. Cabinets shall be fabricated from cold rolled steel with powder coating sheet of minimum 2 mm thick and shall be suitable for wall mounting or pedestal mounting as required. A steel plate/pipe, as per the requirement, shall be provided in the cabinet for mounting the instrument and accessories. The cabinet shall be properly painted from inside and outside and shall have built in locking facility. The cabinet shall also be earthed properly. All equipment in or on enclosures shall be arranged logically and, as far as possible, symmetrically, with projections kept to a minimum. Each enclosure shall be designed on ergonomic principles and shall permit in-situ and safe access for any normal adjustment, maintenance and servicing. The tops of plant-mounted enclosures shall be sloped downwards from front to rear.

The minimum degree of protection shall be IP 54 for indoor locations and enclosures for use outside buildings or in places where splashing may occur shall have a minimum rating of protection to BS EN 60529:1992, IP 65 and have tops which project sufficiently to protect the vertical faces of the enclosure and any component mounted thereon from splashing, inclement weather and direct sunlight. Also, when enclosures for use outside buildings are located where exposure to direct sunlight will give rise to high top-panel surface temperatures such that the internal temperature rises above the manufacturer's recommendation (normally 40°C), the enclosure shall include a sun shield fitted to the top of the enclosure and should have sufficient air ventilation for heat dissipation.

Fixing arrangements for surface-mounting enclosures shall be external to the enclosure and shall ensure that the rear face of the enclosure is not in contact with the surface to which it is fixed. Enclosures shall have hinged access doors, fitted with recessed lockable handles. Doors shall be of rigid construction and provided with close-fitting flexible seals in recesses to prevent the ingress of liquids, moisture, dust and vermin. Hinges shall be of the lift-off pattern and one hinge shall engage before the other for ease of fitting. Wherever necessary, removable access covers secured by quick-release fasteners shall be provided to ensure ease of maintenance for all installed apparatus. Mounting plates, brackets and racks shall be provided for all other internal equipment which shall be hinged or otherwise arranged with quick-release fasteners or captive screws to give quick and easy access to equipment, securing screws, terminals and wiring.

Enclosures for two or more devices with electrical circuits shall have gland plates and terminal blocks as specified elsewhere. Each enclosure shall be designed for the safe testing and servicing of equipment with the power on. Each part which may be live under any circumstances shall be so covered or shielded as to prevent inadvertent contact.

1.9.2 Panel Design and Construction

Unless otherwise specified, all instrument panels, instrument cubicles, control panels, control consoles and desks, associated equipment and terminal racks, telemetry and electronic equipment racks and the like shall be free-standing, floor-mounted units and shall conform to the requirements of this part and will hereafter be referred to as panels. The design and dimensions of control consoles and desks shall be determined according to their intended function but shall be in accordance with the requirements of the Specification drawings. The height shall not exceed 1400mm above the finished floor level.

Unless otherwise specified as per the approved Design and Drawings, the height of panels shall be not greater than 2130mm overall (excluding lifting devices) above finished floor level. Front-of-panel instruments and controls shall be mounted so that the height of their centers above the floor shall be generally between 1800mm and 900mm for indicators, 1400mm and 900mm for recorders and process controllers, 2000mm and 750mm for alarm facias and signal lamps and 1500mm and 750mm for manual controls. Controls, switches and push-buttons shall be positioned below or adjacent to any associated reading instrument. Panels for use in locations such as pumping stations and machinery rooms shall have anti-vibration mountings. The clearance between the extremities of apparatus mounted on the internal walls shall allow safe and unobstructed access to all terminals and to parts requiring maintenance. Panel layout drawings shall normally include a list of all instruments, accessories and components contained therein. If the drawings have insufficient space for the list, a separate schedule of instruments, accessories and components shall be provided and the panel drawing shall contain a cross reference to the contents list and an indication of the panel location of each item on the list.

1.9.3 Panels - major

Panels shall be constructed generally as specified in the preceding clause and as shown in the Specification drawings. Panel material shall be prime-quality, cold-rolled and annealed mild steel or zinc-coated mild steel sheet, suitably braced and stiffened as necessary with flat bar or angle to form a rigid structure.

Panel fronts shall be flat and free from bow or ripple. Exterior corners and edges shall be rounded or welded and ground to give a smooth overall appearance. Flanged edges shall be straight and smooth. Materials shall be chosen with due regard to the panel size, number of cut-outs, instrument weight and position of centre of gravity and method of fabrication, with the following:

- minimum thicknesses
- instrument bearing surfaces, gland plates and pneumatic distribution plates: 3mm
- internal mounting plates: 3mm
- doors, covers and filler panels: 2mm

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No design involving the use of externally-visible assembly or fixing bolts and screws nor any design resulting in dust or water-collecting crevices will be accepted. Stiffeners and supporting frameworks shall be provided where necessary inside panels. Framework shall be hinged or fixed, suitable for the installation of instruments, components and internal equipment for which it is provided and located to give easy access to adjacent equipment.

When a panel is constructed in sections, the sections shall be designed for ease of assembly during installation and, in any case, shall not exceed 2m in length. All necessary nuts, bolts, washers and the like shall be supplied and included in the same shipment as the relevant sections. Sections exceeding 1m in length shall be provided with double doors. Unless otherwise shown in the Specification drawings, each panel shall be mounted on a self-draining base frame fabricated from 150mm deep, steel channel section which shall be drilled or provided with clamps for bolting to the floor. The base frame shall be set back from the panel front face to give a toe space of not less than 25mm. The outside of the base frame shall be covered with an approved kicking strip.

Ceiling and other filler panels shall be fabricated from sheet steel and adequately stiffened. Each section shall have 50mm returned edges along all four sides and shall be braced to the main steelwork of the panel. A chequer-plate floor shall be provided inside and above the level of the base frame, having openings suitable for the bottom entry of cables when applicable. Sufficient removable undrilled gland plates, in sections convenient for handling, shall be fitted close to the appropriate terminal blocks and not less than 230mm above the panel floor or not less than 230mm below the panel top. The gland plates shall have removable side covers giving access to both sides of the gland plate and ensuring vermin-proof and dust-proof construction. Gland plates of a surface-mounted enclosure may form a part of the base or top. Panels containing pneumatic or other instruments using a fluid as the transmission medium shall have distribution plates with bulkhead unions for the termination of internal and external pipework.

All doors shall open outwards and all doors in one panel assembly shall use the same lock and key combination. Panel design shall ensure adequate ventilation and air circulation without permitting the entry of vermin or dust. Panels installed in control rooms or other clean condition areas shall have louvres to allow air circulation. Temporary closures shall be provided to prevent the entry of dust and vermin during transit and installation. After commissioning has been completed, all entries except air-circulation louvres shall be sealed.

No equipment other than front-of-panel items shall be mounted on panel wall surfaces. If electrical and non-electrical instruments are mounted in the same panel, the panel shall be subdivided internally to separate the electrical and non-electrical sections. All connections shall be arranged to ensure that no accidental damage to cabling or electrical components can occur in the event of failure of any non-electrical component or connection. Provision shall be made for safe and easy handling during transit and installation. If lifting eyes are provided, they shall be reversible and panel tops shall be reinforced where necessary.

Where equipment is specified to be installed at a future date, space shall be allocated, and cutouts with removable masking plates, brackets, supports, wiring, terminals and piping and the like shall

be provided. Panels shall be finish-coated at the place of manufacture before commencing the installation of apparatus and other fittings.

1.9.4 Panels - Minor

Panels for installation on the Plant which contain relatively few items of equipment, or where so specified elsewhere, shall be provided as minor panels and shall be constructed generally as specified in the preceding clause and comply with this Clause. Panels shall be fabricated from sheet steel or other approved material less than 2.5mm thick suitably braced to form a robust and rigid structure. Exterior corners and edges shall be rounded to give a smooth overall appearance and assembly bolts, screws or rivets shall not be visible on the front face.

The design shall be such as to ensure adequate ventilation and air circulation where required, without permitting the entry of vermin. Openings for cables shall be made vermin-proof. Doors shall be hinged and shall be provided with close-fitting flexible seals in recesses to prevent the ingress of liquids, moisture, dust and vermin. Unless otherwise specified, panels shall be suitable for floor mounting and shall not exceed 2130mm in height. Where surface mounted panels are provided, the fixing shall prevent the ingress of moisture and the rear of the enclosure shall be not less than 10mm from the wall.

Lifting eyebolts shall be removed and replaced with bolts after installation. Panels shall be extensible, and symmetrically arranged as far as possible with projections kept to a minimum. Where two or more panels are fitted together, they shall form a flush-fronted continuous panel of uniform height. Front door and top cover dimensions shall match. Instruments, relays, and control devices shall be mounted at a height not more than 2000mm and not less than 300mm from floor level.




The arrangement of equipment within each enclosure shall be such as to permit easy access for installation and maintenance. No instruments, relays or other components shall be mounted on rear access doors or removable covers.

1.9.5 Panels - composite

In situations where space limitations preclude the use of separate instrumentation, control and automation (ICA) and switchgear panels and, with prior approval of the Jal Nigam, ICA equipment may be combined within a single enclosure subject to the following conditions:

Enclosure

- The observance of all other clauses herein relating to enclosures, mounting boards and minor panels.
- The written assurance of each supplier of ICA equipment that the proximity of the switchgear will have no detrimental effect on the life or performance of any ICA component
- The total segregation of ICA equipment and switchgear including the glanding and termination facilities.
- The absence of any voltage exceeding 250V ac or 50V dc from any compartment containing ICA equipment.

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- The use of the full height of the panel (excluding the busbar chamber and cable space) for any ICA equipment compartment.

1.9.6 Panels - Glass Reinforced Plastic (GRP)

Any panel required to be installed outside buildings shall be manufactured from double-skin, resin-bonded fibreglass, with a totally encapsulated infill of rigid weatherproof and 'boil proof' plywood to BS 1203:2001 between the two skins to provide a rigid and vandal-proof enclosure. The environmental rating shall be IP 65 or better.

For any application in a non-temperate climate or where so specified elsewhere, the roof section shall be sloping and have a totally-encapsulated infill of end-grain balsa instead of plywood. Box-section steel shall be encapsulated into door edges and door frames. Door locks, handles and hinges shall be of a high tensile strength, non-corroding alloy with stainless steel pins and through fixing bolts. Large plane surfaces shall have adequate reinforcing to ensure rigidity.

The doors shall be complete with latching handles and locks. All door catches and locks shall latch onto steel-reinforced surfaces. Threaded studs shall be incorporated into the design of the panel for the mounting of sub frames within the panel. Any panel drilled to provide fixings for internal equipment will not be accepted. Each cubicle shall be provided with a floor or deck with a removable gland plate for cable entry.

The laminate material shall have flame-retardant characteristics in compliance with BS 476 Class 2, and shall retain 'stability, integrity and insulation' for 30 minutes. Colour-impregnated gel coats backed by coloured resin shall be used to ensure maintenance free and 'colour-fast' finishes. The internal finish colour shall be white. The fronts of externally-visible instruments and windows shall be of glass. An air-gap of 100mm shall be provided between the top surface of the panel and its protective canopy. All internal equipment shall be mounted on supports built into the fibreglass structure. Fixing bolts through the skin will not be accepted.

1.9.7 Panel protection

Adequate facilities for isolation and protection by miniature circuit breaker or fuse for each instrumentation and control circuit and sub-circuit shall be provided and shall be so arranged that any interruption causes minimum disruption of plant, operates the appropriate alarm and cannot result in any unsafe operating condition. All fuses shall be of the cartridge pattern and main fuses shall be of the high rupturing capacity type. Fuse and solid-link carriers and bases shall be of plastic-moulded insulating material as per best industry practices. Ceramic materials will not be accepted. Live connections shall be efficiently shrouded and it shall be possible to change fuses with power on without danger of contact with live metal. The fuses shall be rated to give maximum protection to the equipment in circuit and the rating shall be permanently inscribed on the fuse label and on the fuse carrier.

Unless necessary for the protection of particular equipment, miniature circuit breakers used for individual circuits in a panel or control desk shall not trip on over-voltage or under-voltage. Bases for solid links shall not be interchangeable with those for fuses. Fuses and links in the same circuit shall be mounted opposite each other in separate adjacent rows and shall not alternate in

the same row. At least 10% and not less than two unallocated miniature circuit breakers or fuses and links shall be provided in each panel distribution board. Miniature circuit breakers and fuses of similar size and rating shall be of the same make and type. At least 10%, and not less than two, spare fuses and links of each rating shall be provided and fitted in clips inside the panel.

Each instrument requiring a power supply shall be individually wired and protected so that, in the event of a failure in one circuit, the remainder is unaffected. Power supply circuits shall be of sufficient rating that any protective device may operate without reducing the voltage at the terminals of any other component to an unacceptable level. Remote alarms shall be operated on failure of the electrical supply to a panel or to any internal sub-circuit. Clearly identifiable, switched socket outlets of 15A minimum rating to comply with IS 4615, supplied at the main cabinet operating voltages shall be fitted within the panel at the rate of one for each operating voltage per meter of panel length; for a panel whose length is less than one meter, one switched socket outlet for each main operating voltage shall be provided. Suitable socket outlets for portable tools and hand lamps shall be provided as specified elsewhere.

1.9.8 Panel isolation

Clearly-labelled isolating circuit breakers shall be provided for each incoming power supply. Switches shall be of the quick make-and-break type with spring-loaded contacts that close fully without requiring full operation of the handle. The handle and cover shall be interlocked so that the handle cannot be operated when the cover is open and the cover cannot be opened unless the switch is in the 'off' position. The 'on' and 'off' positions of each switch shall be indicated clearly.

Circuit breakers for panel power supplies shall be mounted near an access point and in positions where they may be operated easily from a standing position. Plug-in isolating links or devices of an approved type shall be provided in any circuit that may still be alive when the power supply isolators are in the 'off' position, as, for example, in circuits controlling equipment whose power supply is independent of the panel. Such links or devices shall be properly screened and, if not incorporated in or adjacent to their associated outgoing terminals, shall be labelled with suitable warning notices. Any item of panel equipment to which panel internal wiring is connected with a plug and socket instead of terminals shall be wired in flexible cable of adequate rating between the 'free' plug and a socket mounted adjacent to the device. The power supply connector shall be a socket.

1.9.9 Panel terminal blocks

External wiring for panel power supplies shall be terminated on the appropriate isolator. Signal cables from strain gauges, analyzers, resistance thermometers, re-transmitting slide wires and thermocouples may be terminated at their appropriate instruments. A terminal block shall be provided as the interface between the corresponding conductors of each internal and external wire and each internal and external connection except those listed above. The terminal blocks shall be mounted vertically where possible and not nearer than 230mm to the floor or less than 230mm from an incoming cable gland.

Terminal block rows shall be spaced apart by not less than 150mm and arranged to permit convenient access to wires and terminals and to enable ferrule numbers to be read without

difficulty. Other circuits shall be grouped on the terminal blocks according to the classification given in the clause for 'Panel internal wiring' which shall be clearly marked along the corresponding section of each terminal board. Groups of different voltages on the same board shall be separated by insulated barriers.

All connections shall be made from the front of terminal blocks and no live metal shall be exposed at the back. All terminal blocks shall be of the type which clamps the wire securely and without damage between two plates by means of a captive screw and which permits removal of any terminal without disturbance to adjacent terminals. Pinch-screw type terminal blocks will not be accepted. Terminal mouldings shall be in melamine to ISO 2112:1990, polyamide or equivalent. Terminal rails shall be hot-dip galvanized. Current bars between the two connection points of each terminal block shall be of copper or brass with tin/lead alloy plating. All steel parts shall be zinc-plated and passivated with a yellow chromate layer.

