ऑयल इंडिया
OIL INDIA
Plot No.19, Sector 16A, Noida-201301, Uttar Pradesh
Phone: 0120-2419000, 2419200
Fax: 0120-2488310
E-mail: corp_c&p@oilindia.in
Web Site: www.oil-india.com

BID DOCUMENT

for

EPCOM of 200 TPD Source Segregated Organic Fraction of Municipal Solid Waste (SSOF-MSW) based Compressed Biogas (CBG) Plant for Commercial use at Sambalpur, Odisha on Domestic Competitive Bidding Basis



Tender No: CQI2639P27

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FORWARDING LETTER

Sub: IFB No. **CQI2639P27**-Bidding Documents for EPCOM of 200 TPD Source Segregated Organic Fraction of Municipal Solid Waste (SSOF-MSW) based Compressed Biogas (CBG) Plant for Commercial use at Sambalpur, Odisha on Domestic Competitive Bidding Basis.

Dear Sir(s),

OIL INDIA LIMITED (OIL), a Government of India "MAHARATNA" Category Enterprise, is engaged in Exploration, Production & Transportation of Crude Oil and Natural Gas and Production of LPG in India with participating interest in E&P sector in various overseas projects. OIL with intent to contribute towards Government of India's efforts for clean and green fuel has established a total of 174.1 MW of Wind Energy Power Plants distributed over the states of Rajasthan, Gujarat, and Madhya Pradesh. OIL has also established two Solar Power Plants (SPP)s of capacity 14.0 MW in Jaisalmer, Rajasthan and 500 KW at Jorhat & 304 KW at different operational locations of OIL. As on date, a total of 188.904 MW of Renewable Energy is under OIL's portfolio. Apart from the above OIL commissioned a Green Hydrogen Pilot Plant of capacity 100 KW at Jorhat on 20.04.2022.

In connection with its operations, OIL invites Local Competitive Bids (LCB) from competent and experienced / approved Contractors / Firms for the mentioned work / service under OPEN E-TENDER SINGLE-STAGE TWO BID SYSTEM through OIL's E- Procurement Portal: "https://etender.srm.oilindia.in/irj/portal" for 'Establish a 200 TPD capacity of SSOF-MSW based Compressed Biogas plant for commercial use.' One complete set of Bid Document covering OIL's IFB for hiring of above services is uploaded in OIL's E-Procurement Portal. You are invited to submit your most competitive bid on or before the scheduled bid closing date and time through OIL's E-Procurement Portal. For your ready reference, few salient points of the IFB (covered in detail in the Bid Document) are highlighted below:

Sl. No.	Description		Details
(i)	IFB No./E-Tender No.	:	**CQI2639P27**
(ii)	Type of Bid	:	Open Indigenous E-Tender, Single-Stage Two Bid System
(iii)	Bid Closing Date & Time	:	As mentioned in the E-procurement portal.
(iv)	Technical Bid Opening Date & Time	:	As mentioned in the E-procurement portal.
(v)	Price Bid Opening Date & Time	:	Will be intimated to the eligible/qualified bidders nearer the time.
(vi)	Bid Submission Mode	:	Bids must be uploaded online in OIL's E- Procurement Portal.
(vii)	Bid Opening Place	:	Office of CEO (OGEL) Oil Green Energy Limited (OGEL) 6th Floor, NBCC Centre Pocket A, Okhla Phase I Okhla Industrial Estate New Delhi, Delhi 110020
(viii)	Bid Validity	:	**120 days from date of Bid Closing**. Note: In exceptional circumstances, OIL may solicit the Bidder's consent to an extension of the period of validity. The request and the response hereto shall be made in writing (or by Fax). A bidder granting the request will neither be required nor permitted to modify their bid.
(ix)	Period for Commencement of work	:	15 days from the date of issue of LOA.
(x)	Bid Security/EMD Amount	:	**Rs. 4,34,00,000.00 only.** Refer Clause No. 9 of Instructions to Bidder (ITB)
(xi)	Bid Security/EMD Validity	:	As mentioned in the E-procurement portal (Minimum 165 days from original bid closing date).
(xii)	Original Bid Security to be submitted	:	Office of CEO (OGEL) Oil Green Energy Limited (OGEL) 6th Floor, NBCC Centre Pocket A, Okhla Phase I Okhla Industrial Estate New Delhi, Delhi 110020
(xiii)	Amount of Performance Security	:	10% of Contract value. Refer Clause No. 25 of Instruction to Bidder (ITB)
(xiv)	Defect Liability Period		12 (Twelve) months from the date of successful completion of PGTR test.
(xv)	Validity of Performance Security	:	03 (three) months beyond the defect liability period.
(xvi)	Location of job		Sambalpur, Odisha
(xvii)	Duration of the Contract	:	21 Months for EPC Works 10 Years for Operation and Maintenance Contract

Sl. No.	Description		Details
(xviii)	Quantum of Liquidated Damage for Default in Timely Completion	:	Refer Clause No. 30 of General Conditions of Contract (GCC) and Clause No. 6 of Special Condition of Contract (SCC).
(xix)	Bids to be addressed to	:	Office of CEO (OGEL) Oil Green Energy Limited (OGEL) 6th Floor, NBCC Centre Pocket A, Okhla Phase I Okhla Industrial Estate New Delhi, Delhi 110020
(xx)	Site Visit	:	To be informed in Pre-Bid
(xxi)	Pre-Bid conference	:	• Date: 27.08.2026 • Time: 1100 Hrs • Mode: Hybrid (Physical as well as Virtual) • Venue for Physical meeting: OGEL Office, NBCC Center, 6th Floor, Ma Anandmayee Marg, Pocket A, Okhla Industrial Area Phase-I, Delhi, India.
(xxii)	Queries regarding Pre bid conference		Any queries regarding pre bid conference may be for forwarded in the prescribed format at Annexure – I to Oil India Limited/OGEL. 1. Mr. Rajeev Kumar Tamuli Email: rk_tamuli@oilindia.in 2. Ms. Priyanka Kumari Email: priyanka.kumari@oilindia.in
(xxiii)	Last Date of receipt of Queries	:	24.08.2026
(xxiv)	Whether tendered quantities are splitable	:	No
(xxvi)	Extension of Bid Closing Date	:	The Company expects the bidders to adhere to the Bid submission end date timeline. Bidders are requested to refrain from seeking extension of "Bid Closing date" and such request for Bid Closing Date extension shall not be entertained by the Company. However, OIL at its discretion may extend the Bid Closing Date due to unforeseen circumstances.
(xxvii)	Submission of Check list	:	**Bidders must mandatorily submit a duly filled CHECKLISTS FOR BEC-BRC** and other relevant technical criteria along with the technical bid. If any bidder fail/declines to submit the checklist duly filled completely within the stipulated deadline will render the bid liable for rejection and will not be considered for further evaluation.

1. GUIDELINES FOR PARTICIPATING IN OIL'S E-PROCUREMENT

1.1. Bids are to be submitted online through OIL's E-Procurement Portal with digital signature. To participate in OIL's E-Procurement tender, bidders should have a legally valid digital certificate of Class 3 with Organizations Name and Encryption Certificate as per Indian IT Act from the licensed Certifying Authorities operating under the Root Certifying Authority of India (RCAI), Controller of Certifying Authorities (CCA) of India (http://www.cca.gov.in). Digital Signature Certificates having "Organization Name" field other than Bidder's Name are not acceptable. However, aforesaid Digital Signature Certificates having Bidder's Name in the "Organization Name" field are acceptable.

Encryption certificate is mandatorily required for submission of bid. In case bidder creates response with one certificate (using encryption key) and then the bidder changes his Digital Signature Certificate, then the old certificate (used for encryption) is required in order to decrypt his encrypted response for getting the edit mode of the response. Once decryption is done, bidder may use new DSC certificate for uploading and submission of their offer. It is the sole responsibility of the bidder to keep their DSC certificate properly. In case of loss of the certificate, OIL INDIA LTD. is not responsible.

The authenticity of above digital signature shall be verified through authorized CA after bid opening and in case the digital signature used for signing is not of "Class 3 with Organizations Name and Encryption Certificate", the bid will be rejected.

Only in case of sole proprietorship firms, Digital Signature Certificates issued in the name of the proprietor is also acceptable provided the bid is submitted in the capacity of a proprietorship firm.

Bidder is responsible for ensuring the validity of digital signature and its proper usage by their employee.

The bid including all uploaded documents shall be digitally signed by duly authorized representative of the bidding company.

The bid including all uploaded documents shall be digitally signed by duly authorized representative of the Bidder / Bidding Company to bind the Bidder / Bidding Company to the contract.

1.2. For participation, applicants already having User ID & Password for OIL's E- Procurement Portal need to register against the IFB. New vendors / existing vendors not having User ID & Password for OIL's E-Procurement Portal shall obtain User ID & password through online vendor registration system in E- Portal.

1.2.1 Bidders without having E-Tender Login ID and password should complete their online registration at least 07 (Seven) days prior to the scheduled Bid Closing Date and time of

the tender. For online registration, bidder may visit OIL's E-Tender site https://etender.srm.oilindia.in/irj/portal.

1.2.2 Necessary Login ID & Password will be issued by OIL only after submitting the complete online registration by the Bidder. In the event of late registration / incomplete registration by Bidder, OIL INDIA LIMITED shall not be responsible for late allotment of User ID & Password and request for bid closing date extension on that plea shall not be entertained by Company.

1.3. Parties, who do not have a User ID, can click on Guest login button in the E- portal to view and download the tender. The detailed guidelines are available in OIL's E-Procurement site (Help Documentation). For any clarification in this regard, bidders may contact E-Tender Support Cell at Duliajan at erp_mm@oilindia.in, Ph.: 0374 - 2807178/4903.

1.4. Details of the process for submission of Bid Security (EMD) through the online payment gateway are available in Vendor User Manual under E-Procurement Portal. (Note: Important Points for on-line Payment can be viewed at Oil India's website at URL: http://oil-india.com/pdf/ETenderNotification.pdf).

1.5. The link to OIL's E-Procurement Portal has been provided through OIL's website (www.oil-india.com).

2. PRE-BID MEETING

In order to avoid clarification/confirmation after opening of bids, wherever specifically mentioned in NIT, Pre-bid meeting shall be held so as to provide an opportunity to the participating bidders to interact with OIL with regard to various tender provisions/tender specifications and to explain the requirements of Company in details to the interested prospective Bidders and to understand bidders' perspective including exchange of views/clarifications, if any, on the Scope of Work, Bid Evaluation Criteria and other terms & conditions of the Tender. Bidders are requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specifications.

a) All costs for attending the Pre-Bid meeting shall be to prospective bidders' account.

b) The bidders meeting the following requirement shall only be considered for attending the pre-bid conference. Bidders should depute their employees (preferably) who are competent to present their queries in the Pre-Bid Meeting. While submitting queries before the pre-bid meeting, bidder(s) shall be required to provide details (of its representative, who will attend pre-bid meeting, and those persons only will be permitted to attend the pre-bid meeting. E-mail ids of personals nominated by prospective bidder for participating in the Prebid meeting may be forwarded to OIL official (rk_tamuli@oilindia.in and priyanka.kumari@oilindia.in) at least 01 day prior to the Pre-Bid Meeting for issuing invitation for the meeting. The maximum

number of persons that would be permitted per bidder for participation in pre-bid meeting shall be limited to two (2) persons.

c) It is highly recommended that prospective bidders forward their pre-bid queries (if any) as per Annexure–1 over e-mail to OIL officials at least 01 day prior to schedule date of pre-bid meeting so that clarification can be provided during the meeting itself. Any Queries received after the above stipulated date will not be accepted. In case of the days specified above happens to be a holiday in OIL, the next working day shall be implied.

d) Further clarification on the bid documents subsequent to pre-bid meeting can be sought within 7 days from publishing the query response and the same should be addressed to the email IDs rk_tamuli@oilindia.in and priyanka.kumari@oilindia.in. Queries / Clarifications against the tender received after the prescribed timeline will not be entertained and replied to. OIL will not be responsible for non-receipt or late receipt of any Bidder's query in OIL's office.

e) Attending pre-bid meeting is optional. Non-attendance of the pre-bid meeting shall not be a cause for disqualification of the bidder.

f) Any modification to the Bidding Documents, which may become necessary as a result of the pre-bid meeting, if agreed by OIL, shall be made by OIL through the issuance of an amendment to tender only.

g) The bidder shall consider in his priced bid, all the pre-bid discussions and subsequent corrigenda issued if any, submitted on or before the bid closing date (BCD), which shall be firm and final. No revisions to the quoted price and no further queries will be allowed after the BCD.

3. BID SUBMISSION TIMING

Bid should be submitted online in OIL's E-Procurement site up to 11.00 AM (IST) (Server Time) on the date as mentioned and will be opened on the same day at 3.00 PM (IST) (Server Time) at BD Department, Noida in presence of the authorized representatives of the bidders.

4. SUBMISSION OF BID RATES

The rates shall be quoted per unit as specified in the "PRICE BIDDING FORMAT" attached under "Notes and Attachments" tab. Bidder should note that no pricing information is furnished in the "Technical Attachment" (Un- priced Techno- Commercial Bid) otherwise the bid will be rejected.

5. BID WITHDRAW

5.1. No Bidder can withdraw his bid within the validity or extended validity of the bid. In the event of withdrawal of any bid within validity period, Oil India Limited will suspend the bidder for a period of two years without conducting any enquiry.

5.2. Once a withdrawal letter is received from any bidder, the offer will be treated as withdrawn and no further claim / correspondence will be entertained in this regard.

6. CONDITIONAL BIDS

Conditional bids are liable to be rejected at the discretion of the Company.

7. BID SUBMISSION

The bidders are required to furnish the composition and status of ownership of the firm in whose name bid documents have been purchased / issued along with one or more of the following documentary evidences (which are applicable to the bidder) in support of the same and scanned copies of the same should be uploaded along with the Un-priced Techno-Commercial Bid documents.

7.1. In case of Sole Proprietorship Firm, Copies of Telephone / Electricity / Mobile Bill, PAN card, latest Income Tax Return form indicating therein the name, business and residential address, E-mail and telephone numbers of the owner and GSTIN number.

7.2. In case of HUF, Copies of Telephone / Electricity / Mobile Bill, PAN card, latest Income Tax Return form, Family Arrangement indicating therein the name, residential address, E-mail and telephone numbers of the owners in general and Karta in particular and GSTIN number.

7.3. In case of Partnership Firm, Copies of Telephone / Electricity / Mobile Bill, PAN card, latest Income Tax Return form indicating therein the name, residential address, E-mail and telephone numbers of all the partners (including the Managing Partner), registered partnership agreement / deed and GSTIN number.

7.4. In case of Co-Operative Societies, Copies of Telephone / Electricity / Mobile Bill, PAN card, latest Income Tax Return form indicating therein the name, residential address, E-mail and telephone numbers of all the Directors or persons who are at the helm of affairs, registration certificate from Registrar of Co-Operative Societies and GSTIN number.

7.5. In case of Societies registered under the Societies Registration Act, Copies of Telephone / Electricity / Mobile Bill, PAN card, latest Income Tax Return form indicating therein the name, residential address, E-mail and telephone numbers of all the Directors or persons who are at the helm of affairs, registration certificate from the Registrar of the state and GSTIN number.

7.6. In case of Joint Stock Companies registered under the Indian Companies Act, Copies of Telephone / Electricity / Mobile Bill, PAN card, latest Income Tax Return form indicating therein

the name, residential address, E-mail and telephone numbers of all the Directors or persons who are at the helm of affairs, Certificate of Incorporation from the Registrar of Companies, Memorandum and Articles and GSTIN number.

7.7. In case of Trusts registered under the Indian Trust Act, Copies of Telephone / Electricity / Mobile Bill, PAN card, latest Income Tax Return form indicating therein the name, residential address, E-mail and telephone numbers of all the Trustee or persons who are at the helm of affairs, registration certificate from the Registrar of the state, Trust Deed and GSTIN number.

8. IMPORTANT NOTES

Bidders shall take note of the following important points while participating in OIL's e-procurement tender:

8.1. **BACKING OUT BY BIDDER**: In case any bidder withdraws their bid within the bid validity period, Bid Security will be forfeited, and the party will be put on Holiday as per the Banning Policy (available in OIL's website) of Company.

8.2. **BACKING OUT BY L-1 BIDDER AFTER ISSUE OF LOA:** In case LOA issued is not accepted by the L1 bidder or the Performance Security is not submitted as per the terms of the contract within the time specified in the Bid Document, the Bid Security shall be forfeited, and the bidder shall be dealt as per the Banning Policy (available in OIL's website) of Company.

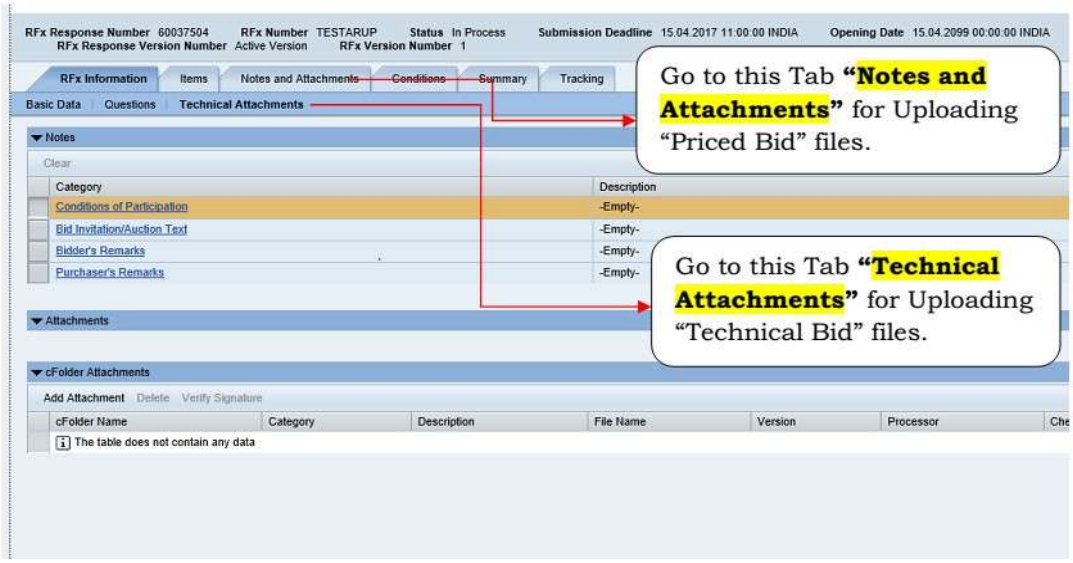
8.3. **FURNISHING FRAUDULENT INFORMATION/DOCUMENT:** The information and documents furnished by the bidder/ contractor in respect of the subject tender/contract are accepted to be true and genuine. However, if it is detected during technical scrutiny or after award of the contract or after expiry of the contract, that the bidder had submitted any fake/fraudulent document or furnished false statement, the offer/contract shall be rejected/ cancelled, as the case may be and the bidder (if fake document/false statement pertains to such bidder) shall be dealt as per the Banning Policy (available in OIL's website) of Company. Undertaking of authenticity of information/documents submitted as per Proforma-VI should be submitted along with the technical bids.

8.4. **ERRING / DEFAULTING AGENCIES:** Erring and defaulting agencies like bidder, contractor, supplier, vendor, service provider will be dealt as per OIL's latest Banning Policy available in OIL's website: www.oil-india.com.

8.5. If the digital signature used for signing is not of "Class-3" with Organizations name, the bid will be rejected.

8.6. The tender is invited under **SINGLE STAGE-TWO BID SYSTEM**. The bidders shall submit both the "**TECHNICAL**" and "**PRICED**" bids through electronic form in the OIL's e-Procurement portal within the Bid Closing Date and Time stipulated in the e-Tender. The Technical Bid should be submitted as per Scope of Work & Technical Specifications along with all technical documents

related to the tender and uploaded in **"Technical Attachments" Tab only. Bidders to note that no price details should be uploaded in "Technical Attachments" Tab Page. Details of prices as per Price Bid format/Priced bid can be uploaded under "Notes & Attachments" tab. A screen shot in this regard is shown below. Offer not complying with above submission procedure will be rejected as per Bid Evaluation Criteria.**



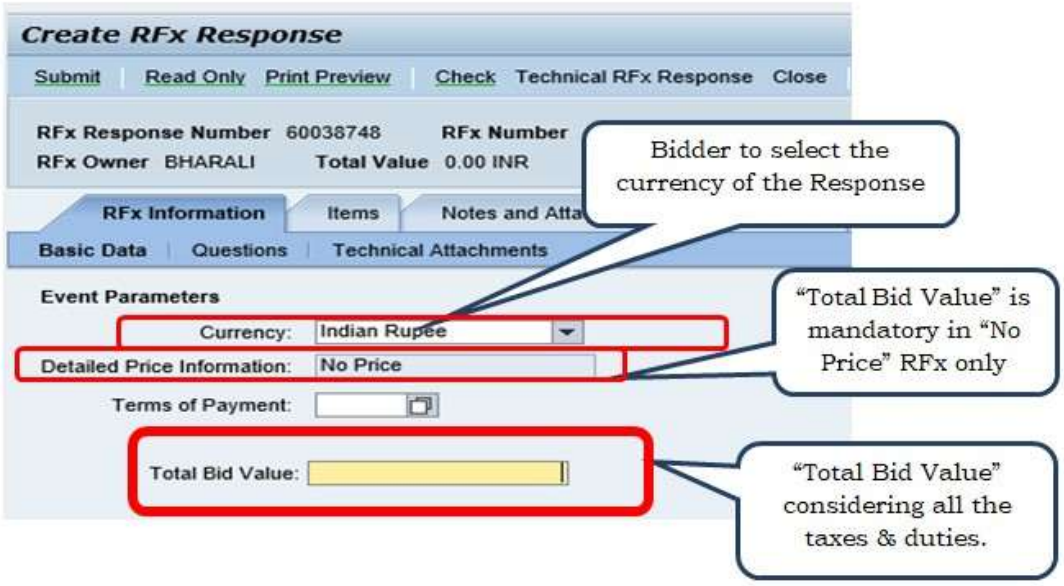
On "EDIT" Mode, bidders are advised to upload "Technical Bid" and "Priced Bid" in the respective places as indicated above:

Notes:

* The "Technical Bid" shall contain all techno-commercial details except the prices.

** The "Priced bid" must contain the price schedule and the bidder's commercial terms and conditions, if any. For uploading Priced Bid, click on Add Attachment, a browser window will open, select the file from the PC and name the file under Description, Assigned to General Data and click on OK to digitally sign and upload the File. Please click on Save Button of the Response to Save the uploaded files.

8.7. **Maintenance of Total bid value in the Response:** For convenience of the Bidders and to improve transparency, the rates/costs quoted by bidders against the E-tender shall be available for online viewing to all the Techno- commercially qualified Bidders against the tender after price bids are opened in the system. For tenders where Detailed Price Information under RFx Information Tab is "No price", the Price Bid is invited against the tender through attachment form under "Notes & Attachment". In such tenders, Bidders must upload their pricing as per the "Price Bid Format" under "Notes & Attachment" and additionally fill up the on-line field "Total Bid Value" under "RFx Information" Tab Page with the Total Cost (Including the GST component) as per the amount of the Price Bid in attachment form.



8.8. The "Total Bid Value" as entered by the Bidder in the on-line response shall be displayed in the E-tender portal amongst the techno-commercially qualified bidders and Company will not take any responsibility whatsoever towards incorrect information furnished by the bidders on the "Total Bid Value" field.

It is to be noted that Amount mentioned in the "Total Bid Value" field will not be considered for bid evaluation and evaluation will be purely based on the Price bid submitted as per the "Price Bid Format" under "Notes & Attachments" tab page.

9. The selected bidder will be required to enter into a formal contract, which will be based on their bid and OIL's Standard Form of Contract.

10. The successful bidder shall furnish a Performance Security Deposit for the amount as mentioned under Clause 2.0 (xiii) above and as indicated under para 25 of ITB/10.0 of GCC before signing the formal contract. The Performance Security Deposit will be refunded to the Contractor after satisfactory completion of the work, but a part or whole of which shall be used by the Company in realization of liquidated damages or claims, if any or for adjustment of compensation or loss due to the Company for any reason. This Security Money shall not earn any interest.