Terminal blocks for input and output analogue signals and for circuits containing volt-free contacts internal or external to the cabinet shall be of the Klippon type SAKC or equivalent which permit the connection of a test millimeter or continuity meter without disconnecting any wiring. Terminal blocks for power supplies for equipment external to the panel shall permit the isolation of the item of external equipment without affecting the operation of any other circuit within or outside the panel.

No more than one core of external cables or one internal wire shall be connected to any terminal. If terminal blocks are used as common points for two or more circuits, individual terminals with the appropriate number of permanent cross-connections shall be provided. The lengths of exposed cable cores shall be sufficient to reach any terminal in the appropriate row or rows. The cores shall be formed into a neat loom and a separate loom shall be provided for each cable. Identification ferrules as specified in the clause for 'Panel wiring identification and termination' shall be fitted on each core of all external cables and on each internal wire. The size of the terminals shall be appropriate to the size and rating of the cable cores which will be connected to them but shall not be smaller than Klippon type SAK2.5 or equivalent.

Each row of terminal blocks shall contain at least 25% spare terminals over the number required for terminating all cores of external cables in that row. Unless otherwise specified or shown in the Specification drawings, each external cable shall contain at least 20% spare circuits, with a minimum of one spare circuit. Terminal blocks shall be numbered consecutively in a sequence different from that used for identifying wiring. The terminal numbers, voltage grouping and terminal board layout shall correspond precisely with wiring diagrams so that quick and accurate identification of wiring can be made. All the terminal boards shall be provided with covers of transparent insulating material that does not sustain combustion and shall be sectionalized where possible to give access to groups of terminals without uncovering all boards. Terminals which may be live when the panel is isolated from its main supplies shall be suitably labelled to minimize the risk of accidental contact.

1.9.10 Panel internal wiring

Panel circuits shall be segregated into the following categories:

Group 1: Power control and very-high-level signal wiring (above 50V):

- AC power supplies
- DC power supplies
- DC current signals above 50mA (such as CT circuits)
- AC voltage and control signals above 50V (such as PT circuits)

Group 2: High-level signal wiring (6V to 50V dc):

- Signals from conventional electronic transmitters and controllers (such as 4mA to 20mA)
- Circuits to alarm enunciators and other solid-state devices (excluding those in categories 2.1, 2.5, 3.1, 3.2 and 3.3)
- Digital signals
- Emergency shut-down and tripping circuits
- On / Off control circuits
- Intrinsically safe circuits
- Speech-frequency circuits

Group 3: Low-level signal wiring (5V dc and below):

- Signals from thermocouples
- Signals from resistance thermometers and re-transmitting slide-wires
- Signals from analytical equipment and strain gauges

For Group 3 wiring, internal connections to the instruments shall be made by one of the following methods:

- The twisted, screened conductors of the external cable shall be led direct to their appropriate instruments via ducting systems installed for this purpose during construction of the panel.
- The conductors of the external cables shall be terminated on terminals segregated from all other categories and the connections to the appropriate instruments shall be made using twisted pairs with individual screening installed for this purpose during construction of the panel.

Internal wiring for all circuits in Group 2 except those sharing a common connection shall be multi-stranded, twisted pair, 0.75mm² minimum copper conductors with HPDE or PVC insulated cable of adequate grade and rating in accordance with BS 6004:2000. Wiring for circuits in other Groups or sharing a common connection shall be run in stranded, 1.0mm² minimum copper conductors with 250V grade, PVC-insulated cable of adequate grade and rating. Wiring sheath colours shall be black for AC circuits, and grey for DC circuits (excluding thermocouple circuits) and blue for Group 2.6 circuits. Circuits supplied at 240V, between 240V and 110V dc shall also be physically segregated from each other and from other circuits. Access to wiring and components of circuits having voltages exceeding 240V shall not be possible unless and until the circuit has been isolated.

Separate ducts, trunking, cable looms, tray work and the like shall be provided within the panel for each category with at least 150mm between parallel paths of Group 1 and those of any other

(Handwritten signatures and initials in blue ink)

Group. Intrinsically-safe circuits and their terminals shall be segregated from other circuits and terminals. All wiring shall be neatly and securely fixed by insulated cleats, bunched and secured by approved plastic strapping or run in approved insulated wiring trunking or non-corrodible flexible tubing. Not more than 75% of the capacity of trunking, ducts, looming, or tubing shall be used. Insulated earth wiring shall be so arranged that access to any equipment or connection point or the removal of any item of equipment is unimpeded. Wiring for future equipment shall be secured and terminated on terminal blocks. Lacing for wiring looms shall be of rot-proof cord or plastic strips. Inter-section wiring in multi-section cabinets shall be via a terminal block in each section.

1.9.11 Panel wiring identification and termination

Identification ferrules shall be fitted at both ends of each wire. The numbers or letters used shall correspond with the appropriate wiring diagram. The ferrules shall be of plastic insulating material with permanent black characters on a colour-coded background for numbers and on a white background for letters, unaffected by oil or water. They shall be so arranged that they can be read logically from left to right when viewed normally. The system of wire identification shall be such that wires in the same circuit on opposite sides of a terminal shall have the same reference, and this system shall be continued through all external cabling. Terminal ferrules (spade, tongue, crimped connections) shall be provided on each conductor.

1.9.12 Panel earthing

A continuous copper earth bar of not less than 25mm x 6mm cross section shall run the full length of each panel and shall be securely fixed and bonded electrically to the main frame. The cable gland-plates and the earth bar shall be provided with suitable brass terminals of not less than 6mm diameter for connecting the metal cladding or armouring of all incoming and outgoing cables to the station earthing system.

A second continuous copper earth bar of not less than 25mm x 6mm cross section, electrically isolated from the steelwork of the panel and metal cladding and armouring of cables, shall be provided for earthing the signal earth connection of each instrumentation and control device and the screen(s) of each instrument cable not earthed elsewhere to the station instrumentation earth plate. The earth bar shall have sufficient brass terminals as specified above for each instrumentation and control device and the screen of every shielded cable plus 25% spare terminals. In multi-section panels, each earth bar shall be electrically bonded to the corresponding bars in the adjacent section(s). Instrumentation and instrument cable screen earthing shall comply with BS 6739: 1986, Section 10, unless otherwise stated in this clause.

1.9.13 Panel Heating

Each panel shall have one or more thermostatically-controlled tubular or ribbed panel heaters to prevent condensation and assist ventilation and which shall be adequate for ambient temperatures down to 5°C. The heater rating shall not exceed 0.2W/mm and the surface temperature of any part which could be contacted accidentally shall not exceed 60°C. Heaters shall be so situated that no deterioration can be caused to any equipment or wiring in the panel. The heating circuits shall be switched and fused independently of the instrumentation and control equipment and manually controlled by an enclosed switch mounted in an accessible position within the panel. Thermostats

shall be mounted remote from the heaters and other sources of heat and shall be fully adjustable over a range of not less than 0°C to 50°C.

Thermostats shall cut out each heater when the internal temperature of the panel exceeds a preset value; differential thermostats shall be used to maintain the panel internal temperature at a pre-set value above the external ambient temperature. If the permanent power supply is not available at the time of installation of the panel and condensation is detected, a temporary power supply shall be connected to the panel of sufficient rating to operate the heaters.

1.9.14 Panel lighting

Each panel shall be adequately illuminated internally, as evenly and as free from dazzle as possible, by fixed fluorescent lighting controlled from totally-enclosed light switches and by totally-enclosed door-operated switches positioned so as not to interfere with access. There shall also be one installed inspection lamp per three meters of panel length or part thereof with adequate flexible connection cable to reach any point in the panel. The control switch for an inspection lamp shall form part of the lamp assembly. Lighting circuits shall be fused independently of any instrumentation and control circuit and designed to allow lamps to be replaced safely and shall be fed from a distribution board and circuit breaker connected on the live side of the main panel ac supply circuit breaker.

1.9.15 Panel ventilation

Each panel shall be provided with ventilation fans as required to ensure that equipment within the panel is maintained within manufacturer's recommendations, with due regard to the environment in which the panel will be mounted. Fans shall be controlled by a suitably labeled enclosed switch mounted internally in an accessible position. Fans shall be mounted with their axes horizontal and shall be arranged to draw clean air into the panel. Air entries shall have filters which can be renewed from outside the panel and shall be designed to prevent the entry of rain, spray, injurious fluids, sand or dust.

1.9.16 Panel piping and tubing

Panels containing equipment using a supply of compressed air shall have a common air pressure-reducing station with duplicate pressure-reducing valves and filters. The pressure reducing station shall also include isolating valves upstream and downstream of each filter/reducing-valve set, pressure-relief valve, pressure indicator and low-pressure alarm unit for the low-pressure header and a pressure indicator for the high-pressure pipework. The pressure-reducing station components shall be mounted in a clear space inside the panel, supported on a suitable framework between the lower horizontal row of instruments and the main low-pressure header.

All piping, fittings and valves downstream of the pressure-reducing station shall be of brass, copper or plastic. PTFE tape shall not be used downstream of the main filters. The low-pressure header shall be brass and shall be near the panel floor with drain valves and tundishes piped to a drain. Branch air headers shall be of brass (15mm diameter minimum) and shall run vertically from the header to the instrument. The low pressure header and each branch shall have a 6mm minimum, non-ferrous shut-off valve for each instrument requiring an air supply and a compression coupling for each air-purge connection. At least 10% spare connections for possible

future instruments shall be provided in each panel section. Any header dismantled before shipment shall have brass unions or flanges at each panel-section junction.

Panel-mounted instruments shall be piped to bulkhead fittings on a gland plate during assembly at the manufacturer's works. Piping shall be colour-coded in accordance with Recommended Practice ISA-RP 7.2 issued by the Instrument Society of America and shall be segregated from wiring so that any leakage is harmless. Each panel-mounted pressure gauge shall have a stainless steel flush-mounted shut-off and fine-regulating valve mounted vertically below. A drip tray shall be provided below each row of gauges. Exhaust and de-pressurizing pipework shall be routed out of the panel.

1.9.17 Panel labels

Labels shall be provided for every panel to describe the duty or otherwise identify the panel and its sections and every instrument, component and item of equipment mounted internally and externally. Where applicable, front-of-panel labels shall be as shown in the Specification drawings. Each label shall be permanently secured to the surface near the item to which it refers. Externally-fitted labels shall be of perspex or other approved transparent plastic, with letters and numbers rear-engraved and filled with black. The rear surface of each perspex label shall be finished with a coat of paint of the same colour as the panel external finish. Instrument duty labels fitted externally shall be below the item to which they refer. Embossed tape or similar adhesive labels will not be approved.

Laminated materials or rear-engraved and filled plastic shall be used for internally-fitted labels, which shall be white with engraved black letters. Labels conforming to the requirements of the preceding paragraphs or other approved means shall be provided:

Labels

- To describe or identify circuits or circuit components
- To identify DC polarity
- To warn or remind about dangerous or potentially-dangerous circumstances
- Wherever elsewhere specified

Unless otherwise specified, all engraving shall be in plain block letters, 4mm high. The minimum practicable number of different sizes shall be used. Manufacturers' nameplates shall not be fitted on panel external surfaces.

1.9.18 Panel finish

For control and instrument panels, desks and cubicles a hard, smooth, durable finish, free of blemishes, shall be provided. Before painting, all external welds and any rough areas shall be smoothed, and all surfaces shall be thoroughly cleaned and free from scale, contaminates, corrosion or grease. If rust-proof or Zintec steel has not been used in the construction, the panel shall be treated with a passivating agent such as phosphoric acid. All internal surfaces shall have a minimum of three coats of paint of which the first shall be an approved antirusting priming coat and the final coat shall be opaque gloss white enamel. All external surfaces shall have not less than five coats of paint of which the first shall be an approved etch priming coat, and the second and third suitable undercoats, all of which shall be rubbed smooth when dry before application of the next coat. The undercoats shall be easily distinguished in shade or colour from the priming

and finishing coats. The two final coats shall be of stove enamel paint, gloss or semi-matt finish, to a colour and finish. Stoving shall be carried out in accordance with the recommendation of the paint manufacturer. The overall dry film thickness (DFT) shall be between 85 and 120 microns. Nuts, bolts, washers and other fixing devices which may have to be removed for transit or maintenance purposes shall be galvanized or otherwise finished to an approved standard. A 500ml tin of matching touch-up paint shall be provided and packed with each panel.

1.10 Recording equipment

1.10.1 Chart recorders

Chart recorders shall be microprocessor-controlled or have auto-balancing potentiometric movements and conform with BS 90:1975 where applicable and shall be able to pass each test specified in BS EN 60873:1993 or equivalent standard. Recording instruments shall have an accuracy of $\pm 0.5\%$ full-scale deflection or better. The operating temperature range shall be 0°C to 50°C . The recorder shall be equipped with indicating scales and pointers for each measured variable. The pen and a reasonable length of chart shall be visible without opening the case. Strip-chart recorders shall be electrically driven and have monthly or fanfold charts of not less than 100mm width which shall advance at a minimum of three selectable rates, including 20mm per hour.

Recorder inks and inking systems shall be suitable for use both in highly-humid conditions and in air-conditioning. Inks of differing colours shall be used for recording two or more quantities on the same chart. Each recorder chassis shall be easily withdrawable from its housing for chart changing without interrupting its circuits. Recorder scales and charts shall be in accordance with BS 1794:1952 and BS 3693:1992 or equivalent as applicable. Single-pen recorders used for more than one measurement shall have rotary-switch selectors with plates engraved to show the density of the selected measurement.

1.10.2 Electrical Indicators and Integrators

Indicators for use with analogue signal-transmission systems shall comply with BS 89:1990 or equivalent and have an accuracy class index of 1.0. Indicator movements shall be critically damped (dead-beat). Indicators for use on more than one circuit shall have rotary switches to select the circuit, with engraved plates to show the circuit selected. Indicators shall have circular scales or shall be of the vertical edgewise type and shall be designed to avoid parallax error. Scales shall be clearly marked in SI units and shall comply with BS 3693:1992 or equivalent. All instruments mounted on one panel or board, or in adjacent groupings, shall have similar styles of figures and letters. Dials shall be white with black scales and lettering not subject to fading.

The material for scales shall be such that no peeling or discolouration will take place with age under any environmental conditions. Major scale marks and numerals shall be of the same size and thickness and shall be separated by not more than twenty-five minor marks. Pointers shall taper to the width of the scale marks. Integrators shall be of the multi-digit cyclometer type. Integrators operating in conjunction with an electromagnetic or ultrasonic flow meter shall use the pulse output from the flow transmitter. Any integrator operating from a device without a pulse output shall have an integral or separate current-to-pulse converter with sufficient adjustment of

the pulse rate to avoid the use of any multiplying factor except in integer power of 10. Each integrator shall incorporate an adjustable limiter whereby any input below a pre-set value is inoperative. Unless otherwise specified, integrators shall have a minimum of eight digits with a decimal point where applicable.

1.10.3 Alarm System

Alarms shall be initiated by the opening or closing of volt-free contacts which shall remain unchanged throughout the periods in which the alarm conditions exist. Alarm circuits shall be capable of conversion from open-healthy to open-alarm or vice versa by a simple modification after installation requiring no additional parts or special equipment.

Each alarm shall initiate the operation of both visual and audible devices. The sound intensity of each audible device shall be suitable for the maximum sound level of its environment.

Audible devices in the same room or area shall have distinguishable sounds and adjustable sound levels.

1.10.4 Matrix Type Alarm Annunciators

The alarm annunciator shall be microprocessor based, modular, split type unit with alarm windows mounted on the front door and electronic modules inside the panel. The weather protection class for alarm annunciator shall be IP-54 of IS 13947, Part-I.

Each alarm shall initiate a visible and audible indication of the specified condition. Unless otherwise specified, alarm indicators shall be grouped together in annunciator units each having at least 20% spare ways. Alarm indicator lamps (Cluster LED type) shall have transparent screens engraved with appropriate legends as approved in the Designs and Drawings. The legend area of each indication shall not exceed 40mm high and 75mm wide.

When any alarm condition occurs, a condition device common to an alarm annunciator system shall sound and the appropriate indicator shall flash on an off. The flashing rate shall not be less than 2 Hz and shall not exceed 5 Hz. On pressing an accept pushbutton, the audible device shall be silenced and the flashing light shall become steady. The alarm indicator shall remain illuminated until the alarm condition ceases and a reset pushbutton has been operated.

The operation or acceptance of one alarm shall not inhibit the operation of the audible device or the flashing of the appropriate alarm indicator if a further alarm condition occurs.

At unmanned locations alarms operated on two or more annunciators shall require acceptance at each annunciator.

Alarms shall be accepted automatically and the appropriate audible device silenced after an adjustable period of 1 to 5 minutes.

An integral 'test' pushbutton shall be provided to illuminate each lamp in the appropriate group and to operate the audible device but shall not cause a spurious alarm condition on any other annunciator.

Alarm circuitry shall be arranged so that spurious or transient alarm states persisting for less than 0.5 seconds do not initiate any action.

Alarm annunciator / indicator legends or labels shall be arranged with three lines of text as follows:

- Top Line: Location; example: sludge blanket level
- Middle line: parameter; Level
- Bottom line: status. High

1.10.5 Push-Buttons and Indicator Lights

Push-buttons in control circuits shall have shrouds, guards or other suitable means for preventing inadvertent operation. Status-indicator lights shall be of the high-intensity LED type. Indicator lights shall be of a design which allows easy LED replacement from the front. Indicator lights shall be easily visible above the ambient light level when viewed from within an included angle of 120 degrees. LEDs shall be chosen to ensure clear discrimination between the energized and de-energized states and to ensure an average working life of not less than 3000 hours. A 'lamp-test' push-button shall be provided for each group of indicator lights. The colours of push-buttons and indicator lights on instrument panels shall be as follows:

INDICATOR LIGHTS ON INSTRUMENT PANELS

Duty Push button	-	Signal lamp
Start or on (energize)	-	Green
Stop or off (de-energize)	-	Red
Open valve	-	Black*
Close valve	-	Black*
Accept	-	Black
Lamp test	-	Black
Reset	-	Black
Motor running (energized)	-	Red
Motor stopped (de-energized)	-	Green
Valve open	-	Red
Valve closed	-	Green
Urgent alarm	-	Red
Non-urgent alarm	-	Yellow
Plant healthy or ready for use	-	White

*Panel-mounted push-buttons for valve operation shall be coloured black, or as per the approved Design and Drawings, with the duty clearly defined by legend on an associated label.

1.10.6 Analogue Signal Transmission

Unless otherwise specified, analogue signal-transmission systems shall be in accordance with BS EN 60546-1:1993 and shall use a signal of 4mA to 20mA DC. Transmitting devices shall have integral indicators to monitor the output signal or connections suitable for use with a portable test

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meter. Transmitters shall be capable of meeting the requirements laid down in the appropriate part of IEC 60770-1:1999.

1.10.7 Analogue Process Controllers

Analogue controllers shall use solid-state components and shall have outputs containing three terms with negligible interaction. The controller fascia shall have measured value, set value and output indication, manual set-value and output controls, auto/manual switch for control mode and remote-local transfer switch for set-value control. Manual control stations shall have measured-value and set-value indication, local/remote switch and control available lamp indicator. Each controller shall have the means to restrict its output signal to a predetermined, fully adjustable band so that the regulating device is not moved to unsafe positions. The adjustment of these safe operating limits shall be by means of accessible, clearly marked, internal components. A continuously adjustable proportional band of not less than 5 to 500% shall be provided. Integral and derivative action times shall be adjustable over ranges which shall not be narrower than 6 seconds to 25 minutes and 0-to 10 minutes respectively. If the integral or derivative action times' adjustments are in steps, the ratio of successive steps shall not exceed 2. The controls used to set the P, I and D values may be at the front of the instrument or mounted internally in an accessible position.

Each controller shall be designed so that in the event of failure, it shall be possible to plug a portable manual station into the controller case and to control the regulating device manually. Controller design shall ensure automatic procedure-less, bump less transfer whenever the instrument is switched from "auto" to "manual" or vice versa. Controller action shall be adjustable from direct to reverse and vice versa by the operation of an internal switch. Analogue process controllers shall be capable of meeting the requirements laid down in the appropriate part of BS EN 60546-1:1993.

1.11 SCADA System

1.11.1 General

This shall be read in line with the Plant Control Configuration Diagram provided with Scope of Work.

The SCADA shall monitor complete parameters of the STP including mechanical equipment (pumps, motors, valves, etc.), process instruments and power network. The system should be such that it has feature as per generic requirements to enable the system for seamless integration with other SCADA System.

The SCADA System shall collect data of various process instruments, mechanical equipment, MFM and I/Os through communication network . The system architecture has been provided for reference purpose.

The system shall collect data through PLC under scope of supply. The field instruments (continuous monitoring online analysers) shall transfer data to PLC and PLC will report to control centre through fibre cable. The fibre cable will be laid across all location in ring so that there is provision for redundant communication.

1.11.2 Basic requirements for the control system

This section summarizes the basic requirements for the control system, including the system's components, its open communication capabilities, its combined DCS functionality, and its scalable architecture.

1.11.3 System components

The control system shall consist of a modular controller (including control, I/O, and communications functions), a peer to peer architecture, comprehensive process automation software (including configuration, documentation, operator interface, historian, and simulation software) and software modules that facilitate open systems connections.

The system shall include a full complement of modular supporting equipment (including mounting racks, power supplies, termination strips, equipment enclosures, prefabricated cables, furniture, etc.), all of which shall be designed to simplify construction.

1.11.4 Open Communications

The control system shall be open to enable easy integration with OPC (OLE for Process Control) [where OLE stands for Object Linking and Embedding (OLE)] server so as to collect the data from the remote housing station.

The control system shall include features traditionally associated with both a programmable logic controller (such as logic processing, modular rugged hardware, and remote I/O architectures) and a distributed control system (such as continuous and complex control, advanced operator interfaces, sophisticated redundancy). These capabilities must seamlessly reside in one control system, without the use of special gateways or interfaces.

1.11.5 Scope of Work

The solution should meet the functionality as per requirements for connectivity of PLC, IP Camera etc. with Control Centre. The scope of supplies for the SCADA shall be as detailed below and as per the guideline provide with Scope of Work.

Scope of Supply

- Supply of Control Centre Hardware and Software for SCADA System
- Networking Equipments (Router, Firewall etc.) for Control Centre.
- Interface / Integration of PLC Units with SCADA System.
- Integration of Field instruments Hardware with Control Centre.
- Testing, Erection & Commissioning of supplied system.
- Training as per detailed Offer.

1.11.6 Hardware Details

This chapter contains a detailed configuration description of automation system. The building sub-systems are as per the Scope of Work SCADA cum Communication Server

- User Interface subsystem like WS
- IP Camera & IP phones (including video) which shall be configured as per the guideline given in Annexure provided as part of Scope of Works.

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- Network Video Recorder and IP PBX system configured as per the guideline given in Annexure provided as part of Scope of Work.
- Local Area Network subsystem like LAN switch, Router, Firewall
- 12 C Single Mode Fibre cable

Each subsystem is built from hardware common components. All subsystems and hardware components are described below:

Subsystem Description

This section lists and describes the subsystems (associated hardware components) at each location.

SCADA CUM COMMUNICATION SERVER, WEB SERVER, ISR SERVER

Qty	Hardware Component	Remarks
1	SCADA cum Communication Server	✓ The interfaces for each server are connected to Ethernet networks to collect data from field.
1	WEB server	✓ Interface with Internet to remote client
1	ISR server	✓ Databases server with Oracle/SQL for Alarm and MIS Report

USER INTERFACE SUBSYSTEM

Qty	Hardware Component	Remarks
2	Workstation Console	✓ The console is provided with 2 TFT Monitor ✓ The interface is connected to the Ethernet networks.
1	Remote access terminal	✓ LAPTOP connected through a serial link and a modem.

LOCAL AREA NETWORK SUBSYSTEM

Qty	Hardware Component	Remarks
1	LAN Switch	Ethernet switch 14 ports (10/100 Base TX)+2 Fibre Port
6	Remote Location LAN switch	Ethernet switch 14 ports (10/100 Base TX)+2 Fibre Port
1	Router	2 LAN+2 WAN, all are 10/100 with 2 V.35 Port
2	Firewall	4LAN+2 WAN, all Wan are 10/100Mbps and LAN are 10/100/1000 Mbps
Lot	12C Single Mode Fibre armored cable	For Connectivity

Peripheral Subsystem

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PRINTERS

Qty	Hardware Component	Remarks
1	Laser Printer(Colour)	Each laser printer is connected to Ethernet network.

UPS

Qty	Hardware Component	Remarks
1	10 KVA UPS for Control room Hardware	The UPS is designed for 10 KVA with two hours backup.
2	3 KVA UPS at all Remote location	The UPS is designed for 2 KVA with two hours backup.

IP Camera (Optional)

Qty	Hardware Component	Remarks
1	IP Camera	Each Camera is connected to Ethernet network for Remote location surveillance

Video Projection System (Optional)

Qty	Hardware Component	Remarks
1	Rear Projection one cube with controller	Each VPS is connected to Ethernet network.

1.11.7 Hardware Components Description

This section describes the common hardware components.

Communication cum SCADA Server, Web Server, ISR Server Characteristics *

Intel® Xeon® Quad-Core Processor E5606 2.13 GHz, 8MB L3 Cache	1
Integrated Two Broadcom dual-port Gigabit Ethernet with TOE enabled	1
8GB Memory (4x2GB), 1333MHz, DDR3 RAM	1
2nd Intel® Xeon® Quad-Core Processor E5606 2.13 GHz, 8MB L3 Cache	1
300GB 15K RPM,6Gbps SAS 3.5 Hot Plug Hard Drive " With RAID5	3
DVD+/-RW ROM, SATA, Internal for Ms 2008 R2	1
High Output Power Supply, Redundant, 460W	1
Power Cord, GType, 230V (Nepal, Sri Lanka, India)	2
2U Cable Management Arm	1
2U Sliding Rail	1
Windows Server 2008	1

* The system (hardware, software, accessories, etc.) being provided during installation would be of latest configuration.

Workstation Console Dual Monitor Characteristics *

Motherboard	Intel® Xeon® Dual-Core Processor W3503 (2.40 GHz, 4 MB cache, 1066 MHz memory)
Video Card	ATI FirePro 2270 (512 MB)
RAM Memory	4GB (2x2GB) DDR3 SDRAM Memory, 1333MHz,ECC 1

HDD	500 GB SATA (7200 RPM) HDD
Input Power Supply	220 to 240 VAC (+/- 10%), 50 Hz (+/- 2 Hz)
Power Cord	Indian Style
CD Drive	16X DVD +/-RW Combo Drive
Keyboard	USB Entry Keyboard
Mouse	USB Optical Scroll Mouse (2 buttons) with Mouse Mat
LAN(Ethernet port)	Dual Broadcom RJ45 10/100/1000 BASE on board Ethernet NIC
I/O Cards	One serial RS-232 port, 4 USB port and one parallel port
Indicator & Switch	Power on/off x 1, HDD x 1. Power on/off x 1, System reset x 1

**The system (hardware, software, accessories, etc.) being provided during installation would be of latest configuration.*

Remote Access Terminal (1no.)

Laptop Characteristics *

Processor	2nd generation Intel® Core™ i3-2350M processor (2.30 GHz, 1333, 3M cache)
Operating System	Genuine Windows® 7 Professional SP1 32bit (English) for India
Display	14.0" HD WLED Anti-Glare (1366x768)
Memory2	2GB2 DDR3 SDRAM at 1333MHz
Hard Drive	320GB 5400RPM SATA Hard Drive
Video Card	Intel® HD Graphics/ Intel® HD Graphics 3000(It depends on processor selected)

**The system (hardware, software, accessories, etc.) being provided during installation would be of latest configuration.*

LAN Switch Characteristics *

Specification	Managed Industrial Ethernet switch
Ethernet Standards	IEEE 802.3 for 10BaseT IEEE 802.3u for 100BaseT(X) and 100BaseFX IEEE 802.3x for Flow Control
Design Standard	FCC Part 15, CISPR (EN55022) class A, Shock- IEC60068-2-27, Vibration-IEC60068-2-6, EN61000-4-2 (ESD), EN61000-4-3 (RS), EN61000-4-4 (EFT), EN61000-4-5 (Surge), EN61000-4-6 (CS), EN61000-4-8, EN61000-4-11 standards
Input Voltage	9.6-60 VDC
Operating Temperature:	0 to 60°C
Ambient Relative Humidity:	5% to 95% Non-condensing
Overload Current Protection	Present

Mounting	DIN Rail Mounting
No. of Ports	12 Nos. (10 CU + 2 FO)
Interface	
Ethernet ports	10 no. RJ45 Ports with 10/100BaseT(X) auto negotiation speed, Full/Half duplex mode, and auto MDI/MDI-X connection
Fiber Port	Two 10/ 100BaseFX port SC Type Single-Mode, 1310 nm Supports Ring, and Self Healing

** The system (hardware, software, accessories, etc.) being provided during installation would be of latest configuration.*

Color Laser Printer Characteristics *

Print speed	Up to 12 & 8 ppm
Print quality	Up to 600x600 dpi with HP ImageREt 3600
(A4 Size, ready)	26/32 sec
Print speed footnote	Exact speed varies depending on the system configuration, software application, driver and document complexity.
Memory, standard	128 MB, expandable to 384 MB
Processor speed	600 MHz
Duty cycle (monthly, A4)	Up to 30000 pages
Connectivity, standard	Hi-Speed USB 2.0 port; built-in Fast Ethernet 10/100Base-TX
Print technology	In-line colour laser printing technology
Print languages	HP PCL 6, HP PCL 5c, HP Postscript level 3 emulation
Paper trays, standard	2
Paper handling input, standard	150-sheet input tray
Paper handling output, standard	150-sheet face-down output bin
Power	Input voltage 115 to 127 VAC (+/- 10%), 60 Hz (+/- 2 Hz), 12 A; 220 to 240 VAC (+/- 10%), 50 Hz (+/- 2 Hz), 6 A
Power consumption	445 watts maximum (active), 18 watts maximum (ready), 6.7 watts maximum (sleep), 0.48 watts maximum (off)
Media sizes supported	Tray 1: A4, A5, A6, B5 (JIS), 10 x 15 cm, 16K, envelopes (ISO DL, ISO C5, ISO B5), post cards (Standard #10, JIS Single, JIS Double); Tray 2 : A4, A5, A6, B5 (JIS), 10 x 15 cm, 16K, envelopes (ISO DL, ISO C5, ISO B5), post cards (JIS Single, JIS Double)
Media sizes, custom	Tray 1: 76 x 127 to 216 x 356 mm; Tray 2 : 100 x 148 to 216 x 356 mm
Media weight, supported	Tray 1: 60 to 176 g/m ² (up to 220 g/m ² with HP laser glossy photo papers); tray 2, optional tray 3: 60 to 163 g/m ² (up to 176 g/m ² with postcards, up to 220 g/m ² with HP laser glossy photo papers)
Recommended operating	15 to 27° C

Operating humidity range	20 to 70% RH
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* The system (hardware, software, accessories, etc.) being provided during installation would be of latest configuration.