11. **RESTRICTIONS ON PROCUREMENT FROM A BIDDER OF A COUNTRY WHICH SHARES LAND BORDER WITH INDIA:** Subject to Order No. F. No. 6/18/2019-PPD dated 23.07.2020 issued by Ministry of Finance, Department of Expenditure, Public Procurement Division, Govt. of India, Bidders should take note of the following:

11.1. Any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the Competent Authority [Registration Committee

constituted by the Department for Promotion of Industry and Internal Trade (DPIIT)]. Further, any bidder (including bidder from bidder) having specified Transfer of Technology (ToT) arrangement with an entity from a country which shares a land border with India, shall also require to be registered with the same competent authority to be eligible to bid in this tender.

11.2. "Bidder" (including the term 'tenderer', 'consultant' or 'service provider' or "contractor" in certain contexts) means any person or firm or company, including any member of a consortium or joint venture (that is an association of several persons, or firms or companies), every artificial juridical person not falling in any of the descriptions of bidders stated hereinbefore, including any agency branch or office controlled by such person, participating in a procurement process.

11.3. "Bidder from a country which shares a land border with India" for the purpose of this Order means:

a) An entity incorporated, established or registered in such a country; or

b) A subsidiary of an entity incorporated, established or registered in such a country: or

c) An entity substantially controlled through entities incorporated, established or registered in such a country; or

d) An entity whose beneficial owner is situated in such a country; or

e) An Indian (or other) agent of such an entity; or

f) A natural person who is a citizen of such a country: or

g) A consortium or joint venture where any member of the consortium or joint venture falls under any of the above

11.4. The beneficial owner for the purpose of para 9.3 above will be as under:

11.4.1 In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has a controlling ownership interest or who exercises control through other means.

Explanation:

a) "Controlling ownership interest" means ownership of or entitlement to more than twenty-five per cent. of shares or capital or profits of the company.

b) "Control" shall include the right to appoint majority of the directors or to control the management or policy decisions including by virtue of their shareholding or management rights or shareholders agreements or voting agreements.

11.4.2 In case of a partnership firm, the beneficial owner is the natural person(s) who, whether acting alone or together, or through one or more juridical person, has ownership of entitlement to more than fifteen percent of capital or profits of the partnership.

11.4.3 In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has ownership of or entitlement to more than fifteen percent of the property or capital or profits of such association or body of individuals.

11.4.4 Where no natural person is identified under (11.4.1) or (11.4.2) or (11.4.3) above, the beneficial owner is the relevant natural person who holds the position of senior managing official.

11.4.5 In case of a trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.

11.5. An Agent is a person employed to do any act for another, or to represent another in dealings with third person.

11.6. The successful bidder shall not be allowed to sub-contract works to any contractor from a country which shares a land border with India unless such contractor is registered with the Competent Authority. A declaration as per Exhibit-I/Proforma-XIII in this respect to be submitted by the bidder.

11.7. Validity of registration: In respect of tenders, registration should be valid at the time of submission of bids and at the time of acceptance of bids. In respect of supply otherwise than by tender, registration should be valid at the time of placement of order. If the bidder was validly registered at the time of acceptance/placement of order, registration shall not be a relevant consideration during contract execution.

11.8. The bidders to provide an undertaking as per **Proforma-XIII** along with their bid complying with Clause No. 11.1 above. If such certificate given by a bidder whose bid is accepted is found to be false, this would be a ground for immediate termination and further legal action in accordance with law.

12. **INTEGRITY PACT**: The Integrity Pact is applicable against this tender:
OIL shall be entering into an Integrity Pact with the bidders as per format enclosed vide "Annexure-2 Integrity Pact" in the tender document. This Integrity Pact proforma has been duly signed digitally by OIL's competent signatory. The proforma has to be returned by the bidder (along with the Un-priced Techno-Commercial Bid) duly signed (digitally) by the same signatory who signed the bid, i.e., who is duly authorized to sign the bid. Uploading the Integrity Pact with digital signature will be construed that all pages of the Integrity Pact have been signed by the bidder's authorized signatory who sign the Bid.

13. OIL now looks forward to your active participation in the IFB.

Thanking you
Yours Faithfully
OIL INDIA LIMITED

Sd/-

(Priyanka Kumari)
Manager-C&P

Tender No: CQI2639P27

Description:

Bidding document for EPCOM of 200 TPD Source Segregated Organic Fraction of Municipal Solid Waste (SSOF-MSW) Based Compressed Biogas Plant at Sambalpur, Odisha on Domestic Competitive Bidding basis

The tender document contains the following sections:

Section	Name	Page Number
Section-I	Forwarding letter	1 - 15
Section-II	Instruction to Bidders (ITB)	16- 37
Section-III	Bid Eligibility & Bid Evaluation	38 - 54
Section-IV	General Condition of Contract	55 - 104
Section-V	Special Condition of Contract	105 - 161
Section-VI	Schedule of Rates	162 - 177
Section-VII	Detailed Scope of Work	178 - 285
Section-VIII	Detailed Technical Specification - Process and Mechanical	286 - 446
Section-IX	Detailed Technical Specification - Civil, Structural and Architectural Works	447 - 596
Section-X	Detailed Technical Specification - Electrical	597 - 662
Section-XI	Detailed Technical Specification - Control and Instrumentation	663 - 726
Section-XII	Forms & Formats	727 - 774
Section-XIII	Annexures	775 - 797

Section - II INSTRUCTIONS TO BIDDER

TABLE OF CONTENTS

1 ELIGIBILITY OF THE BIDDER 19
2 BID DOCUMENTS 19
3 TRANSFERABILITY OF BID DOCUMENTS 19
4 AMENDMENT OF BID DOCUMENTS 20
5 PREPARATION OF BIDS 20
6 BID FORM 21
7 BID PRICE 21
8 DOCUMENTS ESTABLISHING BIDDER'S ELIGIBILITY AND QUALIFICATIONS 22
9 BID SECURITY 22
10 EXEMPTION FROM SUBMISSION OF BID SECURITY 25
11 PERIOD OF VALIDITY OF BIDS 25
12 SIGNING & SUBMISSION OF BIDS 25
13 DEADLINE FOR SUBMISSION OF BIDS 27
14 LATE BIDS 27
15 MODIFICATION AND WITHDRAWAL OF BIDS 28
16 EXTENSION OF BID SUBMISSION DATE 28
17 BID OPENING AND EVALUATION 28
18 OPENING OF PRICED BIDS 29
19 EVALUATION AND COMPARISON OF BIDS 30
20 DISCOUNTS / REBATES 30
21 CONTACTING THE COMPANY 30
22 AWARD OF CONTRACT 30
23 COMPANY'S RIGHT TO ACCEPT OR REJECT ANY BID 30
24 NOTIFICATION OF AWARD 31
25 PERFORMANCE SECURITY 31
26 SIGNING OF CONTRACT 34
27 CREDIT FACILITY 34
28 MOBILIZATION AND ADVANCE PAYMENT 34

29 INTEGRITY PACT 35
30 LOCAL CONDITIONS 35
31 SPECIFICATIONS 36
32 GOODS & SERVICES TAXES 36

1 ELIGIBILITY OF THE BIDDER

1.1. The eligibility of the bidder is listed under **BID EVALUATION CRITERIA (BEC) – BID REJECTION CRITERIA (BRC)** of the tender document.

1.2. The bidder shall bear all costs associated with the preparation and submission of bid. Oil India Limited, hereinafter referred to as "Company or Owner or OIL", will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

2 BID DOCUMENTS

2.1. The services required, bidding procedures and contract terms are prescribed in the Bid Document. This Bid Document includes the following:

a) A Tender Forwarding Letter
b) Instructions to Bidders (ITB)
c) Bid Evaluation Criteria - Bid Rejection Criteria (BEC-BRC)
d) General Conditions of Contract (GCC)
e) Special Conditions of Contract (SCC)
f) Price Schedule
g) Scope of Work
h) Technical Specifications
i) Forms & Formats

2.2. The bidder is expected to examine all instructions, forms, terms and specifications in the Bid Documents. Failure to furnish all information required in the Bid Documents or submission of a bid not substantially responsive to the Bid Documents in every respect will be at the Bidder's risk & responsibility and may result in the rejection of its bid.

2.3. Bidders shall be deemed, prior to submitting their bids, to have satisfied themselves about the weather conditions, working culture in the area, socio-political environment, safety & security aspects, law & order situation and law of the land, and obtain for themselves all necessary information as to the risks, contingencies and all other circumstances, which may influence or affect the various obligations under the Contract.

3 TRANSFERABILITY OF BID DOCUMENTS

3.1. Bid Documents are non-transferable. **Bid can be submitted only in the name of the bidder in whose name the Bid Document has been issued**.

3.2. In case of e-Tender, Bidder must submit the bid using Organizational Class-3 Digital Signature issued by the Competent Authority in favour of the bidder. Bid submitted using Digital Signature other than the Digital Signature of the bidder shall be summarily rejected.

3.3. Unsolicited bids will not be considered and will be rejected straightway.

4 AMENDMENT OF BID DOCUMENTS

4.1. At any time prior to the deadline for submission of bids, the Company may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective Bidder, modify the Bid Documents through issuance of an Addendum(s) / Corrigendum(s) / Amendment(s).

4.2. The Addendum will be uploaded in OIL's E-Tender Portal in the Tab "Technical Rfx" and under External Area - "Amendments" folder. The Company may, at its discretion, extend the deadline for bid submission. Bidders are expected to take the Addendum into account in preparation and submission of their bid. Bidders are to check from time to time the E-Tender portal ["Technical RFx" Tab and under the folder "Amendments"] for any amendments to the bid documents before submission of their bids. No separate intimation shall be sent to the Bidders.

5 PREPARATION OF BIDS

5.1. Language of Bids: The bid prepared by the bidder and all correspondence and documents relating to the bid exchanged by the Bidder and the OIL shall be written in English language. Supporting documents and printed literature furnished by the Bidder may be in another language provided they are accompanied by an accurate translation of the relevant passages in English, duly authenticated by local chamber of Commerce of bidder's country, in which case, for purposes of interpretation of the bid, the translation shall prevail.

5.2. Bidder's / Agent's Name & Address: Bidders should indicate in their bids their detailed postal address including the Fax / Telephone / Cell Phone Nos. and E-mail address. Similar information should also be provided in respect of their authorized Agents in India, if any.

5.3. Documents comprising the bid:

Bids are invited under Single-Stage Two-Bid System. The bid to be uploaded by the Bidder in OIL's E-Tender portal shall comprise of the following components:

5.3.1. Technical Bid (to be uploaded in "Technical Attachments" tab): Complete technical details of the services offered.

5.3.2. Documentary evidence established in accordance with Clause No. 8.

5.3.3. Bid Security (scanned) in accordance with Clause No. 9 hereunder. Original Bid Security should be sent as per Clause No. 9.3 (c) below.

5.3.4. Bid Form as per **PROFORMA-I**.

5.3.5. Statement of Non-compliance as per **PROFORMA–II**.

5.3.6. Integrity Pact, digitally signed by OIL's competent personnel as **Annexure-2**.

5.3.7. **PROFORMA-IV** attached with the bid document to be signed by the bidder's authorized representative.

5.3.8. All other relevant Undertakings and PROFORMAS as applicable as part of Bid.

5.3.9. **BRS-8** with Plant Design Details

5.3.10. All the bid documents should be provided with page number except balance sheet / tender document and its corrigendum.

5.3.11. Each and every page of the tender documents, including any Corrigendum/Addendum issued thereafter, must be signed and submitted with the bid.

5.3.12. The bidders are requested to fill and submit all **BRS, PROFORMA**, and **ANNEXURES** as attached in **Sections XIII and XIV**.

Note: No price should be mentioned in the Technical Bid being uploaded in "Technical Attachments" tab. If any price is mentioned by the bidder in their technical bid, then their bid will be rejected straightway.

5.3.13. The Price Bid as per the Price Bid Format shall be uploaded in "Notes and Attachments" tab.

Note: The Price Bid Format containing the prices along with the currency quoted and any other commercial information pertaining to the service offered.

6 BID FORM

The bidder shall complete the Bid Form as per **PROFORMA – I** and upload the same along with their technical bid.

7 BID PRICE

7.1. Prices must be quoted by the Bidders online as per the price bid format available in OIL's E-Tender Portal under "Notes & Attachment" Tab. Prices must be quoted by the bidders as per the Price Bidding format.

7.2. Prices quoted by the successful bidder must remain firm during performance of the Contract and must not be subject to variation on any account, except as otherwise mentioned in the bid document.