UPS (1 No.) Characteristics

Technology	Micro processor based IGBT, High Frequency Switching Sinusoidal multiple PWM
Rating	10 KVA
Input	230 V AC, +10%, -15%
Output	230 V AC
Battery	Sealed Maintenance Free Batteries, CSB / Panasonic / Global & Yuasa or eqvt
Backup Hours	120 Minutes

UPS (6 NO.) Characteristics

Technology	Micro processor based IGBT, High Frequency Switching Sinusoidal multiple PWM
Rating	3 KVA
Input	230 V AC, +10%, -15%
Output	230 V AC
Battery	Sealed Maintenance Free Batteries, CSB / Panasonic / Global & Yuasa or eqvt
Backup Hours	120 Minutes

Router (2 No.) Characteristics*

Memory	RISC @ 533 MHz
	Flash Memory:256M Bytes
	SDRAM: 256M Bytes
Interface	2 x 10/100/1000 Mbps Ethernet Port
	2 Serial Ports (V.35)
	2 X 10/100 Mbps WAN Interface
	1 Console port
	1 Auxiliary port
Performance	
Throughput	300 Kpps (64-byte packets)
Routing table size	30000 entries
Network Management	IMC - Intelligent Management Center; command-line interface; Web browser; SNMP Manager; Telnet; RMON1; FTP; IEEE 802.3 Ethernet MIB

Operating Temperature	0° to 40° C (32° to 104° F) (Relative Humidity: 5% to 90% non-condensing)
Non Operating Temperature	-40° to 70° C (Relative Humidity: 5% to 90% non-condensing)
Power	100-120/200-240 VAC

**The system (hardware, software, accessories, etc.) being provided during installation would be of latest configuration.*

IP Camera Characteristics

Camera	
Sensor	1/2.7" HD progressive scan CMOS
Lens	C/CS mount lens (lens not included)
Auto Iris Type	DC drive
Illumination (low light sensitivity)	• Color: 0.2 lux at F1.2
	• B/W: 0.05 lux at F1.2
Synchronization	Internal
White Balance	ATW/AWB (range: 3200 to 10000°K)
Dynamic Range	• Color: 100 dB
	• B/W: 110 dB
Auto Electronic Shutter	1/30 to 1/25000 sec.
Electronic Shutter	Auto
S/N Ratio	50 dB (Gamma, Aperture, AGC OFF; DNR ON)
ICR Control	Auto (light sensor control) or DI control
DNR	Built-in DNR
WDR	Level 1-8/Off
AGC control	2X, 4X, 8X, 16X, 32X, 64X
Flickerless Control	Indoor/Outdoor mode
Black Level Control	High/Medium/Low
Auto Exposure	Level ±5
Image Rotation	Flip, Mirror, and 180° rotation
Image Setting	Manual tuning with saturation, sharpness, and contrast
• Video	
Video Compression	H.264 (ISO/IEC 14496-10) or MJPEG
Video Outputs	Ethernet
Video Streams	Up to 3 video streams (2 x H.264 and 1 x MJPEG)
	• Stream 1: H.264, 1280 x 800 resolution (max.)
	• Stream 2: H.264, 720 x 480 resolution (max.)
	• Stream 3: MJPEG, 720 x 480 resolution (max.)
Note	Streams 2 and 3 must be at the same resolution

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Video Resolution and FPS (frames per second)	Not less than 20 FPS in NTSC or PAL
• Network	
Protocols	(<i>ONVIF compliant</i>) TCP, UDP, HTTP, SMTP, FTP, Telnet, NTP, DNS, DHCP, UPnP, RTP, RTSP, ICMP, IGMPv3, QoS, SNMPv1/v2c/v3, DDNS, Modbus/TCP, 802.1X, SSH/SSL
Ethernet	1 10/100BaseT(X) Ethernet port, RJ45 connector
• Serial Interface	
RS-485	1 half-duplex RS-485
• GPIO	
Digital Input	1, max. 8 mA • High: +13 V to +30 V • Low: -30 V to +3 V
Relay Output	1, max. 24 VDC @ 1A
• LED Indicators	
STAT	Indicates if the system is booted properly or not
Network	10 Mbps or 100 Mbps
Power	Power on/off
• Local Storage	
SD Socket	Standard SD socket (SDHC)
• Power Requirements	
Input	• Redundant power inputs • 12/24 VDC, 24 VAC, or Power-over-Ethernet (IEEE 802.3af)
• Physical Characteristics	
Camera Body Housing	Metal, IP30 protection
Installation	Wall mounting, pole mounting, corner mounting
Note	Optional external housing and mounting accessories may be required.
• Security	
Password	User level password protection
Filtering	By IP address
Authentication	802.1X
Encryption	HTTPS, SSH
• Alarms	
Intelligent Video	Camera tamper, virtual fence, alert zone, missing object, unattended object
Note	IVA functions are optional except for camera tamper.
Video Motion Detection	3 independently configurable motion areas
Scheduling	Daily repeat timing schedule
Imaging	JPEG snapshots for pre/trigger/post alarm images

Video Recording	Event recording and stored in the SD card
Email/FTP Messaging	Automatic transfer of stored images via email or FTP as event-triggered actions
Custom Alarms	HTTP event servers for setting customized alarm actions
Pre-alarm Buffer	24 MB video buffer for JPEG snapshot images
• Environmental Limits	
Operating Temperature	Standard Models: 0 to 60°C (32 to 140°F)
	Wide Temp. Models: -40 to 75°C (-40 to 167°F)
Storage Temperature	-40 to 85°C (-40 to 185°F)
Ambient Relative Humidity	5 to 95% (non-condensing)
• Standards and Certifications	
Safety	UL 60950-1
Hazardous Location	UL/cUL Class I Division 2 Groups A/B/C/D (Pending), ATEX Zone 2 Ex nCnAnL IIC T4 (Pending)
EMI	FCC Part 15, CISPR (EN 55022) class A
	EN 61000-4-2 (ESD), Level 3,
	EN 61000-4-3 (RS), Level 3,
	EN 61000-4-4 (EFT), Level 3,
	EN 61000-4-5 (Surge), Level 3,
	EN 61000-4-6 (CS), Level 3,
	EN 61000-4-8,
	EN 61000-4-11
Traffic Control	NEMA TS2
Rail Traffic	EN 50121-4
Shock	IEC 60068-2-27
Freefall	IEC 60068-2-32
Vibration	IEC 60068-2-6

**The system (hardware, software, accessories, etc.) being provided during installation would be of latest configuration.*

Video Projection System (1 No.) – Optional *

Resolution	SXGA+
Individual Cube Size	67" Diagonal
Image Size (mm)	1361 x 1021
Display Technology	DLP, single chip
Native Resolution	1400 x 1050 pixels
Aspect Ratio	4:03
Screen to screen gap	Rear access:
	Adjustable up to 0.2 mm
DMD	0.95" DMD 12 deg.
Light Source	LED - 1R1G1B - 12 sq mm each
Brightness	650 Lumens
Luminance (Nits or cd/m ²)	Based on screen used, lamp mode and screen size

Brightness Uniformity	Greater than 90%
Screen Type	Fresnel/ Lenticular/Black Bead/Cross Prism (XPS)
Full Viewing Angle	180 degrees
Colors	16.7 million
Color Temperature Range	3200K to 9300K
Color Temperature Range	3200K to 9300K
LED Life (typical)	> 60,000 Hours
Inputs	RGBHV on BNC, Dsub -15,
	DVI-DX2, Composite video, (NTSC/PAL/SECAM)
	Component video HDTV, RS232C
Outputs	Video/DVI
Control	RS-232/IR, RS 422/IP
Voltage	AC100-240V @ 50/60 Hz
Power Consumption	< 350 W
Operating Temperature	10-35°C
Operating Humidity	10%~90%
Storage	-20 to 60°C

*The system (hardware, software, accessories, etc.) being provided during installation would be of latest configuration.

12C Single Mode Fibre Cable

Configuration	MULTITUBE DOUBLE SHEATH ARMOURED CABLE
Nos. of Core	12
Maximum Tensile Loading	1361 x 1021
Installation	2700N
Long Term Installed	900N
Operating Temperature	-30°C to +60°C
Normal Dia	14.8 mm
Nominal weight	200 KG/KM
Mode	Single Mode
Single mode Fiber:	(G.652.B)

Server Panel

The equipment can be of any Standard make which can comply with the following standards:

Type	SERVER RACK 42U/600W/1000D
Specification	Captive Front Panel Hardware, Pkt of 20
	Castors (Plain)
	ServerRack , 19"/42U
	consisting of High quality extruded Aluminium vertical profiles 4 Nos.Top and Bottom steel end frames with bottom Panel having gland plate for cable entry, Top cover with FHU provision, Side

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Type	SERVER RACK 42U/600W/1000D
	Panels with latches and venting slots at bottom 1/3 area and 2 pairs of 19" Mounting Angles
	Dimension: 2150 x 600W x 1000D Powder Coated BLACK
	Front CRCA steel single door with Perforation
	Rear CRCA steel single door with Perforation
	Component Shelf, Universal, 19"W/575mmD, Load cc 50 kg.
	Top Mounting, Fan Housing Unit with 4 fans 230 V / 90CFM
	Rotary Keyboard Tray with slides
	Castors (with brake)
	Earth Continuity straps (kit)

The equipment should be of Reputable **make which can comply with the followings standard:**

1. Powerful Integrated Controller

The controller shall consist of a family of intelligent integrated modules, with each performing a dedicated function. It shall have an integrated redundant interface for the I/O modules as well as redundant interface for the Human machine interface.

Controller shall have the reliability factor with high MTBF within the service period of 15 + years As per DIN 40041, reliability is understood to be the "the property of an entity to fulfill its reliability requirements during or after a given time span under given application conditions", therefore concessionaire is required to assure the airconditioned environment of PLC system as stipulated in Annexure provided as part of Scope of Works.as minimum requirement.

2. Modular Architecture

The modular approach shall enable a very small system to be installed with expansion to a very large system without changing the basic hardware or disrupting the architecture. A minimum of the following module types must be available: control modules, I/O modules, communications modules, computer modules, and power supply modules.

3. Controller Packaging

For installation flexibility and high reliability, controller hardware must be designed to withstand harsh conditions within industrial environments, such as heat, humidity, shock, vibration, and electrical surge and discharge.

A. Module Hardware

Module hardware must meet the following requirements:

- The modules shall be identical in appearance.
- All the module shall be housed in a powder coated metal case rack to prevent physical

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damage from handling or dust.

- All control and I/O modules shall be rated for operation within the following ranges: 0-50 Deg C and 5-95% relative humidity, non-condensing.
- I/O and power modules shall have circuitry to protect the system from electrical surge and discharge.

The modules shall comply with the following specifications:

International Electro-technical Commission (IEC)

- IEC 60751 (1983-01) Industrial platinum resistance thermometer sensors
- IEC 61000-4-2 (2001-04) Electromagnetic compatibility (EMC)- Part 4-2
- IEC 61000-4-3 (2002-03) Electromagnetic compatibility (EMC) - Part 4-3
- IEC 61000-4-4 (1995-01) Electromagnetic compatibility (EMC) - Part 4
- IEC 61158 (2000-08): Field-bus standard for use in industrial control systems - Part 2:
- IEC 61131-3 (1993-03) for Programmable controllers - Part 3

The modules shall comply with the following shock and vibration standards:

- Vibration: IEC 68-2-6, Fc: 10-50 Hz, 2g

B. Module Racks

The modules shall be grouped together in racks to form the control system. The racks shall provide the communications mechanism to fully integrate the modules and facilitate intercommunications between racks. A rack should hold approximately ten individual modules, with each slot identical and able to accept any module. Modules should be connected to the backplane using high quality, gold-plated, industry-grade pin connectors.

It shall be possible to remove and reinsert the modules under power with no damage to the rack or modules and without removing any external wiring or cables. The rack and modules shall provide a physical keying mechanism to prevent incorrect module insertion during system operation.

To simplify installation and maintenance, the module racks and modules shall be designed for front access only. All user functions, including diagnostics, field wiring, cable connections, switches and status indications, shall be available from the front of the rack.

C. Power Supply

Redundant power supplies shall be available for card rack mounting to form as an integral part of the system. The module rack must provide two individual power supply buses that to be driven by two independent power sources for high availability placed in the rack in current sharing mode. Each module shall be capable of using power from any of the two buses.

D. Enclosures

The racks shall be mounted in an industrial enclosure with a front & rear -access design, with all frequently accessed items (such as modules, connectors, status indicators, switches, and termination assemblies) located in the front of the enclosure. For maximum flexibility, the enclosures shall be modular, with the ability to be stacked, joined side to side, or joined back to back. To provide the degree of environmental security required, enclosures shall be available in sealed and vented versions. Enclosure shall be

i) for Indoor IP 44 and ii) for Outdoor IP 65

4. Control Module

A control module shall provide process control functions. The control module should be used with dedicated I/O modules to read and control field signals. The module shall also be capable of operation independent of I/O modules, "supervising" operation of other control modules. In addition, the control module shall be capable of executing on a 5 millisecond resolution input-to-output when required by the application.

A. Hardware

The control module shall consist of a single-slot module with a dedicated microprocessor. Memory should be battery-backed RAM so that the module retains its configuration and state information to optionally and automatically restart after a power failure without requiring its database to be downloaded. The minimum memory required is 16MB. Removable memory cartridge must provide up to 4 GB of memory capacity

B. Software

The control system must support a full complement of process control functions. It shall be possible to define these functions using a mix of function blocks, ladder logic diagrams, sequential function charts, and textual programming. Each of the four languages and their interaction within a configuration shall be based on the IEC 61131-3 standard. The languages shall be completely interchangeable and interactive, with a single control module's database capable of including any combination of the four languages.

5. Input / Output Devices

Input/output Modules shall be intelligent I/O modules. Each module should be able to communicate with the CPU in a dedicated fashion without requirement of any additional interfacing hardware so as to reduce the common cause of the Failure. Each module should have its own microprocessor to execute its input/output function, maintain Jal Nigamp of its configured data, and perform module diagnostics.

All process I/O shall be electrically isolated from both computer common and communications common. Isolation shall meet be min 1500 VAC requirements. Modules shall automatically determine their physical address and report this information to the controller. No range jumpers or user- configurable physical address jumpers should be necessary.

All configurable data shall be set via software, with no hardware jumpers used. Configurable data should include channel tag.

All the I/O modules shall have max 8 channels for the Analog and 16 channels for the Digital modules. Special modules like Counter inputs shall monitor dry contact pulses with an input resolution of one HZ minimum. More numbers per channel may be accepted if the overall reliability factor of MTBF withing the service period of 15 + years is achieved. As per DIN 40041, reliability is understood to be the "the property of an entity to fulfill its reliability requirements during or after a given time span under given application conditions", therefore concessionaire is required to assure the airconditioned environment of PLC system as stipulated in Annexure provided as part of Scope of Works. as minimum requirement.

A. Field Termination for I/O Modules

Each I/O module's field signals shall be wired into the system such that an I/O module can be removed at any time without disturbing the field wiring.

The field wiring should be separate from the I/O module(s). The extension from the module(s) shall be accomplished via a marshalled I/O cable assembly. This assembly should be a multi-conductor cable that attaches to the module rack (and the back of the I/O module) on one end and a finished termination end.

The marshalled termination assemblies shall be DIN rail-mounted PCB-based fixtures that include terminal blocks and two receptacles for accepting the interconnect cable plug. These receptacles must be female to eliminate the possibility of power from the terminal block being exposed on pins.

1.12 System Communications

The communication networks in the system shall provide redundant, high-speed, secure controller information exchange via Ethernet TCP/IP. Communication between individual modules shall be via redundant, local, independent buses that allow complete integration of the family of modules.