7.3. All duties and taxes (excluding GST) including Corporate Income Tax, Personal Tax, Assam Entry Tax etc. and other Cess/levies payable by the successful bidder under the Contract for which this Bid Document is being issued, shall be included in the rates, prices and total Bid Price submitted by the bidder and the evaluation and comparison of bids shall be made considering the quoted GST in the Price Bid Format. For example, personal taxes and/or any corporate taxes arising out of the profits on the contract as per rules of the country shall be borne by the bidder.

8 DOCUMENTS ESTABLISHING BIDDER'S ELIGIBILITY AND QUALIFICATIONS

8.1. These are listed in BEC-BRC of the tender documents.

9 BID SECURITY

9.1. Bidder shall furnish as part of its bid, Bid Security for the amount as specified in the **"Forwarding Letter"** along with Annexure - 7.

9.2. The Bid Security is required to protect the Company against the risk of Bidder's conduct, which would warrant the security's forfeiture of the Bid security, pursuant to sub-para 9.7 below.

9.3. All the bids must be accompanied by Bid Security for the amount as mentioned in the Bid document and shall be in any one of the following forms:

9.3.1. A Bank Guarantee in the prescribed format issued from any scheduled Indian Bank or any Branch of an International bank situated in India and registered with Reserve bank of India as scheduled foreign bank only will be acceptable.

Bank Guarantee issued by banks in India should be on non-judicial stamp paper/Franking receipt of requisite value as per Indian Stamp Act, purchased in the name of the Banker or the bidder.

Bank Guarantee shall be valid for 150 days from the scheduled bid closing date.

Bank guarantee with any condition other than those mentioned in OIL's prescribed format shall not be accepted and bids submitted by bidders with such Bank guarantee will be liable for rejection.

Bank Guarantee should be so endorsed that it can be invoked at the issuing bank's branch located at Noida or alternatively at Delhi.

9.3.2. DD/Bank draft/Cashier cheque in favour of OIL INDIA LIMITED and payable at NOIDA/Delhi.

9.3.3. Bid Security amount through mode of NEFT or RTGS may be deposited on or before bid closing date and time to the following designated OIL's bank account:

S. No.	Bank Details of Beneficiary: OIL INDIA LIMITED	
1.	Bank Name	STATE BANK OF INDIA
2.	Branch Name	CAG BRANCH II, New Delhi
3.	Branch Address	4TH AND 5TH FLOOR, REDFORT CAPITAL PARSVNATH TOWERS, BHAI VEER SINGH MARG, GOLE MARKET, NEW DELHI-110001
4.	Bank Account No.	**30192825337**
5.	Type of Account	Cash Credit/Overdraft
6.	IFSC Code	**SBIN0017313**
7.	MICR Code	110002562

If the Bid security is submitted through NEFT or RTGS mode, the bidder must upload following details along with their un-priced techno-commercial bid:

i. Name of Banker
ii. Branch Name & code of the Banker
iii. Deposited Amount
iv. UTR Number
v. Tender Number
vi. Screenshot/proof of confirming the transfer of amount.

(Note: In case of online submission of Bid security by bidder, the amount will be refunded only after adjusting bank charges, if any. The bank charges will be to bidder's account. However, the Bid Security will be governed by the terms and conditions of the Bid document).

9.4. Any Bid not accompanied by a proper bid security in accordance with above-mentioned sub-clauses 9.1 & 9.3, shall be rejected outright by the Company as non-responsive without any further reference.

9.5. Bid Security of unsuccessful bidders will be discharged after finalization of the tender.

9.6. Successful Bidder's Bid Security will be discharged upon the Bidder's signing of the contract and furnishing valid and proper Performance Security to OIL (if applicable) as per the contract. Successful bidder will, however, ensure validity of the Bid Security till such time the Performance Security (if applicable) in conformity to relevant clause of tender is furnished.

9.7. The Bid Security shall be forfeited:

9.7.1. If a Bidder withdraws their Bid during the period of (including any subsequent extension) specified by the Bidder or any extensions thereof agreed to by the bidder, and/or

9.7.2. If the bidder having been notified of the acceptance of their bid by the Company during the validity period of the bid including extension agreed to by the bidder:

a) Fails or refuses to accept LOA/contracts and /or

b) Fails or refuses to furnish Performance Security.

9.7.3. If a bidder furnishes fraudulent document/information in their bid and subsequent clarification against the tender /contracts.

9.8. The scan copy of the original Bid Security in the form of bank guarantee/DD/Banker Cheque/ Cashier cheque shall be uploaded by the bidder along with their Bid in in e-Tender portal of Oil India Limited. The original Bid Security shall be submitted by bidder in a sealed envelope & must drop in the Tender Box, placed at the office of General Manager (Contract & Purchase), Oil India Limited, Corporate Office, Plot No. 19, Sector-16A, Noida on or before Bid closing date & Time, failing which the bid shall be rejected outright. Tender No. & Bid Closing date & Name of bidder must be written on the envelope containing the Bid Security for proper identification.

9.9. In case any bidder withdraws their bid during the period of bid validity, Bid Security will be forfeited, and the party shall be debarred from participating in future tenders for a period as per Company's policy.

9.10. Bid Security shall not accrue any interest during its period of validity or extended validity. OIL shall not be liable to pay any bank charges, commission on the amount of Bid Security.

9.11. The bidder shall extend the validity of the Bid Security, if and when specifically advised by OIL, at the bidder's cost.

9.12. In case any Bid security in the form of Bank Guarantee is found to be not genuine or issued by a fake banker or issued under the fake signatures, the bid submitted by the concerned bidder shall be rejected forthwith and the bidder shall be debarred from participating in future tenders for the period to be decided by Company.

9.13. In case a bidder does not accept the LOA /Contract issued within the validity of their offer, the Bid Security shall be forfeited, and the party shall be debarred from participating in future tenders for a period to be decided by company.

9.14. The Bank guarantee issued by a Bank amongst others shall contain the complete address of the Bank including Phone.

9.15. Bidders claiming waiver of Bid Security shall upload supporting documents as mentioned in **Para No.10** below along with technical bid.

10 EXEMPTION FROM SUBMISSION OF BID SECURITY

In case any bidder is exempted from paying the Bid security, they should upload the supporting documents along with their technical bid. The detailed guidelines for exemption of the Bid security are given below.

a) PPP [Public Procurement policy] for Micro and Small Enterprises is not applicable for this tender (being works contract tender). Hence, exemption from submission of bid security against MSE Units is not applicable for this tender.

b) Central as well as State Government Departments and Public Sector Undertakings (CPSUs) are also exempted from submitting bid security.
Note: Bids without EMD shall be rejected, if the technical offer does not include a valid copy of relevant Document/Certificate towards exemption of EMD, issued by appropriate authority.

11 PERIOD OF VALIDITY OF BIDS

11.1. Bids shall remain valid as per the requirement mentioned in the forwarding letter from the date of closing of bid prescribed by the Company. Bids of shorter validity will be rejected as being non-responsive. If nothing is mentioned by the bidder in their bid about the bid validity, it will be presumed that the bid is valid for **120 days** from Bid Closing Date.

11.2. In exceptional circumstances, the Company may solicit the Bidder's consent to an extension of the period of validity. The request and the response thereto shall be made in writing through Fax or e-mail. A Bidder may refuse the request. A Bidder granting the request will neither be required nor permitted to modify their Bid.

12 SIGNING & SUBMISSION OF BIDS

12.1. Signing of bids

12.1.1 Bids are to be submitted online through OIL's E-procurement portal with digital signature. The bid and all attached documents should be digitally signed by the bidder using "Class 3" digital certificates with Organization's Name [e-commerce application (Certificate with personal verification and Organisation Name)] as per Indian IT Act 2000 obtained from the licensed Certifying Authorities operating under the Root Certifying Authority of India (RCAI), Controller of Certifying Authorities (CCA) of India before bid is uploaded. Digital Signature

Certificates having Bidder's Name in the "Organization Name" field are only acceptable. Digital Signature Certificate having "Organization Name" field other than Bidder's Name shall be rejected summarily

The bid including all uploaded documents shall be digitally signed by duly authorized representative of the bidder holding a Power of Attorney to bind the Bidder to the contract.

If any modifications are made to a document after attaching digital signature, the digital signature shall again be attached to such documents before uploading the same.

In case the digital signature is not of "Class-3" with organization name, the bid will be rejected. Bidder is responsible for ensuring the validity of digital signature and its proper usage by their employees.

12.1.2 The original and all copies of the bid shall be typed or written in indelible inks. Since bids are to be submitted ONLINE with digital signature, manual signature is NOT relevant. The Letter of Authority (as per PROFORMA-IV) shall be indicated by written Power of Attorney accompanying the Bid.

12.1.3 Any physical documents submitted by bidders shall contain no interlineations, white fluid erasures or overwriting except as necessary to correct errors made by the Bidder, in which case such correction shall be initialled by the person or persons who has / have digitally signed the Bid.

12.1.4 Any Bid, which is incomplete, ambiguous, or not in compliance with the Bidding process shall be rejected.

12.2. Submission of bids

The tender is processed under **Single Stage Two-Bid System**. Bidder shall submit the technical bid and Priced bid along with all the Annexures and Proforma (wherever applicable) and copies of documents in electronic form through OIL's e-procurement portal within the Bid Closing Date & Time stipulated in the e-tender. For submission of Bids online at OIL's E-Tender Portal, detailed instructions are available in "User Manual" available in OIL's E-Tender Portal. Guidelines for bid submission are also provided in the "Forwarding Letter". The Technical Bid is to be submitted as per Terms of Reference/Technical Specifications of the bid document and Priced Bid as per the Price Schedule. The Technical Bid should be uploaded in the "Technical Attachment" Tab Page only. Prices to be quoted as per Price Bid Format and should be uploaded as 'Attachment' under "Notes & Attachments" Tab. No price should be given in the "Technical Attachment", otherwise bid shall be rejected. The priced bid submitted in physical form shall not be considered. However, the following documents in one set should necessarily be submitted in physical form in sealed envelope super-scribing the Tender no., Brief Description of services

and Bid Closing/Opening date & Time along with the bidder's name and should be submitted to Senior Manager (BD), BD Department, Oil India Limited, Plot No. 19, Sector 16-A, Noida-201301, Uttar Pradesh, India. on or before 12:45 Hrs (IST) on the bid closing date indicated in the IFB:

a) Printed catalogue and literature if called for in the bid document.
b) Copy of EMD
c) Any other document required to be submitted in original as per bid document.
d) Documents sent through E-mail / Fax / Telephonic method will not be considered.

12.2.1 All the conditions of the contract to be made with the successful bidder are given in various Sections of the Bid Document. Bidders are requested to state their non- compliance to each clause as per **PROFORMA-II** of the bid document and the same should be uploaded along with the Technical Bid.

12.2.2 Timely delivery of the documents in physical form as stated in Para 12.2 above is the responsibility of the bidder. Bidders should send the same through Registered Post or by Courier Services or by hand delivery to the Officer in Charge of the particular tender before the Bid Closing Date and Time. Company shall not be responsible for any postal delay/transit loss.

12.2.3 Bids received through the e-procurement portal shall only be accepted. Bids received in any other form shall not be accepted.

13 DEADLINE FOR SUBMISSION OF BIDS

13.1. Bids should be submitted online as per the online tender submission deadline. Bidders will not be permitted by System to make any changes in their bid/quote after the bid submission deadline is reached. Bidders are requested to take note of this and arrange to submit their bids within the submission deadline to avoid last minute rush/network problems

13.2. No bid can be submitted after the submission deadline is reached. The system time displayed on the e-procurement web page shall decide the submission deadline.

13.3. The documents in physical form as stated in Para 12.2 must be received by the Company at the address specified in the "Forwarding Letter" on or before 12:45 Hrs. (IST) on the Bid Closing Date mentioned in the "Forwarding Letter". Timely delivery of the same at the address mentioned in the Forwarding Letter is the responsibility of the Bidders.

14 LATE BIDS

Bidders are advised in their own interest to ensure that their bids are uploaded in system much before the closing date and time of the bid. The documents in physical form if received by the Company after

the deadline for submission prescribed by the Company shall be rejected and shall be returned to the Bidders in unopened condition immediately.

15 MODIFICATION AND WITHDRAWAL OF BIDS

15.1. The Bidder after submission of Bid may modify or withdraw its Bid prior to Bid Closing Date & Time in the e-portal using Digital Signature by the person or persons who has / have digitally signed the Bid. Withdrawal or modification of bid through physical correspondence shall not be considered and accepted.