1.12.1 Module Communication Bus

All the communication to the I/Os in the PLC shall use a deterministic. This protocol must be compliant to IEC61158, and open. It shall be possible to connect a minimum of 100 nodes on a single network

The bus must be redundant. Minimum data transmission rate is 10 Mbps.

- ✓ Communication on the expanded network shall be accomplished in a manner identical to that of local communication bus. The extension shall be transparent to the user, and no extra software configuration effort shall be required.

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1.12.2 Configuration Software

The configuration software shall be portable. It shall run on a personal computer of the most current Windows based operating system.

The software shall execute in the off-line mode when the computer is not attached to any controller hardware, allowing controller databases to be created, edited, and documented. When the computer is attached to the controller hardware via the networked or direct-connected PCs, the networked workstations, or by running in the industrial computer module, an on-line mode of operation shall be available to allow use of all off-line functions plus on-line troubleshooting tools. This software shall be able to be used to configure continuous, batch, and safety protection control strategy configurations from a single user console.

IEC 61131-3

The configuration software shall allow controller databases to be created using the following standard languages defined by the specification IEC 61131-3: function blocks, ladder logic, sequential function charts, and structured text.

1.12.3 Graphical Configuration and Documentation

Controller configuration should provide graphical configuration methods, with functions entered into a database using a point and click object-oriented routine. The resulting database should be its own documentation because of the graphical appearance. Furthermore, the graphical database must be transferable directly to the controller as it exists, including all graphical information, with no compile routine necessary before transferring the database to the controller. The graphically configured database shall be stored and executed in the controller, and the controller-resident database shall be viewable graphically on-line and uploadable to a PC or workstation without the need for storing the "source" database off-line.

A. On-Line Tools

The configuration software shall provide on-line tools that assist in troubleshooting control schemes. These tools must include on-line display of variables, the ability to force values and states, support for on-line database changes, and on-line real-time trending.

It should be possible to display variables' values and the status of ladder logic and SFC elements while viewing an on-line controller database. The ladder logic and SFC element states shall be indicated using colors.

The configuration software shall provide the ability to write values, states, and modes to independent variables and elements in the controller. It shall also provide the ability to force non-independent variables and elements to a predetermined value, state, or mode.

During troubleshooting, the user shall have the ability to stop the controller and single-step its execution. This will provide a way to clearly understand complex configuration schemes and highly interactive logic that might need to be examined.

B. Prebuilt Library of Functions

The configuration software shall include a predefined library of control schemes. The library must include at least:

- Single PID loop with alarm
- Single PID loop with external setpoint and alarm
- Ratio control loop with alarm
- Cascade loop with alarm
- Primary control loop with alarm etc.

Separate, optional libraries should be available for specialized applications.

The configuration software shall also allow commonly used functions created by the user to be added to a library for future use.

C. On-Line Help

On-line help screens in the configuration software shall be available to assist while creating a database. The help screens shall include descriptions of every configuration element (e.g. each function block and ladder logic element).

D. System Architecture

A system architecture graphic depicting the hardware within the control system should be provided. This graphic should give status information for the modules in the system by using colors to indicate general health of the modules.

1.12.4 Windows Based Operator Software

The industrial-grade PC-based operator interface software shall be able to run on a personal computer of the most current technology under Windows. The software shall provide all standard operator functions, including process monitoring, alarm management, real-time and historical trends, reports, plus provide process graphic displays, an integrated historian, Internet enabler, batch manager and control simulator.

1.12.5 Reliability

The system must be designed for maximum reliability and minimal downtime. This should be achieved through a fault-tolerant design with minimal common cause failures and state-of-the-art redundancy schemes.

System shall offer highest possible MTBF within the service period of 15 + years is achieved. As per DIN 40041, reliability is understood to be the "the property of an entity to fulfill its reliability requirements during or after a given time span under given application conditions", therefore concessionaire is required to assure the airconditioned environment of PLC system as stipulated in Annexure provided as part of Scope of Works.as minimum requirement.

Controller

The controller must have a fault-tolerant design, with redundancy in the same model.

A. Standard Fault Tolerance

The module communication bus and each I/O communication bus must be redundant. If one side of a redundant bus should fail, communications should continue, uninterrupted, on the remaining side of the bus.

The module rack shall provide two separate power supply modules, with each module capable of drawing power from any of the two.

B.

1.12.6 Operator Interface

Window based operator interfaces need to be supplied such that the failure of one component, card, or module does not cause the operator to lose any portion of the process window.

1.12.7 Features Required in SCADA System

The system will be based on latest version of **SCADA** system. The main SCADA system will be redundant. Based on application, servers are to be distributed with redundancy. For cyber security it is proposed that security solutions shall be provided and separate DMZ zone be made so that outside intrusion can be minimised. Network monitoring system shall also be provided for monitoring of network devices. SCADA system will have many extra features and the proposed system should support multiple PLC/ RTU Protocol like Modbus, Profibus, DNP (Serial/TCPIP), OPC etc.

1.13 Detailed Specification of SCADA System Components

1.13.1 Data Acquisition

The SCADA system shall perform data acquisition from PLC and field equipment. PLC is to be located at each location of the plant. PLC communications with Control Centre shall utilize the Open protocol like Modbus, Profibus and Ethernet tcp/ip.

1.13.2 Data Exchange

The SCADA systems shall be able to exchange various types of data with the other application software using ActiveX Data Objects (ADO) or Dynamic Data Exchange (DDE).

1.13.3 Data Processing

a) Analog data

Analog data processing shall be performed according to the requirements listed below.

- Conversion to Jal Nigam Units
- Reasonability limits checking
- Limit monitoring

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b) Digital/Status Input Data

The following status input data types shall be accommodated as a minimum:

Two-state points: The following pairs of state names shall be provided:

- (1) Open/Closed
- (2) Tripped/Closed
- (3) Alarm/Normal
- (4) On/Off
- (5) Auto/Manual
- (6) Remote/Local

c) Calculated Data

It shall be possible to define the calculations on real-time data and historical data, periodically and on request. The results shall be incorporated into the database as calculated data available for display & report generation.

The user shall be able to define calculated analog values using database points as the arguments and mathematical functions as the operations. Functions such as addition, subtraction, multiplication, division, maximum value, minimum value, average, count, square root, exponentiation, trigonometric functions, logarithms and other statistical functions shall be provided.

The SCADA system shall be capable of analysing the open/closed status of switching devices, such as Motor, PUMP etc. The configuration shall be updated whenever a switching device status change is detected.

1.13.4 Quality Codes

Quality codes indicate the presence of one or more factors that affect the validity of a data value. All quality codes that apply to a data value shall be maintained in the database for that data value. At least following quality codes shall be supported:

- Telemetry failure
- Delete from scan
- Limit violated
- Manually replaced
- Alarm inhibit
- Abnormal data

1.13.5 Sequence-Of-Events Recording

The Sequence-of-events (SOE) data shall be collected by the SCADA system from PLCs. The description of each event shall include the database description name, device state, the date, and the time (to the nearest millisecond) of each event.

1.13.6 Supervisory Control

An authorized user of an SCADA system shall be able to control the operation of field devices connected to PLCs. A control action shall require a confirmation of selection prior to execution of control command.

The user shall be able to select and operate any controllable switching device. Controllable switching devices will be of like, Pump, Motor.

1.13.7 Information Storage and Retrieval

Information Storage and Retrieval (ISR) system shall collect and store analog data (telemetered and calculated) periodically at every 5 minute (configurable) and status data by exception. Associated quality codes shall be included. It shall be possible to perform calculations on the stored data, and the results of these calculations shall be collected and stored. Other information such as alarms, events, SOE and reports shall also be stored. The data shall be stored on hard disc with date tag on daily basis for easy retrieval. Subsequently, the data shall be retrieved for analysis, display, trending, and report generation.

1.13.8 Extensive Use of Standard

The **SCADA Software** should be such that it uses an extensive use of standards, achieved by a corporate commitment to comply with all standards that are recognized on the SCADA market, and in particular:

- Intel (or compatible) based hardware;
- Operating system options of WNT 4.0, Windows 2000 or Windows 2003;
- Uses Microsoft Foundation Class (MFC) Object Oriented Database;
- Developed with Microsoft Developer's Studio;
- Installed using Microsoft Install Shield utilities;
- Component Based Architecture;
- Interfaced using Active X controls (OCX);
- TCP/IP for Local and Wide Area Networks (LAN & WAN) ;
- Web-enabled Operator Consoles;
- Control Center Application Programming Interface (CCAPI) Initiatives

1.13.9 System Sizing & Extensibility

The hardware and software openness of **SCADA** allows the customer to smoothly upgrade the proposed system with great facilities. Common upgrading needs include (but not limited to) the following items:

- Additional measurement points (analog and digital);
- Additional protocol-compliant IEDs;
- Additional protocol-compliant PLCs;
- Additional operator consoles;
- Additional printers;
- Connection to other SCADA centers

1.13.10 SCADA Interfaces

User interface and gateway services communicate with SCADA over the following interfaces:

- **OLE Automation Control Interface** - OLE Automation provides the easiest programming interface to SCADA. OLE automation client services may be built using Visual Basic or C++. The service may direct SCADA to add, delete, or modify SCADA objects, may issue controls, and may retrieve measurement data. The OLE Automation interface may be distributed across CPUs, such that a service on one server uses SCADA running on another server;
- **Publisher/Subscriber Control Interface** - The publisher / subscriber interface allows for high performance data update and automatic refresh. This interface is based on TCP/IP sockets, and may run on the same server or between servers. This may be used directly from C++ or using custom OLE controls in Visual Basic;
- **Custom ITelemetrySink Interface** - The custom ITelemetrySink interface is used by gateway services for high performance data transfer. This interface works between two processes on the same server. This interface supports C++ programming.

1.14 Graphical User Interface (GUI)

The GUI shall operate within a window environment The system shall use displays which mimic the existing control panels so that the operators working in conventional control room environment are comfortable while working on the new system. Concessionaire shall develop control panel display generally similar to the one existing in conventional control room.

The GUI shall allow the personnel to monitor and control the equipment through the control panel displays and Tabular displays. The control panel displays shall be dynamically updated for measurands, device positions, annunciations. To have better visibility of control panels, it shall be possible to iconise each control panel separately. Operator shall select that icon to zoom/view that panel display & carry out operations such as alarm annunciation accept/reset, device close/open operations etc.

1.14.1 Trending

Trend displays shall enable the user to select real-time and historical data for trending on graphical displays and for tabular displays. It shall be possible to take print of these trends.

1.14.2 Alarms

Alarms are conditions that require user notification when detected. Audio, visual alarm shall be generated for all such conditions. It shall be possible to accept & reset all trip & non-trip alarm annunciation appearing on control panel facia from control panel display itself. Alarm annunciation on control panel shall have following characteristics:

Condition	Facia	Sound
Alarm initiation by relay contact	Flashing Glow	On

Accept PB pressed	Steady Glow	Off
Reset	Off (if relay contact is reset) Steady Glow (if relay contact is not reset)	Off

Other alarm conditions shall be acknowledged from respective alarm list displays. Other alarm conditions shall include, but not be limited to the following:

- (a) Telemetered or calculated value limit violations
- (b) Un-commanded changes of a power system device state
- (c) Data source communication errors resulting in loss of data
- (d) SCADA hardware and software element failures.

The standard products for advanced alarm management shall also be provided. Regardless of the alarm management technique used, all alarm messages shall be recorded with time & date tag on auxiliary memory for review and printing on demand by the user.

Displays shall highlight alarm condition using a combination of colour, intensity, inverse video and blinking. Alarm messages shall be a single line of text describing the alarm that has occurred with date & time of occurrence.

1.14.3 Events

Events are conditions or actions that shall be recorded by the SCADA system but do not require user action. Events shall be recorded in the form of an event message. The event message format shall be similar to the alarm message format. Events shall include but not be limited to the following:

- Values returning to normal from a limit violation state
- Device status change on manual operation.

1.14.4 Hardcopy Printing of Display

A means shall be provided to produce a copy of a display. The display printout shall be initiated from user friendly push buttons/pull down menus. The options for printing mode shall include at least selection for orientation, background colour, page size, colour or black & white print and print preview. It shall also be possible to print selected portions of display and direct printing on any of the connected printer.

1.14.5 Report Generation

The user shall be able to schedule periodic reports generation, direct a report to a display, print a report, and archive a report. Hardcopy report formats shall be handed over to Concessionaire for generation of report formats in the system. It shall also be possible to define and generate the additional user configurable reports. The generation and printing of any report shall not effect normal scanning of data from PLC. The report scheduling display shall enable entry of the following parameters, with default values provided where appropriate:

- (a) Report name
- (b) Report destination (printer or archiving device)
- (c) Time the system should produce the report.

Handwritten signatures and initials in blue ink, including a large 'y' on the left, a 'u' in the middle, and a 'b' on the right.

1.15 SCADA System Access Security

A mechanism for defining and controlling user access to the SCADA system shall be provided.

1.15.1 Alarm Summary Displays

Displays that list or summarize all unacknowledged and acknowledged alarms shall be provided. The user shall be able to select between viewing alarms in chronological and reverse chronological order. The default shall be most recent alarms. The summary shall separate acknowledged and unacknowledged alarms. To facilitate identification of unacknowledged messages the time field shall blink or entire row shall blink. It shall be possible to sort alarms by user defined text, date, time.

1.15.2 Event Summary Displays

Event summary displays shall list the most recent events. The user shall be able to select between viewing events in chronological and reverse chronological order. The user shall be provided with a convenient and efficient means of selecting an event summary display. It shall be possible to sort events by user defined text, date, time.

1.15.3 Operating Information Summaries

The operating information summaries defined below shall be provided. Summary items will be listed in reverse chronological order with the most recent item shown on the first page. The user shall have the ability to sort summary items by device.

1.15.4 Abnormal Summary

The summary display shall list devices and values that are found to be abnormal, i.e., are not in their normal state. Telemetered, calculated, and manually entered status and data values shall be included.

1.15.5 Out-Of-Scan Summary

The out-of-scan summary display shall list device status and data values that are not currently being processed by the system.

1.15.6 Alarm Inhibit Summary

This display shall list devices and data values for which the user has suspended alarm processing.

1.15.7 Tag Summary

This display shall list and describe all active device tags.

1.15.8 Help Displays

Help displays shall be provided to aid the user in interpreting displayed information and to guide the user through a data entry or control procedure.

1.15.9 Alarm Beeper Services

The Alarm Beeper service audibly notifies the operator of recent alarms by playing a wave file. Wave files can be used to distinguish between Alarm priorities. All the Windows' .wav files or customised .wav files can be used.

1.15.10 Alarm Pager Services

The Alarm Pager service allows the user to configure the system to issue various pages in response to specified alarms.

1.16 Quality Assurance Plan

To ensure total conformation of the application to the user requirement and to make sure that S/W package development is of high quality, proper quality control activities shall be performed and documented throughout the development. For this, the Concessionaire shall give a S/W quality assurance plan to establish system of controls and make the S/W development activity less intangible and more manageable throughout life cycle of S/W development.

The Vendor shall be ISO 9001:2000 certified and shall ensure that all the activities including documentation comply with the standards.

1.16.1 Preventive Maintenance

Time for regular preventive maintenance with a frequency of not less than once per quarter will be required during the Concession Term. This should include general checkup of various parameters, running diagnostics etc. to avoid any possible failure or deterioration in response time.



Schedule 11 (Part F)
Testing and Commissioning Requirements

Inspection and Testing During Construction

1.1 General

All inspection and testing shall be carried out in accordance with the relevant Indian Standard or internationally approved equivalent standard. QA plan shall clearly indicate tests which are intended to be witnessed by the Concessionaire alone and those by Concessionaire and Project Engineer.