15.2. No Bid can be modified or withdrawn subsequent to the deadline for submission of Bids.

15.3. No Bid can be withdrawn in the interval between the deadline for submission of Bids and the expiry of the period of Bid Validity specified by the Bidder on the Bid Form. Withdrawal of a Bid during this interval by a Bidder shall be debarred from participation in future tenders of OIL.

16 EXTENSION OF BID SUBMISSION DATE

Normally no request for extension of Bid Closing Date & Time will be entertained. However, OIL at its discretion, may extend the Bid Closing Date and / or Time due to any reasons.

17 BID OPENING AND EVALUATION

17.1. Company will open the Bids, including submission made pursuant to Clause 12.0, in presence of Bidder's representatives who choose to attend at the date, time and place mentioned in the Forwarding Letter. However, an authorization letter (as per PROFORMA- III) from the Bidder must be produced by the Bidder's representative at the time of Bid Opening. Unless this Letter is presented, the representative will not be allowed to attend the Bid Opening. The Bidder's representatives who are allowed to attend the Bid Opening shall sign a register evidencing their attendance. Only one representative against each Bid will be allowed to attend.

17.2. In technical bid opening, only "Technical Attachment" will be opened. Bidders therefore should ensure that technical bid is uploaded in the "Technical Attachment" Tab Page only in the E-portal.

17.3. In case of any unscheduled holiday or Bandh on the Bid Opening Date, the Bids will be opened on the next full working day. Accordingly, Bid Closing Date / time will get extended up to the next working day and time.

17.4. Bids which have been withdrawn pursuant to Clause 15 shall not be opened. Company will examine bids to determine whether they are complete, whether requisite Bid Security

Declarations have been furnished, whether documents have been digitally signed and whether the bids are generally in order.

17.5. At bid opening, Company will announce the Bidder's names, written notifications of bid modifications or withdrawal, if any, the presence of requisite Bid Security Declaration and such other details as the Company may consider appropriate.

17.6. Normally no clarifications shall be sought from the Bidders. However, for assisting in the evaluation of the bids especially on the issues where the Bidder confirms compliance in the evaluation and contradiction exists on the same issues due to lack of required supporting documents in the Bid (i.e. document is deficient or missing), or due to some statement at other place of the Bid (i.e. reconfirmation of confirmation) or vice versa, clarifications may be sought by OIL. In all the above situations, the Bidder will not be allowed to change the basic structure of the Bid already submitted by them and no change in the price or substance of the Bid shall be sought, offered or permitted.

17.7. Prior to the detailed evaluation, Company will determine the substantial responsiveness of each bid to the requirement of the Bid Documents. For purpose of these paragraphs, a substantially responsive bid is one, which conforms to all the terms and conditions of the Bid Document without material deviations or reservation. A material deviation or reservation is one which affects in any substantial way the scope, quality, or performance of work, or which limits in any substantial way, in-consistent way with the Bid Documents, the Company's right or the bidder's obligations under the contract, and the rectification of which deviation or reservation would affect unfairly the competitive position of other bidders presenting substantial responsive bids. The Company's determination of Bid's responsiveness is to be based on the contents of the Bid itself without recourse to extrinsic evidence.

17.8. A Bid determined as not substantially responsive will be rejected by the Company and may not subsequently be made responsive by the Bidder by correction of the non- conformity.

17.9. The Company may waive minor informality or nonconformity or irregularity in a Bid, which does not constitute a material deviation, provided such waiver, does not prejudice or affect the relative ranking of any Bidder.

18 OPENING OF PRICED BIDS

18.1. Company will open the Priced Bids of the techno-commercially qualified Bidders on a specific date in presence of representatives of the qualified bidders. The techno-commercially qualified Bidders will be intimated about the Priced Bid Opening Date & Time in advance.

18.2. In case of any unscheduled holiday or Bandh on the Priced Bid Opening Date, the Bids will be opened on the next working day.

18.3. The Company will examine the Price quoted by Bidders to determine whether they are complete, any computational errors have been made, the documents have been properly signed, and the bids are generally in order.

18.4. Arithmetical errors will be rectified on the following basis. If there is a discrepancy between the unit price and the total price (that is obtained by multiplying the unit price and quantity) the unit price shall prevail and the total price shall be corrected accordingly. If there is a discrepancy between words, and figures, the amount in words will prevail. If any Bidder does not accept the correction of the errors, their Bid will be rejected.

19 EVALUATION AND COMPARISON OF BIDS

The Company will evaluate and compare the bids as per BEC-BRC of the Tender Documents.

20 DISCOUNTS / REBATES

20.1. Unconditional discounts / rebates, if any, given in the bid will be considered for evaluation.

20.2. Post bid or conditional discounts / rebates offered by any bidder shall not be considered for evaluation of bids. However, if the lowest bidder happens to be the final acceptable bidder for award of contract, and if they have offered any discounts / rebates, the contract shall be awarded after taking into account such discounts/rebates.

21 CONTACTING THE COMPANY

21.1. Except as otherwise provided in Clause 17.0 above, no Bidder shall contact Company on any matter relating to its bid, from the time of the bid opening to the time the Contract is awarded except as required by Company vide sub-clause 17.6.

21.2. An effort by a Bidder to influence the Company in the Company's bid evaluation, bid comparison or Contract award decisions may result in the rejection of their bid.

22 AWARD OF CONTRACT

Award criteria: The Company will award the Contract to the successful Bidder as per the evaluation criteria mentioned under BEC-BRC of the tender document, provided further that the Bidder is determined to be qualified to perform the Contract satisfactorily.

23 COMPANY'S RIGHT TO ACCEPT OR REJECT ANY BID

Company reserves the right to accept or reject any or all bids and to annul the bidding process and reject all bids, at any time prior to award of contract, without thereby incurring any liability to the affected bidder, or bidders or any obligation to inform the affected bidder of the grounds for Company's action.

24 NOTIFICATION OF AWARD

24.1. Prior to the expiry of the period of bid validity or extended validity, Company will notify the successful Bidder in writing by registered letter or by fax or E-mail (to be confirmed in writing by registered / couriered letter) that its Bid has been accepted.

24.2. The notification of award will constitute the formation of the Contract.

24.3. Upon the successful Bidder's furnishing of Performance Security pursuant to Clause 25 below, the Company will promptly notify each unsuccessful Bidder.

25 PERFORMANCE SECURITY

25.1. Successful bidder has to submit Performance Security amount as mentioned in Forwarding Letter, within Thirty (30) from the date of issue of Letter of Award (LOA).

25.1.1. The Performance Security should be submitted in the form of irrevocable Bank Guarantee (as per **Annexure-8**) issued by Nationalized or Scheduled Bank in favour of M/s. Oil India Limited and payable at Noida/Delhi. The Bank Guarantee must be on Non-Judicial Stamp Paper of requisite value as per Indian Stamp Act purchased in the name of Banker. Duly filled 'Undertaking' towards details of BG (Format attached in tender) must be submitted along with original copy of PBG.

25.1.2. Alternately, the Performance Security can also be paid through Bank Draft/Cashier's Cheque/Banker's Cheque / Fixed Deposit Receipt (Account OIL INDIA LIMITED) / irrevocable Letter of Credit/NEFT/RTGS/ Electronic Fund Transfer (subject to credit in OIL's account within prescribed time) to designated account of OIL.

a. If the Performance Security is submitted in the form of Bank Draft, Banker's Cheque, Cashier's Cheque, Fixed Deposit Receipt or Letter of Credit, the same should be in favour of "Oil India Limited" payable at Noida/Delhi.

b. Performance Security amount through NEFT or RTGS mode may be deposited on or before bid closing date and time to the following designated OIL's bank account:

S. No.	Bank Details of Beneficiary: OIL INDIA LIMITED	
1.	Bank Name	STATE BANK OF INDIA
2.	Branch Name	CAG BRANCH II, New Delhi

3.	Branch Address	4TH AND 5TH FLOOR, REDFORT CAPITAL PARSVNATH TOWERS, BHAI VEER SINGH MARG, GOLE MARKET, NEW DELHI-110001
4.	Bank Account No.	**30192825337**
5.	Type of Account	Cash Credit/Overdraft
6.	IFSC Code	**SBIN0017313**
7.	MICR Code	110002562

c. If the Performance security is submitted through NEFT or RTGS mode, the bidder shall submit details such as UTR No., Contract No., Bidder's name & Deposited Amount etc.

25.1.3. Submission of Bid Security in the form of Electronic Bank Guarantee (e-BG):

Bidders/Contractors are advised to submit the e-BG from any of the list of approved banks whose details are provided in **Annexure-3** which are presently providing facility to issue an e-BG.

BENEFICIARY DETAILS FOR ISSUE OF ELECTRONIC BANK GUARANTEE (e-BG)		
A.	Name	OIL INDIA LIMITED
B.	PAN	AAACO2352C
C.	Date of Incorporation	18-02-1959
D.	Email-ID	bintymasharma@oilindia.in
E.	Mobile No.	8876752701
F.	Local Address	OIL House, Plot No. 19, Sector-16A, Noida, Uttar Pradesh-201301
G.	Registered address	Duliajan, Dibrugarh, Assam-786602

25.1.4. In case of Bidders submitting Performance Security in the form of Bank Guarantee/Bank Draft/Cashier's Cheque/Banker's Cheque/Fixed Deposit Receipt/Letter of Credit, the original hard copy of Performance Security shall be submitted within the time frame as stipulated in the LOA.

25.1.5. In case of Bidders submitting Performance Security in the form of Fixed/Term Deposit, bidders have to submit a declaration as per the format prescribed in **PROFORMA-XI**. Further, the bidder may arrange the confirmation mail regarding issue of fixed deposit with the following details directly from bank's official e-mail id to Oil India's following e-mail id dtarafder@oilindia.in and bintymasharma@oilindia.in.

FD No.	Issue Date	Maturity Date	FD Amount	Beneficiary/ Contractor Name	Whether Above Pledged in Favour of 'Oil India Limited' (Yes/No)	FD Amount Pledged (in ₹) as Per Bank's Book of Accounts	Mode of FD Renewal (Auto Renewal/ Auto closure)	Remarks (if any) of the issuing Bank

25.1.6. No other mode of payment other than the mode covered under point nos. a & b will be accepted by the Company.

25.2. Performance Security shall not accrue any interest during its period of validity or extended validity.

25.3. The Bank Guarantee issuing bank branch must ensure the following:

The Bank Guarantee issued by the bank must be routed through SFMS platform as per the following details:

25.3.1. MT 760/MT 760 COV for issuance of bank guarantee.

25.3.2. MT 760/MT 767 COV for amendment of bank guarantee.

[Contract Number should reflect in the SFMS text under MT 760/MT 760 COV]

The above message / intimation shall be sent through SFMS (indicating the Contract Number) by the BG issuing bank branch to HDFC Bank Limited, E-13/29 IFS Code –HDFC0000003; SWIFT Code – HDFCINBB; Branch Address: HDFC Bank Limited, E-13/29, 2nd Floor, Harsha Bhavan, Middle Circle, Connaught Place, New Delhi 110001.

a) Bank Guarantee issued by a Scheduled Bank in India at the request of some other Non-Scheduled Bank of India shall not be acceptable.

b) Further correspondence against BG towards Performance Security must contain the Contract Number.

25.4. This Performance Security must be valid for **90 (Ninety) days** after the date of expiry of the contract period/defect liability period (if any). In the event of contract being extended within the provisions of the contract agreement, the contractor will have to extend suitably the validity of the "Security Deposit" for the extended period.

25.5. The Performance Security Deposit will be refunded to the Contractor after **90 (Ninety) days** of satisfactory completion of works/defect liability period (if any) under the contract (including extension, if any), but a part or whole of which shall be used by the Company in realization of

liquidated damages or claims, if any or for adjustment of compensation or loss due to the Company for any reason.

26 SIGNING OF CONTRACT

26.1. At the same time as the Company notifies the successful Bidder that its Bid has been accepted, the Company will either call the successful Bidder for signing of the agreement or send the Contract Form provided in the Bid Documents, along with the General & Special Conditions of Contract, Technical Specifications, Schedule of Rates incorporating all agreements agreed between the two parties.

26.2. The successful Bidder shall sign and date the contract and return it to the Company after receipt of LOA. Till the contract is signed, the LOA issued to the successful bidder shall remain binding amongst the two parties.

26.3. In the event of failure on the part of the successful Bidder to sign the contract, OIL reserves the right to terminate the LOA issued to the successful Bidder and invoke the Performance Security if submitted by the successful Bidder. In case the Bidder fails to sign the contract or submit the Performance Security within the stipulated time as defined in the tender document, Oil India Limited will suspend the Bidder for a period of two years without conducting any enquiry.

27 CREDIT FACILITY

Bidders should indicate clearly in the Bid about availability of any credit facility inclusive of Government-to-Government credits indicating the applicable terms and conditions of such credit.

28 MOBILIZATION AND ADVANCE PAYMENT

28.1. Request for advance payment shall not be normally considered. However, depending on the merit and at the discretion of the Company, advance against Commencement of work charge may be given at an interest rate of 1% above the prevailing Bank rate (CC rate) of SBI from the date of payment of the advance till recovery / refund.

28.2. Advance payment agreed to by the Company shall be paid only against submission of an acceptable bank guarantee whose value should be equivalent to the amount of advance plus the amount of interest covering the period of advance. Bank guarantee shall be valid for 2 months beyond completion of Commencement of work and the same may be invoked in the event of Contractor's failure to mobilize as per agreement.

28.3. In the event of any extension to the Commencement of work period, Contractor shall have to enhance the value of the bank guarantee to cover the interest for the extended period and also to extend the validity of bank guarantee accordingly.

29 INTEGRITY PACT

29.1. OIL shall be entering into an Integrity Pact with the Bidders as per format enclosed vide Annexure-2 of the Bid Document. The Integrity Pact has been duly signed digitally by OIL's competent signatory and uploaded in the OIL's e-portal. The Integrity Pact shall be returned by the bidder (along with the technical Bid) duly signed by the same signatory who signed the Bid i.e. who is duly authorized to sign the Bid. Uploading the Integrity Pact in the OIL's E-portal with digital signature will be construed that all pages of the Integrity Pact have been signed by the bidder's authorized signatory who has signed the bid. If any bidder refuses to sign Integrity Pact or declines to submit the Integrity Pact, their bid shall be rejected straightway.

29.2. In the event of any dispute between the management and the contractor relating to those contracts where Integrity Pact is applicable, in case, both the parties are agreeable, they may try to settle dispute through mediation before the panel of Independent External Monitors (IEMs) in a time bound manner. If required, the organizations may adopt any mediation rules for this purpose. In case, the dispute remains unresolved even after mediation by the panel of IEMs, the organization may take further action as per the terms and conditions of the contract.

29.3. Bidders may contact the Independent External Monitors for any matter relating to the IFB at the following addresses:

a) Shri Radhakrishna Kini A, IPS (Retd.)
E-mail: arvkini2004@yahoo.co.in & arvkini2004@gmail.com

b) Dr. Ved Prakash, ITS (Retd.)
E-mail: ved60prakash@gmail.com

c) Shri Ajit Mohan Sharan, IAS (Retd.), Former Secretary, Ministry of Ayush, Govt. of India,
E-mail: ams057@gmail.com

30 LOCAL CONDITIONS

It is imperative for each Bidder to be fully informed themselves of all Indian as well as local conditions, factors and legislation which may have any effect on the execution of the work covered under the Bidding Document. The bidders shall be deemed, prior to submitting their bids to have satisfied themselves of all the aspects covering the nature of the work as stipulated in the Bidding Document and obtain for themselves all necessary information as to the risks, contingencies and all other circumstances, which may influence or affect the various obligations under the Contract.

No request will be considered for clarifications from the Company (OIL) regarding such conditions, factors and legislation. It is understood and agreed that such conditions, factors and legislation have been properly investigated and considered by the Bidders while submitting the Bids. Failure to do so shall not relieve the Bidders from responsibility to estimate properly the cost of performing the work within the provided timeframe. Company (OIL) will assume no responsibility for any understandings

or representations concerning conditions made by any of their officers prior to award of the Contract. Company (OIL) shall not permit any Changes to the time schedule of the Contract or any financial adjustments arising from the Bidder's lack of knowledge and its effect on the cost of execution of the Contract.

31 SPECIFICATIONS

Before submission of Bids, Bidders are requested to make themselves fully conversant with all Conditions of the Bid Document and other relevant information related to the works / services to be executed under the contract.

32 GOODS & SERVICES TAXES

32.1. In view of GST Implementation from 1st July 2017, all taxes and duties including Excise Duty, CST / VAT, Service tax, Entry Tax and other indirect taxes and duties have been submerged in GST. Accordingly, reference of Excise Duty, Service Tax, VAT, Sales Tax, Entry Tax or any other form of indirect tax except of GST mentioned in the bidding document shall be ignored.

Bidders are required to submit copy of the GST Registration Certificate while submitting the bids wherever GST (CGST & SGST / UTGST or IGST) is applicable.

32.2. Bidder should also mention the Harmonised System of Nomenclature (HSN) and Service Accounting Codes (SAC) at the designated place in the Price Bid Format.

32.3. Where the OIL is entitled to avail the input tax credit of GST:

OIL will reimburse the GST to the Supplier of Goods / Services (Service Provider) at actual against submission of Invoices as per format specified in rules/ regulation of GST to enable OIL to claim input tax credit of GST paid. In case of any variation in the executed quantities, the amount on which the GST is applicable shall be modified in same proportion. Returns and details required to be filled under GST laws & rules should be timely filed by supplier with requisite details.

The input tax credit of GST quoted shall be considered for evaluation of bids, as per evaluation criteria of tender document.

32.4. Where the OIL is not entitled to avail/take the full input tax credit of GST:

OIL will reimburse GST to the Supplier of Goods / Services (Service Provider) at actual against submission of Invoices as per format specified in rules / regulation of GST subject to the ceiling amount of GST as quoted by the bidder. In case of any variation in the executed quantities (If directed and / or certified by the In-Charge) the ceiling amount on which GST is applicable will be modified on pro-rata basis.

The bids will be evaluated based on total price including GST.

32.5. It is the responsibility of the bidder to quote the correct GST rate. The classification of goods / services as per GST (Goods & Service Tax) Act should be correctly done by the contractor to ensure that input tax credit on GST (Goods & Service Tax) is not lost to the OIL on account of any error on the part of the contractor.

32.6. Further, it is the responsibility of the bidders to make all possible efforts to make their accounting / IT system GST compliant in order to ensure availability of Input Tax Credit (ITC) to Oil India Ltd.

32.7. GST liability, if any, on account of supply of free samples against any tender shall be to bidder's account.

32.8. In case the bidder is covered under Composition Scheme under GST laws, then bidder should quote the price inclusive of the GST (CGST & SGST / UTGST or IGST). Further, such bidder should mention "Cover under composition system" in column for GST (CGST & SGST/UTGST or IGST) of price schedule.

32.9. OIL will prefer to deal with registered supplier of goods / services under GST. Therefore, bidders are requested to get themselves registered under GST, if not registered yet. However, in case any unregistered bidder is submitting their bid, their prices will be loaded with applicable GST while evaluation of bid. Where OIL is entitled for input credit of GST, the same will be considered for evaluation of bid as per evaluation methodology of tender document.

32.10. Procurement of Specific Goods: Earlier, there is no tax incidence in case of import of specified goods (i.e. the goods covered under List-34 of Customs Notification no. 12/2012-Cus dated. 17.03.2012 as amended). Customs duty is not payable as per the policy. However, under GST regime, IGST Plus GST compensation cess (if applicable) would be leviable on such imports. Bidders should quote GST as inclusive considering IGST component for the imported Materials portion while quoting their prices on destination basis. However, GST rate to be specified in the price bid format.

32.11. The Supplier of Goods / Services may note the Anti-profiteering Clause (Clause No. 12.5) of Part-I GCC and quote their prices accordingly.

32.12. In case the GST rating of bidder on the GST portal / Govt. official website is negative / blacklisted, then the bid may be rejected by OIL.

End of section-II

Section - III Bid Eligibility Criteria

Table of Contents

1 GENERAL CONFORMITY 40
1.1 Vital Criteria for Bid Acceptance 40
2 ELIGIBILTY CRITERIA 40
3 TECHNICAL EVALUATION CRITERIA 41
3.1 Experience of the Bidder 41
4 FINANCIAL EVALUATION CRITERIA 42
4.1 General Requirements 42
4.2 Notes to Financial Evaluation Criteria 43
5 COMMERCIAL EVALUATION CRITERIA 44
5.1 General Requirements 44
6 PRICE EVALUATION CRITERIA 49
6.1 General Requirements 49
6.2 General Notes 52
7 PURCHASE PREFERENCE CLAUSE 54
7.1 Purchase Preference to MSE Bidders 54
7.2 Purchase Preference Policy (Linked with Local Content) (PP- LC) 54
8 AWARD OF CONTRACT 54
9 DOCUMENT AUTHENTICITY UNDERTAKING 54
10 COMPLIANCE OF THE COMPETITION ACT, 2002 54

1 GENERAL CONFORMITY

The bid shall conform to the specifications and terms and conditions given in the Bidding Documents. Bids will be rejected in case material and services offered do not conform to the required parameters stipulated in the technical specifications. Notwithstanding the general conformity of the bid to the stipulated specifications, the following requirements will have to be particularly met by the Bidders without which the same will be considered as non-responsive and will not be considered for evaluation. All the documents related to BEC shall be submitted along with the Technical Bid and details of documents with reference to page and clause number should be provided in **BRS 2** – Technical evaluation sheet for BEC.

1.1 Vital Criteria for Bid Acceptance

The bid shall conform generally to the specifications and terms and conditions given in the Bid Documents. Bidders are advised not to take any exception/ deviation to the Bid Documents. Exceptions/Deviations, if any, should be brought out during the Pre-Bid Conference as scheduled against this Tender. After processing such suggestions, Company may communicate the changes, if any, through an addendum to the tender document in this regard. Still, if any exceptions/deviations are maintained in the bid, such conditional/ nonconforming bids shall not be considered, but shall be liable for rejection.

2 ELIGIBILTY CRITERIA

The bidder must be incorporated in India and must maintain more than or equal to 20% local content (LC) for the offered services to be eligible to bid against this tender.

Regarding calculation of local content and submission of documents during bidding & execution of contracts, provision of Public Procurement (Preference to Make in India) Order, 2017 of Department for Promotion of Industry and Internal Trade (DPIIT), Govt. of India as revised vide Order No. P-45021/2/2017-PP (BE-II) dated 16th September 2020 (and as amended time to time) with modifications as notified vide MoPNG Order No. FP20013/2/2017-FP-PNG-Part (4) (E-41432) dated 26th April 2022 (including subsequent amendments thereof, if any) shall be applicable.

If such local content is not maintained during execution of contract, OIL reserves the right to invoke the Performance Securities and additional Bank Guarantee submitted by the bidding and supporting companies, in addition to resorting to other options as may be deemed appropriate.

Whether or not the bidders want to avail PP-LC benefit against this tender, it is mandatory for them to meet the following at the bidding stage.

a) The bidder must provide the specific percentage (%) of local content in their bid, without which the bid is liable for rejection being non-compliant.
b) The Bidder shall submit an undertaking from the authorized signatory of bidder having the Power of Attorney along with the bid specifying the LC Percentage and such undertaking shall become a part of the contract, if awarded [Format enclosed].

c) The aforesaid undertaking of the bidder shall also be supported by a certificate from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of other than companies) giving the percentage of local content.

d) Bidder to submit a copy of their Certificate of Incorporation/ Registration in India.

3 TECHNICAL EVALUATION CRITERIA

3.1 Experience of the Bidder

For demonstrating technical competence and experience (the "technical capacity"), the Bidder shall have undertaken "Similar Works" in in the capacity of Developer/EPCOM such as,

3.1.1 Shall have prior experience of setting up and operation and maintenance of MSW waste to Biogas/Bio-CNG plant including ETP in last 10 Financial years of following capacity. The said Plant should be in operation at the time of bidding.

- One plant of minimum **160 TPD** Feedstock capacity

OR

- Two plants of minimum **100 TPD** Feedstock capacity

OR

- Three plants of minimum **80 TPD** Feedstock capacity

Shall have prior experience of operation and maintenance of MSW to Biogas/Bio-CNG plant including ETP of a minimum capacity of 80 TPD plant for at least 1 (one) year of O&M experience in last 10 Financial years.

a) **Definition of Developer**

"Developer means the Company responsible for Design, Engineering, Financing, Construction, Procurement, Installation, Commissioning **and Operation & Maintenance (O&M)** of the Biogas/ CBG Project based on Municipal Solid Waste (MSW) as feed stock at single location and Operation & Maintenance (O&M) for the same plant in India as on date of bid submission.