1.2 Testing on Construction Completion

Prior to the commencement of Trial Operations on Construction Completion the Concessionaire shall submit the following to the Jal Nigam:

- (1) As-Built Drawings
- (2) Operation and Maintenance Manuals
- (3) Site test results

The initial charges of oil, grease, generator fuel / oil, chemical, disposal of cake, etc. necessary for Trail Operation shall be provided by the Concessionaire.

a) Manual Commissioning Tests

Manual commissioning tests shall be such preliminary trials, tests and retests on individual items of the Facilities and Associated Infrastructure in order to demonstrate that the STP as a whole is ready to undergo the manual operation tests and that these will take place with a minimum of interruption.

b) Manual Operation Tests

When the manual commissioning tests have been completed so that the Facilities and Associated Infrastructure have been demonstrated to the satisfaction of the Jal Nigam, the Concessionaire shall commence the manual operation tests.

These tests shall demonstrate the correct operation of the Facilities and Associated Infrastructure whilst using the minimum quantity of automatic control and monitoring equipment. Such equipment shall be at least that required for the maintenance of safety and for the normal mode of operation of the Facilities and Associated Infrastructure.

The Facilities and Associated Infrastructure will be required to demonstrate satisfactory operation at all design flow rates.

c) Automatic Commissioning Tests

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The Automatic Commissioning Tests shall be such preliminary trials, tests and retests on individual items of the STP or complete system in order to demonstrate that the Facilities and Associated Infrastructure as a whole is ready to undergo the tests of completion and that these will take place with a minimum of interruption.

1.3 Dry Test Requirements

As a minimum requirement the following dry tests shall be carried out as a general requirement:

- (1) A general inspection to check for correct assembly and quality of workmanship
- (2) A check on the presence of lubricant, cooling medium, electrolyte, etc.
- (3) A check on adequacy and security of Facilities and Associated Infrastructure fixing arrangements.
- (4) A general check to ensure that all covers, access ladders, water proofing, guard railings etc. are in place.
- (5) A check on damp-proofing, rust-proofing and vermin-proofing and particularly the sealing of apertures between building structures, chambers etc. and the outside.

a) Civil and Building Works

As a minimum requirement, check for the presence of foreign bodies in pipe work and structures shall be carried out on the civil and building works.

b) Mechanical Works

As a minimum requirement, preliminary running checks as far is permitted by circumstances in order to ensure smooth operation of Facilities and Associated Infrastructure shall be carried out on the mechanical systems.

c) Electrical Works

As a minimum requirement the following dry tests shall be carried out on the electrical systems:

- a. Check phasing and polarity.
- b. Carry out point to point check on cables.
- c. Check on security of cable terminations.
- d. Check on completeness and adequacy of earthing systems.
- e. Check setting on protection relays, sizes of fuses and motor overload settings.
- f. Carry out checks on cabling systems in accordance with the requirements of the relevant standards.
- g. Check operation of main circuit breakers by secondary injection methods.
- h. Check rotational direction of Plant.
- i. Check instrument loop integrity, functionality and calibration.
- j. Check operation of standby generator installation and mains / generator changeover procedures; a 4 hour load test (using the normal load of the Works) shall be carried out on the generator when the load is available.
- k. Check plant functionality.



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- l. Check functionality of the central MMI and its power supply.

1.4 Process plant item / equipment

All process plant items / equipment shall be tested to ensure they meet the requirements for quality of workmanship, construction and performance as laid down in the Concession Agreement.

1.5 Trial Operations

The Trial Operations shall be used to prove the operation of the Facilities and Associated Infrastructure are in compliance with the KPIs at varying flows and with varying Influent Standards.

- 1) The quality of Treated Effluent produced
- 2) Guaranteed Energy Consumption
- 3) Quality of Digested Sludge

Raw Sewage shall be used as the main feed stock for Trial Operations. These tests shall be carried out to demonstrate the process performance of the Facilities and Associated Infrastructure. In order to demonstrate this, the Concessionaire shall ensure that each part of the Facilities and Associated Infrastructure are loaded to rated throughput.

The following tests, inter alia, shall be carried out:

- (1) Check for leaks on vessels, structures, pumps and pipe work.
- (2) Running of all pumped systems in order to check for.
 - ✓ Correct functionality.
 - ✓ Absence of leaks.
 - ✓ Smoothness of running and the absence of undue vibration or stress.
 - ✓ Check drive running currents where the solution pumped is different from that pumped during hydraulic wet tests.
- (3) Carry out calibration of instruments.
- (4) Carry out valve operation, diversions etc. to fully hydraulically load each process element (or where there is a requirement to withstand an over load), overload each process element.
- (5) Demonstrate correct functionality of electrical, control and instrumentation systems not checked during dry or hydraulic wet tests or which may have changed as a result of the different operating conditions now prevailing.

1.6 Trial Operation & minimum performance standards test record

The Concessionaire shall maintain two copies of Trial Operation test reports for documentation of the following information on daily basis.

- Print outs of data logs from SCADA system.
- Samples collected for assessment the quality of Treated Effluent
- Electricity consumption.
- Stabilized Digested Sludge characteristics

Log sheets required for noting down readings / results of various tests shall be prepared.

Schedule 11 (Part G)
Specifications for Operation and Maintenance

1.1. General

The Facilities and Associated Infrastructure shall run 24 hours every day and 365 days each year continuously under normal operation.

1.2. The O&M Manual

The Concessionaire shall submit an O&M Manual as per the Concession Agreement before COD. The O&M of the Facilities and Associated Infrastructure shall be done as per the approved O&M Manual, any approved updations to it as agreed by the Jal Nigam and the EHS Plan.

1.3. Guidelines of Operations

1.3.1. Inventory Control

Throughout the O&M Period, the Concessionaire shall provide and maintain tools and spare parts in accordance with the Concession Agreement.

The current stock levels shall be updated on-line by monitoring signals of the SCADA system (e.g. level of chemical tanks). All delivery of spare parts and consumables shall be recorded as appropriate.

The Concessionaire shall carry out inventory checks every six months. The inventory checks shall be scheduled to avoid disturbance to the O&M.

1.3.2. Chemicals, Dangerous Goods and Hazardous Materials

The Concessionaire shall provide and maintain storage of chemicals, dangerous goods and hazardous materials required for the O&M. Dangerous goods include any of the goods or substances to which the Dangerous Goods Ordinance applies.

1.4. Guidelines for Maintenance

The Concessionaire shall carry out corrective and preventive maintenance of the Facilities and Associated Infrastructure in accordance with the Design and Drawings, O&M Manual, Scheduled Maintenance Programme and EHS Plan to ensure the facilities and equipment perform to the specific standards.

The maintenance of all civil structures shall be done for a period of 15 years as per the frequency as per CPWD maintenance manual 2012 as approved by Jal Nigam.

1.5. Maintenance Management

A Computerized Maintenance Management System (CMMS) shall include functions for the creation and upkeep of work orders and maintenance records. The database shall include the following information:

- Preventive maintenance programmes of systems, equipment, building and infrastructure of the Facility, which are used to generate work orders for preventive maintenance automatically;
- Logs of system or equipment fault / breakdown and automatic generation of work orders for corrective maintenance;
- Date of inspection / maintenance (preventive or corrective) carried out;
- Names and positions of Concessionaire's staff carried out the inspection / maintenance;
- Logs of manual alterations of any operations records, etc;
- Details of inspection / maintenance carried out including:
 - ❖ Causes of maintenance
 - ❖ Maintenance procedures
 - ❖ Special gears / equipment used
 - ❖ Spare parts used
 - ❖ Equipment / parts replaced
 - ❖ Any follow-up actions / recommendations (e.g. change of operational procedures, etc.)

The CMMS shall have functions to organise, sort and filter the maintenance records in the database as required and perform statistical analysis and generate reports for performance monitoring. The CMMS database shall be archived on a monthly basis. One electronic copy of the entire database shall be stored on the Site for retrieval as necessary.

1.5.1. Calibration of Instruments and Measuring Equipment

The Concessionaire shall maintain accuracy and reliability of all measurement facilities throughout the O&M Period to enable correct and effective monitoring and control of the Facilities and Associated Infrastructure.

The Concessionaire shall be responsible for the calibration and re-calibration as necessary of all measurement facilities. All calibration work shall be carried out so as not to delay or disrupt the O&M. Calibration frequency shall not be less than that recommended by the manufacturers of the instruments or measuring equipment and in any case no longer than 12-month intervals.

1.5.2. Tools and Spare Parts

During the O&M Period, the Concessionaire shall provide and maintain tools and spare parts in accordance with the Concession Agreement.

The storage of special tools and inventory of spare parts shall be recorded and monitored.

At the expiry of the O&M Period, the Concessionaire shall handover to the Jal Nigam all special tools and spare parts in accordance with the Concession Agreement. The stock level of spare parts shall be sufficient for 1 year operation from the end of the Concession Term.

1.6. Records and Reporting

1.6.1. Archiving of SCADA and CMMS Data

The Concessionaire shall maintain all operation and maintenance records, including SCADA, throughout the O&M Period in a safe and secure manner. Any amendment to the records shall only be made in accordance with proper checking and authorization procedures, which shall be included as part of the O&M Manual.

The Project Engineer shall be allowed to check the above mentioned data and records described at any time.

As far as possible, all records shall be kept electronically utilizing the Concessionaire's computer facilities with backup security. If the computer facilities fail, then appropriate paper records shall be produced and filed.

1.6.2. Site Diary

The Concessionaire shall maintain a Site Diary which shall include, as a minimum, the following information on a daily basis:

- Date and weather;
- Operation hours;
- Labour on the Site;
- Flow and quality records of influent and effluent;
- Disposal records of treatment by-products;
- Accidents and incidents;
- Instructions to the Concessionaire;
- Comments by the Concessionaire;
- Complaints received and action taken;
- Authorized visitors to the Site; and

The Site Diary shall be checked and signed by authorized personnel of the Concessionaire in accordance with the O&M Manual.

The Concessionaire shall keep appropriate records of all personnel employed at the Site. These records shall be available for inspection by the Project Engineer at any time.

1.6.3. Safety and Health Records

The Concessionaire shall keep records on all safety and health matters as per the requirements of the Concession Agreement, O&M Plan and the EHS Plan and update such records daily for inspection by the Project Engineer.



1.6.4. Daily report

The Concessionaire shall provide details in the form of daily reports, of operational data and information in relation to the O&M of the Facilities to the Jal Nigam in a systematic and concise manner, which shall include the following

- Availability of the Facilities and the Associated Infrastructure
- Characteristics of the Treated Effluent and deviations from the KPIs, if any
- Characteristics of the Digested Sludge and deviations from the KPIs, if any

1.6.5. Monthly Report

The Concessionaire shall provide details in the form of monthly reports, of operational data and information in relation to the O&M of the Facilities to the Jal Nigam in a systematic and concise manner. Monthly reports shall be submitted to the Jal Nigam by the 7th day of the subsequent month and shall include the following:

- Availability of the Facilities and the Associated Infrastructure
- Characteristics of the Treated Effluent and deviations from the KPIs, if any
- Characteristics of the Digested Sludge and deviations from the KPIs, if any
- Summary of energy consumption (fuel and electricity) of the Facility;
- Quantities of chemicals, reagents, fuel and spare parts consumed;
- Stock level of chemicals, reagents, fuel and spare parts;
- Programme showing the scheduled maintenance (including planned and ongoing) work in the following month.

1.6.6. Quarterly Report

The Concessionaire shall provide details in the form of quarterly reports, of operational data and information in relation to the O&M of the Facilities to the Jal Nigam in a systematic and concise manner. Quarterly reports shall be submitted to the Jal Nigam within 7 days of end of a quarter and shall include the following:

- Availability of the Facilities and the Associated Infrastructure
- Characteristics of the Treated Effluent and deviations from the KPIs, if any
- Characteristics of the Digested Sludge and deviations from the KPIs, if any
- Summary of energy consumption (fuel and electricity) of the Facility;
- Quantities of chemicals, reagents, fuel and spare parts consumed;



- Stock level of chemicals, reagents, fuel and spare parts;
- Programme showing the scheduled maintenance (including planned and ongoing) work in the following quarter.

1.6.7. Annual Report

The Concessionaire shall submit Annual Reports to the Jal Nigam within 30 days of end of the year and the report shall include the following:

- summaries of quantities and characteristics of Sewage received and treated at the Varanasi STP during the reporting year;
- overall performance of the Varanasi STP with highlights on non-compliance with KPIs as reported in each quarter;
- summary of expiry dates for licences, permits and certificates for the O&M;
- summary of major equipment breakdown, repair, overhaul, renewal, replacement, modification, performance tests, condition surveys carried out;
- summary of incidents related to safety and health, environmental issues, security and complaints;
- scheduled maintenance, overhaul, renewal, replacement, modification of major plant and equipment, Performance Tests and Condition Surveys in the forthcoming 12 months;
- list of Changes ordered by the Jal Nigam, with details and status;

1.6.8. Monthly Environmental Monitoring Report

The Concessionaire shall submit Monthly Environmental Monitoring Reports to the Jal Nigam providing overview of compliance with EHS Plan. \

1.6.9. Testing Methodology and Frequency

The raw sewage and treated effluent shall be tested and checked for compliance with KPIs as defined below.

Parameters to be Measured	Frequency	Methodology
Treated Effluent (BOD, TSS, TN, NH4-N, COD, TP)	Continuous	Analysing the average of real time values of respective online instruments/analyzers
Treated Effluent (BOD, TSS, TN, NH4-N, COD, TP, Fecal Coliform)	One composite sample a day	24-hour composite be collected and analysed. These samples shall be stored in a refrigerator at a temperature between 1°C and 4°C. The sample shall not be allowed to freeze.



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Parameters to be Measured	Frequency	Methodology
Treated Effluent (BOD, TSS, TN, NH ₄ -N, COD, TP, Fecal Coliform)	One Composite sample of a day every month	The sample shall be tested in National Accreditation Board for Testing and Calibration Laboratories (NABL) accredited laboratory recognised by CPCB and SPCB.
Digested Sludge		
Outlet Concentration of dewatered sludge	At time of disposal	Seven samples of sludge shall be collected at the time of disposal and analyzed for faecal coliforms. The geometric mean of the densities of these seven samples shall not exceed the fecal coliform limits.
Fecal coliform limit	At time of disposal	Seven samples of sludge shall be collected at the time of disposal and analyzed for faecal coliforms. The geometric mean of the densities of these seven samples shall not exceed the fecal coliform limits.
Outlet Concentration of dewatered sludge, Fecal coliform limit	Once in month	The Outlet Concentration of dewatered sludge and fecal coliform of any one sample every month shall be tested in National Accreditation Board for Testing and Calibration Laboratories (NABL) accredited laboratory recognised by CPCB and SPCB

Schedule 11 (Part H)
Indicative Vendor List

The Concessionaire can procure the material and / or equipment for development of Facilities and Associated Infrastructure from the indicative list of vendors detailed in the list below.

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
1	Cement OPC	Ultratech, Gujrat Ambuja, Vikram, Coramandel, Birla Super, JK, Prism, JP, Birla
2	Cement (SRC)	ACC, Gujrat Sidhee, Gujrat Ambuja
3	Cement (White)	Birla, JK
4	Cement (PPC)	ACC, Gujrat Sidhee
5	Bricks	Ordinary Burnt Clay Bricks of any brand conforming to IS: 1877 with minimum Crushing Strength of 40 Kg/cm ² and Water Absorption Ratio restricted to 25% for Bricks used in Panel Walls and 20% for Bricks used in Load Bearing Walls
6	Mild, Tor Steel, CRS Steel	TISCO, SAIL, Vizag, RINL
7	Structural Steel	SAIL, TISCO, Vizag
8	Screws	GKW Nattlefold, Oxidised
9	Dash Bolt Fasteners	Fischer, Hilti
10	Ceramic Tiles	Kajaria, Nitco, Johnsons
11	Glazed Tiles (1 st Quality)	H & R Johnson, Kajaria,
12	Granite Tiles	Bell Granito, H & R Johnson, RAK Ceramics – Dubai, Restile Ceramic
13	Glass Mosaic Tiles	Bisazza India, Pino Bisazza
14	Paver Blocks	Conwood Prefab, Hindustan Prefab or equivalent

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
15	Adhesives	Pidilite, Fairmate, Bal Adhesive, MC Bauchemie, Cementone India, Fosrock, Sunanda Speciality Coating
16	MS Door Frames & Shutters	Agew, Ferrosteel, Sen Harvic, Weldoors, Yashashri Polyextrusion
17	(With Galvanising)	
18	Door Shutters (Wooden)	Kutty, Anchor, Classic, Goyal, Timber Techniks, Sejpal Doors, Wood Designs, Yashashri Polyextrusion, Anand Wood Crafts, Northern Doors
19	Door Shutters (FRP) & Plastic	Everest fibre glass Industries, Unipals India, Advance Marketing, Yashashri Polyextrusion, Sintex
20	Hardware (Handles, Hinges, Mortice Locks)	Shalimar, Sobeet, Vijayan, Navbharat Brass Works, CIEF, Amarbhoy Dossaji
21	Aluminium Windows	Aluminite, Aluplex, Almech, Indrajit Associates, Aldoweit, Crystal Corporation, Indal, Jindal, Ajit India
22	Night Latch	Godrej, Sobeet, Vijayan, Yale
23	Paints:	
24	a. Internal	Snowcem, Asian, ICI, British Paints, Shalimar, Nerolac, Burger, Jenson & Nicholson
25	b. External	NITCO Paints, Killick Nixon, Hindustan Colours and Chemicals, Supreme, Shalimar, Burger, Jenson & Nicholson, Super Snowcem.
26	Synthetic Plaster Finish	Nitco, Accro, Damani Dye Stuff, Supreme, Renova
27	Waterproofing Works	India Waterproofing Co., Likproof India, Overseas Waterproofing Co.
28	Waterproofing Compound	Accoproof, Pediproof, CICO, Impermo, Vamiplas 302, Vamiproof 101 & 102
29	Glazing	Float Glass of Modi , Asahi , Saint Gobain
30	M.S. Rolling Shutters	Swastik, Standard, Shudwar
31	(With Galvanising)	

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
32	Aluminium Grills	DECO, Alumnigrille
33	Aluminium Joinery	Crystel Corporation, Alumlite, Aluplex, Alm
34	Anti-stripping Agent	Yuva, BE 100
35	Chemical Admixtures and Compounds for RCC and Mortar	MC Bauchemie, Krishna Conchem Products, Sunanda Chemicals, Pidilite, Fairmate, Fosroc, Sika Qualcrete
36	Anti-Corrosive Paint	Krishna Conchem Products, CICO Chemisol Adhesive, Shalimar, Burger
37	Sanitary ware	Hindustan, Parry, Cera, John Gas, Jotisum
38	Flushing Cistern	Flush Line or equivalent Approved ISI Manufacturers
39	Sanitary Fittings and Fixtures	Mark, Jaguar, Gem, Dripless, Kingston, Essco, Metro, Ess Ess
40	Lead for Lead Joints	Approved ISI Manufacturers
41	Rubber Ring	Approved ISI Manufacturers
42	Stainless Steel Sink	Nirali, Tuff, Diamond, Kingston, Neel Kamal
43	SW Gully Trap and Stone ware Pipes	Perfect, Sonya, Girco, Elecon, Rajura
44	Cast Iron Covers	RIFCO, Mohit Steel, Ashok Iron Works, Jayswal Neco
45	Piling Works	Kvaerner, Afcons, Michigan Engineering, Larsen & Toubro, DBM Geotechnics, Meher Foundations, Safe Foundations, Simplex
46	Fire-fighting Works	Monsher, Mather & Platt, Bells Controls, Nitin Fire, Rahul Fire
47	Elevators	Otis, Mitsubishi, Kone, Bharat Bijlee, Schindler
48	Sodium Nitrate	Devica Chemicals or equivalent Approved ISI Manufacturers
49	Sodium Silicate	Devica Chemicals or equivalent Approved ISI Manufacturers
50	Marine Plywood	Anchor, Kitply

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
51	Neeru	Swastic Instant Neeru or equivalent Approved ISI Manufacturers
52	Lime for Whitewash	As directed by Engineer-in-charge
53	Tarfelt	1.1.1.1.1 Shalimar, Lloyds
54	Lightening Conductor	Approved ISI Manufacturers
55	Teak Wood	C.P. Teakwood, First Quality with following Tolerances.
		Sap Wood to the extent of 25%
		Wrap to the extent of 10 mm in 3m Knots/meter
56	S.W. Pipes	Burn & Co., Perfect Potteries, Navroji Vakil, Kashmirira
57	CI Soil Pipes & Fittings as per IS : 3989/84	NECO, CENTRI
58	G.I. Pipes Class "C"	TATA, Zenith, Jindal, Suryaprakash
59	G.I. Fittings	Approved ISI Manufacturers
60	Gate Valve / Non Return Valve	Sant, Zoloto, Leader
61	S.W. Pipes	Rajura or other Approved ISI Manufacturers
62	Flush Valve	Jaguar , Ess Ess
63	Water Meter	Capstan or other Approved ISI Manufacturers
	Electrical	
1	11 KV Switchgear + 11 KV VCB Breaker & Panel	Jyoti,Schneider, Crompton Greaves Ltd., ALSTOM, Bharat Heavy Electricals Ltd, Kirloskar Electric Co. Ltd, ABB
	11 KV SF6 Breaker + 11 KV SF6 Insulated 3-Panel, 4-Panel extensible type RMU	Schneider, ALSTOM, Crompton Greaves Ltd., Kirloskar Electric Co. Ltd, Bharat Heavy Electricals Ltd, ABB

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
2	Power Transformer 11 KV/ 0.433KV	Crompton Greaves Ltd., Emco, Bharat Bijlee, Andrew Xule, GE Power, Pactil, NGEF, Voltamp, BHEL
	LT Switchgear + Power Control Center + Motor Control Center + Lighting & Small power Distribution Boards	
3	Main L.T Panels, PDB, LDB	Incorporating L&T, Siemens, GEC, Schneider Switchgear Components, Chavare Engineering Pvt. Ltd.
4	PCC / MCC	Advance Electro Control, Vidyut Control, Tricolite, Larsen & Toubro Ltd., Siemens, Associated Electrical, Bhartia Cutler Hammer, Control and Switchgear, GE Power, Schneider
5	MCC	Interlec, Positronocs, Jay Switchgear, Chavare Engineering, L&T, Siemens, ABB, Schneider, Crompton, Spark Electro
6	415 V Air Circuit Breaker	English Electric Ltd., Larsen & Toubro Ltd., Siemens India Ltd., Schneider, Jyoti, ALSTOM
7	ACB 8-Way, Feeder Pillar 6-Way, 4 Way & Mini Pillars	Popular Brass Metal Works, ABAK, Manish, Fitwell, Super Panel, Control & Switchgear, Chavare Engineering Pvt. Ltd.
8	Power Capacitors	Crompton Greaves Ltd.
		MEHER
		Manohar Brothers
		Madhav
		Khatau & Junker
		Domain
		Siemens (Apcos)
		Javiac
		Schneider

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
		EPCOS
9	XLPE – HT Cables as per IS:7098 Part II – 1985	CCI, Asian, Finolex, Torrent, Macro, Fixolite, Polycab, Vardhaman
10	Indicating Digital Meters	AE, Meco, L&T, Conzerv
11	Instrument & Meters	Universal Electrics Ltd.
		Automatic Electric Ltd.
		Meco Instruments (P) Ltd.
		Industrial Motors (P) Ltd.
		Havells Pvt. Ltd.
		Gollica Electricals P. Ltd.
		Rajdhani
		Conserve (Schneider)
		El-Measure
12	Push Buttons and Indication Lights	Larsen & Toubro Ltd.
		Siemens
		Bhartia Cutler Hammer
		Vaishnov
13	Crimping Lugs, Glands of Double Compression Type	Dowells, Jainson, Lotus, Braco
14	Jelly filled Telephone Cables	Finolex, Universal, RPG
15	Tag Block with Boxes	Krone
16	Rossets	ITL, Tele Connectors India


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Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
17	MCB, RCCB	MDS, Siemens, Schneider, Hager
18	Switches and Sockets	MDS (Leagrand), Schneider, Anchor, Cona, ROMA
19	PVC Copper Wires (FRLS Grade)	Sundeeep, Finolex, RR Kabel, LAPP, Polycab
20	Motors	Siemens, ABB, Bharat Bijlee, Crompton, Kirloskar, Texmo, NGEF, Alstom
21	Cable Glands and Lugs	Dowell, Lotus, A.G. Electricals, Siemens
22	Cat-6 Lan Wire	Lucent, LAPP, AMP
23	PVC Pipe	Diamond, Precision (PPI), Asian
24	Lighting Fixtures	Wipro, Phillips, Clipsal, Crompton, Bajaj, K-Lite, Keselec Shredder
25	Fans & Air-Circulators	Crompton, Bajaj, Almonard, Usha, Cinni, Rallies, Orient, Khaitan
26	Relays	ABB, Siemens, Alstom (AREVA), Schneider, L&T
27	Relays (for 1.1 KV 11 KV Switchgear)	English Electric Ltd.
		ALSTOM
		Universal Electrics Ltd.
		Easun Reyrolles relays
		Asian Brow Baveri
		Seimens
		Control and Switchgear
		Larsen & Toubro Ltd.
		Domain
		Schneider
28	Micro Processor Based Relays for Motor Protection	GE Power

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
		Rockwell
		Larsen & Toubro Ltd.
		Seimens
		ALSTOM
		Domain
		Schneider
		ABB
29	Battery (Maintenance Free)	Standard Batteries Ltd.
		Chloride Indian Ltd.
		Amco batteries Ltd.
		Exide
		Tatagreen
30	Voltage & Frequency Stabilizer	Applied Electronics Ltd.
		Jindal Electric
		Surya Electro
		Servocon
		Logicstat
		Globe Rectifier
31	Lightening Protection Unit	National Radio & Electronics Co. Ltd.,Lithnting Protection International Ltd.
32	Instrument Transformers (CT's & PT's)	Mysore Electrical Industries
		Automatic Electric Ltd.
		Kappa Electricals

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Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
		Matrix
		Schneider
33	Battery Charger	Uptron Powertronics (Shretron)
		Statcom
		Automatic Electric Ltd.
		Chabi
		Kerla State Electricity Corp.
		APCO
34	Fire Extinguishers	Steelage Industries
		Kooverji Devshi & Co. Ltd.
		Vijay Fire Protection System Pvt. Ltd.
		Amco
		Ahluwalia
35	Fuse Base	Siemens, L & T, Popular Brass Metal
36	Ceiling Fans	Bajaj Electricals Ltd.
		Orient
		Usha Compressor Pvt. Ltd.
		Crompton Greaves Ltd.
		Khaitan
		Havells
37	Control Cables	LAPP, Finolex
38	Batteries	Amar Raja, HBL Knife, Exide, Emco
38	11 KV End Termination & Straight through Joint	Raychem, Xicon, Danson

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Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
39	Measuring Instruments	MECO, IMP, KEW, Rishiline (L&T), Conzerv
40	PVC Insulated Cable for Working Voltage up to 1.1 KV as per IS: 694: 1990	Finolex, Asian, Polycab, Reliance, Fixolite, Torrent, Universal, Fortgloster, Vardhaman, Fixolite, Macro, CCI
41	XLPE – LT Cables as per IS:7098 Part – I: 1988	CCI, Asian, Finolex, Torrent, Macro, Fixolite, KEI, Polycab with Nitrogen Corring, Gloster
42	PVC Insulated (HD) Cable up to 1.1 KV as per IS:1554 Part I – 1988	Torrent, Macro, Vardhaman, Finolex, CCI, Asian, Polycab
43	Air Conditioners	Samsung, LG, Voltas, Carrier
44	Lamps HPMV,HPSV Metal Hallide Lamps & Accessories	Vallient, Fixolite, Bajaj, Philips
45	MCB,ELCB,RCCB,HRC	Indo Asian, MDS, Datar
46	T. W. Boards & Blocks	Double Folding Polished Board shall be in one Piece. Block up to 8" x 10" shall be in two Pieces
47	T. Switch S.P. or 2-Way S.A. to I.S.A.	Khosla, Keycee, GNE, Modern, Kalki
48	Three Pin Socket: 5A to 15A	Khosla, Keycee, Standard, Ellora
49	Ceiling Rose	Khosla, Keycee, Ellora, Oshan, Modern
50	Ring Main Unit, HT, Switch and Fuse Unit	MEI, South Andrew Yule or Department approved
51	C.T. / P.T.	Department approved
52	Auto Transformer Starter	MEI, Kilburn, JMP, Siemens, Andrew Yule, GEC, KEC
53	Trivector Meter	Department approved

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
54	Measuring Instrument	IMP, AE, UE, MECO, FE, Rishiline (L&T), Conzerv
55	Current Transformer	AE, Gilbert & Maxwell, IMP, Siemens, SEGC (C.S.), VM Electric or Department approved
56	PVC Conduits, PVC Pipes, HDPE Pipes	Garware, Finolex, Shakti, Circlearc, Popular, Prince
57	GOD Switches and Dropout Fuse Outfit	Kiran, Pactil, Atas or Department approved
58	Chain Pulley Block	Elephants, Hercules, WMI
59	Lugs	Dowels, Lotus, AG Electricals
60	Motor Protection Relays	Universal, Thresold, E.E., L&T, Minilac, Siemens, C&S. Telemecanique, Indo-Asian
61	Feeder Pillar, Mini Pillar	Popular Brass Metal Works, Anil Electrical Industries or Department approved
62	MCB & MCB, D.B.	MDS, Siemens, EE, Telemecanique, Havells, Indo-Asian, Standard, Versa Trip, Helcon, Safeline, Datar, Schneider
63	ELCB	Datar, MDS, Standard, GE, Telemecanique, Havells, Safex, HH-ELCON, Naptune, Gutts, Indo-Asian, Siemens, GE, Schneider
64	PVC Wires, Copper Aluminium Conductor, Flexible Cables	Philco, Phyroflux, Paragon, Polyplast, V-Plast, Apex, Silvex, Delta, Pagoda, Spacecab, HMT, Ralicab, Finolex
65	HRC Fuses	L&T, Indo Asian, Siemens, Havells, ARCON, Standard, Samrat
66	Fuse Switches, SW Fuse	L&T, Siemens, Crompton, Telemecanique, Indo-Asian, Havells, HH-ELCON, Standard, KEW, Kalki, Sentinel, Stenly, Samrat, Schneider
67	Switches, Sockets	Kalki, CPL, Anchor, Precision, MK, HME, EEW
68	Cable Glands	HME, EEW, Conzerv & Department approved,
69	HC Fuse Distribution Board	CPL, EE, Ess Ess, Stenly, KEW, Kalki, Standard