For Operation & Maintenance experience, the developer should be the O&M service provider of its own constructed plant or by their own subsidiary shall also be allowed.

b) **Definition of EPCOM**

"EPCOM means the Company which has experience for Design, Engineering, Construction, Procurement, Installation, Commissioning **and Operation & Maintenance (O&M)** of the Biogas/ CBG Project based on MSW as feed stock executed in India, and Operation & Maintenance (O&M) for the same plant.

For Operation & Maintenance experience, the EPCOM should be the O&M service provider of its own constructed plant or by their own subsidiary shall also be allowed.

c) **Definition of Similar Work**

Design, Engineering, Construction, Procurement, Installation, Commissioning of Biogas/CBG Project based on MSW as feed stock, executed at single location and **successful 12 (Twelve) months of** operation and maintenance of the same plant with single point responsibility.

3.1.2 Notes on BEC Clause 3 above:

a) For proof of requisite experience, the following documents must be submitted along with the bid.

i. Copy of Concession Agreement or contract document or work order documents showing details of work.

AND

ii. Completion Certificate showing gross value of the job/service, description of job/service and duration of the contract.

OR

Bank statement for payment received against invoice (s) raised for the work/TDS certificate.

b) Only Letter of Intent (LOI)/Letter of Award (LOA) or Work Order(s) are not acceptable as evidence of experience.

c) Mere award of contract(s) will not be counted towards experience. Successful completion of the awarded contract(s) to the extent of volume/period, as stipulated under Clause Nos. 3.1 will only be treated as acceptable experience.

d) Bid will be rejected if not accompanied with adequate documentary proof in support of Work experience as mentioned in Clause 3.1 above.

e) The Bidder is allowed to use the experience of O&M contractor who are Parent or Subsidiary company of the bidding entity having a minimum of 51% stake in the company.

f) Sub-contract orders shall not be acceptable/considered in support of Past Experience Criteria

4 FINANCIAL EVALUATION CRITERIA

Following financial criteria shall be met by the bidder:

4.1 General Requirements

4.1.1 The bidder must have annual financial turnover from operation of **Rs. 36,28,57,200.00** in any of the preceding three (3) financial years reckoned from the original bid closing date as per the Audited Annual Reports.

[**Annual Financial Turnover from Operation of the bidder shall mean** - "Aggregate value of the realization of amount made from the sale, supply or distribution of goods or on

account of services rendered, or both, by the company (bidder) during a financial year" as per the Companies Act, 2013 Section 2 (91).]

4.1.2 The Net Worth of the Bidder must be positive for the financial/accounting year preceding the original Bid closing date.

[**Net worth shall mean** = Share capital + Reserves created out of profits and securities Premium – Aggregate value of accumulated losses (excluding revaluation reserves) – deferred expenditure – Miscellaneous Expenditure to the extent not written off and carried forward Loss - Reserves created out of write back of depreciation and amalgamation]

4.2 Notes to Financial Evaluation Criteria

4.2.1 For proof of Annual Financial Turnover & Net worth, any one of the following documents/photocopies must be submitted along with the bid:

a. A certificate issued by a practicing Chartered/Cost Accountant (with Membership Number and Firm Registration Number), certifying the Annual turnover & Net worth as per format prescribed in BRS-4.

OR

b. Audited Balance Sheet along with Profit & Loss account

Note: Mention of UDIN (Unique Document Identification Number) is mandatory for all Certificates issued w.e.f. February 1, 2019, by Chartered Accountant in Practice.

4.2.2 Considering the time required for preparation of Financial Statements, if the last date of preceding financial/accounting year falls within the preceding six months/within the due date for furnishing of audit report as per Section 139(1) of IT Act, 1961 (read along with latest circulars/notifications issued by CBDT from time to time) reckoned from the original bid closing date and the Financial Statements of the preceding financial/accounting year are not available with the bidder, then the financial turnover of the previous three financial/accounting years excluding the preceding financial/accounting year will be considered. In such cases, the Net worth of the previous financial/accounting year excluding the preceding financial/accounting year will be considered. However, the bidder has to submit an undertaking in support of the same along with their technical bid as per PROFORMA-X.

4.2.3 In case the bidder is a Central Govt. Organization/PSU/State Govt. Organization/ Semi-State Govt. Organization or any other Central/State Govt. Undertaking, where the auditor is appointed only after the approval of Comptroller and Auditor General of India and the Central Government, their certificates may be accepted even though FRN is not available. However, bidder to provide documentary evidence for the same.

4.2.4 In case the bidder is a Government Department, they are exempted from submission of document mentioned under para-a. and b. above.

4.2.5 Bid will be rejected if not accompanied with adequate documentary proof in support of Annual turnover & Net worth as mentioned in Para 4.0.

4.2.6 Only documents (Work Order, Completion certificate, etc.) which have been referred/specified in the bid shall be considered in reply to queries during evaluation of Bids.

5 COMMERCIAL EVALUATION CRITERIA

5.1 General Requirements

The following vital commercial criteria should be strictly complied, failing which the bid will be rejected:

5.1.1 **Power of Attorney:** Bidder must be a Single Person / Entity (whether Developer/ EPCOM / Indian Subsidiary of Foreign Supporting Company), the Power of Attorney (PoA) and Board Resolution , if required to be issued by the bidder in favour of the authorized employee(s), in respect of the particular tender, for purpose of signing the documents including bid, all subsequent communications, agreements, documents etc. pertaining to the tender and act and take any and all decision on behalf of the bidder shall be as per the constitution of the bidder as below:

a) In case of Proprietorship: by Proprietor
b) In case of Partnership: by all Partners or Managing Partner
c) In case of Public / Limited Company: PoA in favour of authorized employee(s) by Board of Directors through Board Resolution or by the designated officer authorized by Board to do so. Such Board Resolution should be duly countersigned by Company Secretary / MD / CMD / CEO

5.1.2 Bids from Limited Liability Partnership (LLP)/Joint Venture (JV)/Consortium are not acceptable.

5.1.3 Bids are to be submitted under Single-Stage Two-Bid System i.e., Un-priced Techno-Commercial Bid and Price Bid in their respective fields in e-tender portal. Only the price Bid should contain the quoted price. There should not be any indication of price in the Un-priced Techno-Commercial bid; otherwise, the bid shall be rejected straightway.

5.1.4 The price quoted by the successful bidder must be firm during the performance of the contract and not subject to variation on any account except as mentioned in the bid document. Any bid submitted with adjustable price quotation other than the above will be treated as non- responsive and rejected.

5.1.5 Bid Documents/User Id & Password for OIL's E-Tender portal are not transferable.

5.1.6 Any bid received in the form of Physical document/Telex/Cable/ Fax/E- mail will not be accepted.

5.1.7 Bids shall be typed or written in indelible ink. The bidder or his authorized representative shall sign the bid digitally, failing which the bid will be rejected.

5.1.8 Bids shall contain no interlineations, erasures or overwriting except as necessary to correct

errors made by bidder, in which case such corrections shall be initiated by the authorized signatory. However, white fluid should not be used for making corrections. Any bid not meeting this requirement shall be rejected.

5.1.9 Any bid containing false statement will be rejected and action will be taken by Company as per Bid Document.

5.1.10 Bids are invited under Single-Stage Two-Bid System i.e. Un-priced Techno- Commercial Bid and Price Bid separately. Bidders must submit both "Technical" and "Price" Bids in electronic form through online OIL's e-tender portal accordingly within the Bid Closing Date and time stipulated in the e- tender. The Technical Bid is to be submitted as per Scope of Work & Technical Specifications of the tender under "Technical Attachment" Tab and the Priced Bid as per the PRICE BID FORMAT attached under "Notes and Attachments".

5.1.11 Bidder must accept and comply with the following provisions as given in the Tender Document in toto, failing which offer will be rejected:

i. Firm price
ii. EMD/Bid Security/Bid Bond
iii. Period of validity of Bid
iv. Price Schedule
v. Performance Bank Guarantee/Security deposit
vi. Delivery/Completion Schedule
vii. Scope of work
viii. Guarantee of material/work
ix. Liquidated Damages clause
x. Tax liabilities
xi. Arbitration/Resolution of Dispute Clause
xii. Force Majeure
xiii. Applicable Laws
xiv. Specifications
xv. Integrity Pact

5.1.12 Bid received with validity of offer less than 120 (One Hundred Twenty) days from the date of Technical Bid opening will be rejected. Bidder must submit a declaration regarding bid validity as per the format prescribed in PROFORMA-I

5.1.13 Bid Security must be furnished (except those exempted) as a part of the Techno- Commercial Un-priced Bid. The amount of bid security should be as specified in the Forwarding Letter. Any bid not accompanied by a proper bid security will be rejected straightway.

Note:

- In case the Bidder submits Bid security in the form of Bank Guarantee (BG), the BG must be valid for minimum 165 days from the original bid closing date.
- In case of extension of Bid closing/ Opening Date, Bid Security validity should be extended suitably by the bidder, as and when advised by OIL.

5.1.14 The Integrity Pact is applicable against this tender. OIL shall be entering into an Integrity Pact with the bidders as per format enclosed vide ANNEXURE-2 of the tender document. This Integrity Pact Proforma has been duly signed digitally by OIL's competent signatory. The Proforma has to be returned by the bidder (along with the Un-Priced Techno-Commercial Bid) duly signed (digitally) by the same signatory who signed the bid, i.e., who is duly authorized to sign the bid. Uploading the Integrity Pact with digital signature will be construed that all pages of the Integrity Pact have been signed by the bidder's authorized signatory who sign the Bid.

5.1.15 **CERTIFICATION OF DOCUMENTS BY INDEPENDENT THIRD-PARTY INSPECTION AGENCIES (TPIA)**:

a) OIL INDIA LIMITED (OIL) has engaged the following 17 (Seventeen) Independent Inspection Agencies for a period of 04 (four) years with effect from 06.06.2028 to verify and certify various documents required against BEC of the tender:

Sl. No.	Name of Independent Inspection Agency	Contact E-mail ID
i.	M/s. Dr. Amin Controllers Pvt. Ltd.	a. rkjain@rcaindia.net b. Pradeep.mathur@rcaindia.net c. info@rcaindia.net
ii.	M/s. TUV India Private Limited	a. salim@tuv-nord.com b. mumbai@tuv-nord.com c. noida@tuv-nord.com
iii.	M/s. Conformity India International Private Limited	a. mktg@ciindia.in
iv.	M/s. Ravi Energie Private limited	a. baroda@ravienergie.com b. tpia@ravienergie.com
v.	M/s. SGS India Private Limited	a. dhaval.vora@sgs.com b. sgs.india@sgs.com
vi.	M/s. Assure Quality management Certification Services Private Limited	a. aqmcs@aqmcd.com
vii.	M/s. IRCLASS Systems and Solutions Private Limited	a. industrial_services@irclass.org b. Bhavesh.satam@irclass.org
viii.	M/s. TUV Rheinland (India) Pvt. Ltd.	a. Shailesh.deotale@ind.tuv.com b. Kaushal.gohil@ind.tuv.com c. info@ind.tuv.com

		d. ravi.kumar@ind.tuv.com
ix.	M/s. Gulf Llyod Industrial Services (I) Pvt. Ltd.	a. contact@gulfllloyds.com b. inspection@gulfllloyds.com
x.	M/s. Baltic Testing India Pvt. Ltd.	a. office@balticontrolindia.com
xi.	M/s. Sanmarg Engineering Validation & Assessment Pvt. Ltd.	a. Amrita@sanmargeva.com
xii.	M/s. Meenar Global Consultants LLP	a. sales@mgcllp.in
xiii.	M/s. Rites Limited	a. nrinspn@rites.com b. info@rites.com c. sbu.ninsp@rites.com
xiv.	M/s. Bureau Veritas (India) Private Limited	a. bvindia.corporate@bureauveritas.com
xv.	M/s. TÜV SÜD South Asia Pvt. Ltd.	a. Hemnat.chavan@tuvsud.com b. Jayashree.rane@tuvsud.com
xvi.	M/s. Adornment Engineers India Private Limited	a. jks@adornmentengineers.com
xvii.	M/s. TCRC Inspections Pvt. Ltd.	a. admin@tcrcinspections.com b. ashismallick@tcrcgroup.com a. tenders@tcrcgroup.com

b) Bidders are required to have their documents, as mandated under the Bid Evaluation Criteria (BEC) / Bid Rejection Criteria (BRC) of the tender, verified and certified by any one of the empanelled Independent Third-Party Inspection Agencies listed above. The Inspection Certificate, duly issued by the selected agency, must be submitted along with the Technical Bid. All costs related to verification and certification by the Third-Party Inspection Agencies shall be borne solely by the respective bidders. Payments in this regard shall be made directly by the bidders to the Inspection Agencies. OIL shall not be held responsible for any payment-related dispute between the bidders and the inspection agencies.