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Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
70	Air, Oil Circuit Breakers (HT,LT)	Kilburn, Easun, MEI, Jyoti, Andrew Yule, Siemens, L&T, GEC, Soutern, BHEL, Telemecanique, Crompton & Department approved
71	Energy Meters	Jaipur or Department approved
72	Capacitors	GEC, Khatau Junkar, Crompton, L&T, Momaya, Madhav, Atlanta, Prabhodhan, Maladay, Asian, Schneider, EPCOS, (S+M) or Department approved
73	Steel Tubular Poles	Indian Electric Poles, Bombay Tubes, Nityanand, Rajan Tubes or approved ISI Manufacturers
74	GI Pipes, Poles	Zenith, Tata, Bharat, Jindal, Suryaprakash
75	Terminal Box, Bracket, Junction Box, Control Pillar	ELM, United, DVK or Department approved
76	Street Lighting Luminaries	Bajaj, Crompton, Philips, Genelec, Keselac, ELM, Mysore, Wipro, GE-Apar, Canara, Glolite, Indo-Asian
77	Chokes, Ignitors	Bajaj, Crompton, Philips, Genlec, Keselac, GE-Apar, Glolite, ECE, Indo-Asian
78	Power Contactors	L&T, Siemens, Bharat Cutter & Hammer, Telemecanique, HH-ELCON, Kirloskar, Crompton
79	Lamps	Bajaj, Crompton, Philips, Cema, HMT, Electron, Surya, Mysore, Sylvania-Laxman, Solarson, ECE, Indo-Asian
80	Rotary Selector Switches	L&T, Siemens, Kaycee, EE, BISON (ELM), Schneider
81	Post Top Lantern	Philips, Crompton, Glolite, Bajaj, Parimal, Tulip, Keselec, ECE, Genlec, ELM, Wipro, Indo-Asian
82	Street Light Controller, Timer	L&T, (TSQ 100) 24 hrs. Dial, ELM, GIC
83	ASCR Conductors	Department approved
84	Alternators	Kirloskar, Jyoti, NGEF, AVK-SEGC, KEL, Caterpillar, Stamford, CG Newage
85	Diesel Engines	Kirloskar, Greaves Cotton, Cummins, Ashok Leyland, Cater Piller, Perkins, Volvo, Sterling Wilson, Mahendra & Mahendra Powerica

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
86	Cable Jointing Kit	Raychem, Xicon, Benson, Mahindra (Push on) M Seal
87	Pole Paint	Jenson & Nicholson, Asian (S+M), Nerolac
88	Fluorescent Fixtures	Bajaj, Crompton, Philips, GEC, Genelec, Mysore, Wipro, Glolite, Litwell, Prestolite, Indo-Asian
89	Analyzers	Forbes Marshall, Endress& Hauser, Yokogawa, Hach USA
90	Level Switch, Level Indicator	Levcon, Revathi, Fitzer. S.B. Electro-Mechanical. Endress & Hauser, P&F, Fisher Rosemount, Forbes Marshall
91	Flow Meter – Magnetic, Ultrasonic	Endress & Hauser, Fisher Rosemount, Forbes Marshall
92	Soft Starters	Allen Bradley, Schneider, Innovative Tecno
93	Motors	Bharat Bijlee, Crompton, ABB, Siemens, Kirloskar, NGEF
94	Electrical Panels	Interlec, Positronocs, Jay Switchgear, Chavare Engineering, L&T, Siemens, ABB, Schneider, Crompton, Spark Electro
	Instrumentation	
1	Variable Frequency Drive (VFDs)	ABB, Nord, Mitsubishi
2	PLC	Allen Bradley, Mitsubishi, GE, Siemens, Messung, Honeywell, Schneider
3	SCADA	Allen Bradley, Ellipse, Wonderware
4	Pressure Gauges	H.Guru, Gluck
5	Level Switches, Level Transmitters	Levcon, Revathi, Fitzer. S.B. Electro-Mechanical, Endress & Hauser, P&F, Fisher Rosemount, Forbes Marshall
6	Online Parameter Systems	Endress & Hauser, Hach, S kan
7	TOC, Turbidity, DO, MLSS & other Analysers	Hach, ABB, Fisher Rosemount, Forbes Marshall, Endress & Hauser, S Kan
8	PH Meter	Forbes Marshall
		Orion

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Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
		Analytical Instruments Chemtrols Royce Endress hauser Hach
9	Conductivity Meter	Forbes Marshall Orion Analytical Instruments Chemtrols Royce Endress hauser Hach
10	DO (Dissolved Oxygen) Analyzer	Orion Chemtrols Analytical Instruments Forbes Marshall Royce Endress hauser Hach
11	Indicative BOD/ COD/ TOC Analyzer	Forbes Marshall Royce Endress hauser Hach

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
		Orion
		Chemtrols
		Analytical Instruments
12	Ultrasonic Level Transmitter	Toshniwal
		Hach
		Krone Marshall
		Siemens
		ABB
13	Level Switch	Endress Hauser
		EIP
		Nivo Control
		ABB
		Level Cone
		Magnetrol
		Forbes Marshall
		Hach
		Orbit
		Softbit
14	Pressure Transmitters	Danfoss
		Switzer
		Fiebig
		H. Guru
		Forbes Marshall
		Siemens

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
		Emerson
		ABB
15	Electromagnetic Flow Meters	Krone Marshall
		ABB
		Schlumberger
		Siemens
		Endress Hauser
		YBL Yokogawa
		Magnetrol
16	Ultrasonic Flow Meter	Krone Marshall
		ABB
		Hach
		Yokogawa
17	TSS (Total Suspended Solids) Analyzer	Orion
		Chemtrols
		Analytical Instruments
		Forbes Marshall
		Royce
		Endress hauser
		Hach
18	RCL (Residual Chlorine) Analyzer	Orion
		Chemtrols
		Analytical Instruments
		Forbes Marshall

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
		Royce
		Endress hauser
		Hach
19	Ammonia Analyzer	Orion
		Chemtrols
		Analytical Instruments
		Forbes Marshall
		Royce
		Endress hauser
		Hach
20	Alkalinity Analyzer	Orion
		Chemtrols
		Analytical Instruments
		Forbes Marshall
		Royce
		Endress hauser
		Hach
21	Total Nitrogen Analyzer	Orion
		Chemtrols
		Analytical Instruments
		Forbes Marshall
		Royce
		Endress hauser
		Hach

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Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
22	Total Phosphorus Analyzer	Orion
		Chemtrols
		Analytical Instruments
		Forbes Marshall
		Royce
		Endress hauser
		Hach
23	Nitrate Analyzer	Orion
		Chemtrols
		Analytical Instruments
		Forbes Marshall
		Royce
		Endress hauser
		Hach
24	Control System / Instrumentation, DCS / PLC & SCADA System	Siemens
		Schneider
		Honeywell
		Rockwell Automation
		GE Fanuc
		Omron
		Phoenix
		ABB
25	Communication cum SCADA Server, WEB	DELL
		Hewlett Packard

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
	server, ISR server	IBM
26	Workstation Console Dual Monitor	DELL
		Hewlett Packard
		IBM
27	Remote Access terminal (Laptop)	DELL
		Hewlett Packard
		IBM
28	LAN Switch	MoxA
		Garrettcom
29	Color Laser Printer	Hewlett Packard or Equivalent
30	UPS	American Power Conversion
		Hi-Rel
		or Equivalent
31	Router	Hewlett Packard
		JUNIPER
		MOXA
32	IP Camera	HIKVISION
		PANASONIC
		AXIS
		GRANDSTREAM
		SONY
33	Video Projection System	Delta
		BARCO
34	12C single Mode Fibre	Sterlite

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Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
	cable	AKSH
		Finloex
35	Optic Fibre Cables	Dlink
		Cords
		RR Cable
		Icon
		Aksh
	Mechanical	
1.	Mechanical Screens – Coarse & Fine	Voltas, Emco, KCP, Batliboi, Shivpad,
		Jasb- Eng. Ltd.
		Headworks
		Huber
		Johnson Screen I nd. Ltd.
2.	Detritus Mechanism	Dorr Oliver, Voltas, Emco, KCP, Batliboi, Shivpad
3.	Grit Separator	Smith & Lovelace
		Voltas
		Huber
		Triveni
		HDO
		EIM CO
4.	Primary & Secondary Clarifiers	HDO
		Degremont
		EIM CO
		Voltas

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
		Triveni
5.	Gravity Thickeners	HDO
		Degremont
		EIM CO
		Voltas
		Triveni
6.	Centrifuge	Humbolt
		Alfa Laval
		Hiller
		Penwalt
7.	Belt Filter Press	Techno Fungi
		Triveni
		EIM CO
		Huber
		Anderitz
		Voltas
8.	Chlorinator	Banco
		ALDOSS
		METTITO
		Wallace & Tiernan
		Penwalt
		Pefect chloro
9.	Bio Gas Engine	MWM
		Jenbacher

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Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
		Guascor
		Cater pillar
		Waukesha
10.	Membrane Gas Holder	Sattler
		Eco membrane
		GGE
		Ovivo
11.	Bio Gas Scrubber	Innovative Environmental Technology
		Green Power Ltd
12.	Agitator Mixers	REMI
		Mixtite
		Philgear
		Johnson
		Essen pro
		Fibre & Fibre
		Voltas
13.	Geared Motors	Bonfigli
		SEW
		REMT
14.	Flame Arrestor Moisture Trap PVRV/ Flare System	Combustion Research Associates
15.	Pumps: Horizontal Centrifugal	Kirloskar, Kishor, Johnson, KSB, Grundfos, Worthington, Mather & Platt, Jyoti, Homa
16.	Horizontal Centrifugal Pumps	Kirloskar Brothers Limited (KBL)
		WPIL

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Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
		KSB Pumps
		Wilo
		Jyoti
		Mather & Platt
		Becon Weir
		KISHORE
		JOHNSON
		GRUNDFOS
		HOMA
		ABS
17.	Pumps: Submersible	Kishor, Kirloskar, KSB, Grundfos, Aqua, Flowmore, ABS
18.	Sump Pump	Flygt
		Grundfos - Pumps
		ABS
19.	Pumps: Vertical Turbine	KBL
		WPIL
		MATHER & PLATT,
		JYOTI
		HOMA
		FLOWMORE
20.	Pumps: Screw	Roto, Ramo, Flosys, Alfa Helical, Tushaco
	(Positive Displace / Progressive Cavity Type)	
21.	Screw Pumps	Netzsch

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Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
		Seepex
		Tushaco
		Roto
		PCM
		Spans Babcock(Netherland)
		Hitachi
		ABS
22.	ARCHIMEDEAN SCREW PUMPS	Spans Babcock(Netherland)
		Hitachi
		ABS
		RAMO
		FLOSYS
		ALFA HELICAL
23.	Pumps: Chemical Dosing	Milton Roy, Swellore, Shapotools, Prominent, Sandur, Roto
	(Positive Displacement Type)	
24.	Dosing System/ Dosing Pump Metering Pump	Asia LMI
		Prominent
		Toshcon
		Milton Roy
		Swelore Engg. Pvt. Ltd.
		V.K. Pumps
		Shapotools
25.	Centrifugal Air Blower	Turbomax, DaeHa Engg., Korea Fluid Machinery

15X

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Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
26.	Gate Valves/ Sluice Valves	Kirloskar Brothers Limited
		Indian Valve Company
		VAG
		rvc
		L&T
		Shivdurga
		Josh Engineering
		IVC
		Durga
		Audco
27.	Knife Edge gate Valves	VAG
		Fouress
		Kirloskar Brothers Limited
		Jash Engineering
		Indian Valve Company
		Vass (Dezurick)
		Wag
		R&D multiple
28.	Butterfly Valves	Fouress
		VAG
		Do rot
		Kirloskar Brothers Limited
		Uppadhyay
		BDK

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Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
		Indian Valve Company
		IVC
		Audco
		Durga
29.	Zero Velocity Valve	Kirloskar Brothers Limited
		Indian Valve Company
		L&T
		VAG
30.	Air Valve	Kirloskar Brothers Limited
		Indian Valve Company
		L&T
		VAG
31.	Gas Valves	Audco
		AVK
32.	Pressure Release Valve	Kirloskar Brothers Limited
		Indian Valve Company
33.	Non Return Valves	Kirloskar Brothers Limited
		Indian Valve Company
		Uppadbyay
		VAG
34.	Sluice Gates	Indian Valve Company
		Jash Engineering
35.	Cast Iron Pipes & Fittings and Dismantling	The Indian Iron & Steel Company Ltd.
		Electro Steel Castings

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
	Joists	Tala Iron & Steel Co. Oriental Casting
36.	DI Pipes	J indal Saw Ltd. Electro Steel Casting Tata Metaliks Kubota Pipes Ltd Electro Therm Pvt Ltd
37.	C.I Pipes	II S co. KESRAM Kejariwal
38.	HDPE Pipes	RIL Duraline Penwalt
39.	C.S. Pipes	Jindal Zenith Tata
40.	Crane- HOT/EOT and Pulley block	Reva Engineering Avon Cranes W.H. Brady & Co. Ltd. Marris Indef Safex JAPS
41.	Chain Pulley Block	Reva Engineering Hercules Hoists Ltd.

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Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
		W.H. Brady & Co. Ltd.
42.	Centrifugal Turbo Air Blower	Siemens
		ABS
		Aerzen
		Howden
43.	Gas Compressors and Blowers	Kirloskar Pneumatic Co.
		Ingersoll Rand
		Chicago Penumatic (I) Ltd.
		Elgi
		Marpo
44.	Gear Reducers	Essen Pro
		Radicon
		Elecon
		Greaves
		Greaves Cotton
		Shanti
		Allen Beri
		CPEC
45.	Fine Bubble Membrane Diffusers	SSI
		ED!
		OTT
		REHAU
		ABS
		Flygt

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
		Parkson
46.	Chlorinators	Metito, Chloro Control, Industrial Devices, Pennwalt
47.	Submersible Mixers	ABS, Grundfos
		Wilo
		Flygt
48.	Submersible Pumps	Flygt
		KSB Pumps
		ABS
		Wilo
		Gnmdfos
		Kishore
		MBH
		Kiroloskar
		Aquamachine
Flow More		
49.	Agitators	Dorr-Oliver, Voltas, Emco, KCP, Batliboi, Shivpad, Fibre & Fibre, Standard Engineers, Helx
50.	Centrifuge	Alfa Laval, Humbolt, Pennawalt
51.	Chain Pulley Block, Electrical Hoist, JIB Crane	Elephant, Hercules, WMI, Indef, Wh Bardy
52.	Pipes:	
53.	MS / GI Pipes	Tata, Zenith, Indus tubes, Swastic, Jindal
54.	SS Pipes	Jindal, Lloyds, Zenith, Remi, Prakash
55.	CI Pipes	Kesoram, ISSCO, RIFKO,SRIF, Electrosteel, Electrotherm

Sr.No	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
56.	DI Pipes	Electrosteel, Lanco, Jindal
57.	PVC Pipes	Prince, Supreme, Reliance, Premium, Kissan, Garware
58.	UPVC Pipes	Geroge Fisher, Astral
59.	HDPE Pipes	Hallmark, Vijay, Sangir, Sriram Polymers
60.	RCC Pipes	Indian Hume Pipes, Premier Prestressed Concrete Product, Patel Hume Pipes
61.	Sluice Gate	Voltas, Emco, KCP, Batliboi, Jash, Yeshwant, IVC, Durga
62.	Valves: Butterfly, Non-Return, Knige Gate, Gate, Ball, Globe, Diaphragm, Plug	Audco, BDK, Crane Process Control, Fouress, Intervolve, IVC, Jash, Kirloskar, Vaas
63.	Disc Filter	Yucheaon, Siemens, Huber
64.	UV system	Geofluid Calgon, Alfa UV, Trojan
65.	MBBR Media	Kaldness, Benenv, Captor, Lipnor, Pegasus,

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Schedule 12
STP Site

Land admeasuring 6 Acres at the Site (at the proposed STP location indicated below) required by the Concessionaire to develop the Varanasi STP will be carved out from the Site admeasuring 49.42 acres.



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