c) The verified and certified documents must be submitted along with the Technical Bid. Any bid submitted with un-verified supporting documents shall not be considered. However, in case a bidder submits its bid along with all relevant supporting documents as per BEC/BRC without getting all/some of them verified by the designated Independent Inspection agency, such bid can be provisionally considered, provided it is accompanied by an **Undertaking by the Bidder on their official letterhead towards submission of the duly verified and certified copies/**

Inspection Certificate within 07 (Seven) days from the actual date of bid opening. No reminders or clarifications will be issued by the Company in this regard, and failure to submit the verified/ certified documents within the stipulated time shall result in outright rejection of the bid , at the sole risk and responsibility of the bidder.

d) The methodology of verification/certification of documents followed by the agencies is broadly as under, but not limited to:

i. It is the sole responsibility of the bidders intending to participate in the tender to thoroughly understand the requirements of the tender, particularly the documents required under BEC/BRC. The bidders must present all relevant documents to any of the empanelled third-party certifying agencies for verification/certification. Neither OIL nor the Inspection Agencies shall be responsible for the selection or appropriateness of the documents submitted for verification. It is entirely the bidder's responsibility to ensure that the appropriate documents are verified/ certified in support of BEC/BRC compliance.

ii. The concerned Independent Third-Party Inspection Agencies shall depute their qualified/competent inspector to the Bidder's premises to check the original documents and certify the copies which the bidder shall submit along with their bids. OIL will reserve the right to ask the inspection agencies to verify the documents with source, if required at no extra cost to OIL. Verification/Certification of documents by OIL's empanelled third-party inspection agencies shall not automatically make the bidder techno-commercially-acceptable or eligible for award of contract.

iii. Verification/Certification of documents are normally categorized as under:

A. GENERAL REQUIREMENT:

- Check Bidder's PAN Card
- Check Bidder's GST Certificate
- Check Bidder's Certificate of Incorporation
- Power of Attorney

B. Additional Documents: (If applicable against the tender)

- Bidders general structure and organization
- Joint Ventures Agreements – To cross-check with JV Partners
- Consortium Agreements – To cross-check with Consortium Partners
- Holding/Parent/Subsidiary/Sister Subsidiary/Co-Subsidiary Company – To check the Share Holding pattern, Corporate Guarantee etc.

C. Technical Criteria

- To check Experience Proof- Completion Certificates, Reference contact verification, Original Work Order/Contract Copy and any other document(s), if called for vide BEC/BRC of the Tender.
- Health, Safety and Environmental Management Policy

D. Financial Criteria

- To check the Line of Credit, if incorporated in the tender.

NOTES:

I. Bidder's self-declared undertakings, Audited Balance Sheet & Profit-loss statement and/or CA certificate having UDIN are not required to be verified by the TPI agency. If any documents, LOI/LOA/Contracts, etc., submitted towards BEC/BRC experience criteria are issued by Oil India Limited, such documents need not be verified by TPI agency.

II. Undertaking from TPI Agency as per format (**Proforma-XV**) enclosed should be submitted along with the Bid.

III. In case of clarifications sought by OIL against BEC/BRC, supporting documents (historical in nature) to those submitted in the original bid will also have to be verified from the same TPI agency which has originally verified their bid documents. OIL shall categorically mention the documents that are to be submitted with TPI verification in the clarification sought. In case the bidder fails to submit the TPI verified documents, as sought by OIL, as part of their clarification, their offer will be liable for rejection.

6 PRICE EVALUATION CRITERIA

6.1 General Requirements

6.1.1 Price bids shall be opened in respect of only the techno-commercially acceptable bidders whose bids have been found to be substantially responsive. A substantially responsive bid is one that meets the terms and conditions of the Tender and / or the acceptance of which bid will not result in indeterminate liability on OIL.

6.1.2 Bidders are required to quote for all the items as per Price Bid Format, otherwise the offer of the bidder will be straightway rejected.

6.1.3 If there is any discrepancy between the unit price and the total price, the unit price will prevail, and the total price shall be corrected. Similarly, if there is any discrepancy between words and figure, the amounts in words shall prevail and will be adopted for evaluation.

6.1.4 The quantities shown against each item in the "Price Bid Format shall be considered for the purpose of Bid Evaluation. It is, however, to be clearly understood that the assumptions made in respect of the quantities for various operations are only for the purpose of evaluation of the bid and the Contractor shall be paid on the basis of the actual number of quantities consumed.

6.1.5 Service is not splitable. Based on the evaluation of techno-commercially qualified bidders, the entire scope of service will be awarded to the bidder with the lowest evaluated bid value (EBV) only, as explained in para 6.1.12.

6.1.6 The bidders are advised not to offer any discount/rebate separately and to offer their prices in the Price Bid Format after considering discount/rebate, if any.

6.1.7 Conditional and unsolicited discount will not be considered in evaluation. However, if such bidder happens to be the lowest recommended bidder, unsolicited discount without any condition will be considered for computing the contract price.

6.1.8 Initially the EBV shall be calculated till three decimals. In case of identical overall lowest offered rate by more than 1(one) bidder, the selection will be made by calculating the EBV beyond third decimal i.e. 4th or 5th.

6.1.9 OIL will prefer to deal with registered bidder under GST. Therefore, bidders are requested to get themselves registered under GST, if not registered yet. However, in case any unregistered bidder is submitting their bid, their prices will be loaded with applicable GST while evaluation of bid.

6.1.10 The bidders must quote their charges/rates in the manner as called for vide "Schedule of Rates" and the summarized price schedule format, otherwise the offer of the bidder will be straightway rejected.

6.1.11 Price Bid uploaded without giving any of the details of the taxes (Including rates and amounts) will be considered as inclusive of all taxes including GST. When a bidder mentions taxes as extra without specifying the rates & amount, the offer will be loaded with maximum value towards taxes received against the tender for comparison purposes. If the bidder emerges as lowest bidder after such loading, in the event of order on that bidder, taxes mentioned by OIL on the Purchase Order/Contracts will be binding on the bidder.

6.1.12 **Calculation for Estimated Bid Value (EBV):** The bids qualified in the PQ stage will only be further evaluated for stage financial evaluation. The financial evaluation shall be done by considering the following:

a) Total EPC Cost quoted by bidder (X1).
b) Present Value of Total O&M Cost, excluding grid electricity charges, of 10 years quoted by bidder. (X2).
c) Present Value of annual Electricity consumption Cost based on the guaranteed energy consumption per day as per BRS-7 quoted by bidder, and cost of electricity considered at **Rs. 7.00** per unit (kWh) with annual escalation @2% for 10 years (X3).
d) The Quantity of Biogas at inlet of purification system in Nm^3 per MT of Volatile Solid in the slurry feed to digester as guaranteed by the bidder for 10 years based on Volatile Solids as **36.736 MT** per day for evaluation purpose only (Y).
e) For calculation of present value, the discount factor shall be considered at 10% and the discount factor for PV is 10% (N)

Evaluated Bid Value (EBV) Rs. / Nm^3 = (X1+X2+X3) / Y

The bidder whose evaluated bid cost is the lowest will be selected for the award of contract. A sample calculation sheet is provided below for sake of clarity.

Illustrated Example: Sample Calculations for Evaluated Bid Value for CBG Project

Bidder	Bidder -1	Bidder-2	Bidder -3	Remarks
Plant Capacity MSW, TPD	200	200	200	As per Tender

Volatile Solids in Slurry feed to Digestor, T, TPD (For calculation purposes only)	36.736	36.736	36.736	
Quantity of Biogas at inlet of Purification System per MT of Volatile Solids, Nm^3	425	435	450	As Quoted by bidder
Total EPC Cost with GST (X1) Rs in lakh	13500	14500	15100	As Quoted by bidder
Total O&M Cost with GST in 1st Year (excluding Electricity charges) - Rs. in lakh	855	900	880	As Quoted by bidder
O&M Cost with GST for 10 Year - Rs. in lakh				
1	855	900	880	As quoted for 10 years
2	897.8	945.0	924.0	
3	942.6	992.3	970.2	
4	989.8	1041.9	1018.7	
5	1039.3	1094.0	1069.6	
6	1091.2	1148.7	1123.1	
7	1145.8	1206.1	1179.3	
8	1203.1	1266.4	1238.2	
9	1263.2	1329.7	1300.2	
10	1326.4	1396.2	1365.2	
PV of O&M Price(X2)	6997.1	7365.4	7201.7	Derived
Discounting Rate	10.00%	10.00%	10.00%	As per Tender
Electricity Consumption per day in kWh as guaranteed	8640	10500	9700	As Quoted by bidder
Electricity Consumption per Annum (365 days), in kWh	3153600	3832500	3540500	As Derived
Cost of Energy Rs. / kWh	7	7	7	As per Tender
Annual Increase in Electricity Charges	2%	2%	2%	As per Tender
Electricity Charges				
1	220.8	268.3	247.8	As derived for 10 years from first year
2	225.2	273.6	252.8	
3	229.7	279.1	257.8	
4	234.3	284.7	263.0	
5	238.9	290.4	268.3	
6	243.7	296.2	273.6	
7	248.6	302.1	279.1	
8	253.6	308.2	284.7	
9	258.6	314.3	290.4	

10	263.8	320.6	296.2	
PV of Total Energy Charges, Rs in Lakh (X3)	1608.8	1955.1	1806.2	Derived
Total Production of Biogas in 10 years at inlet of purification system in Nm^3 (Y)	56986720	58327584	60338880	Sum of 10 Years
EBV-Rs/Nm^3	38.791	40.839	39.954	(X1+X2+X3) / Y

6.2 General Notes

6.2.1 In case bidder takes exception to any clause of bidding document not covered under BEC/BRC, then the Company has the discretion to load or reject the offer on account of such exception if the bidder does not withdraw/modify the deviation when/as advised by company. The loading so done by the company will be final and binding on the bidders. No deviation will however be accepted in the clauses covered under BEC/BRC.

6.2.2 Bidders should provide self-attested copies of GST Registration Certificate, PAN Card, ESIC registration (if applicable), P.F. Registration Number OR Declaration (Declaration by applicant that provisions of Provident Fund Act are not applicable to them. In case P.F. is required to be deposited later on, the same will be deposited by the bidder (Applicant). In case successful bidder doesn't have P.F. Code at the time of bidding and PF Act is applicable on him/her, the same has to be provided by him/her before signing of contract agreement and issue of Work Order by OIL.

6.2.3 To ascertain the substantial responsiveness of the bid the Company reserves the right to ask the bidder for clarification in respect of clauses covered under BEC- BRC also and such clarifications fulfilling the BEC/BRC clauses in toto must be received on or before the deadline given by the Company, failing which the offer will be evaluated based on the original submission. However, mere submission of such clarification shall not make the offer responsive, unless Company is satisfied with the substantial responsiveness of the offer.

6.2.4 If any of the clauses in the BEC contradict with other clauses of tender document elsewhere, then the clauses in the BEC shall prevail.

6.2.5 Bidder(s) must note that requisite information(s)/financial values etc. as required in the BEC/BRC & Tender are clearly understandable from the supporting documents submitted by the Bidder(s); otherwise, Bids shall be rejected.

6.2.6 OIL will not be responsible for delay, loss or non-receipt of applications for participating in the bid sent by mail and will not entertain any correspondence in this regard.

6.2.7 The originals of such documents [furnished by bidder(s)] shall have to be produced by bidder(s) to OIL as and when asked for.

6.2.8 Bidders have to submit a declaration as per the format prescribed in PROFORMA -XVI regarding compliance of Safety Measures along with the technical bid.

6.2.9 Bidders have to submit a declaration as per the format prescribed in PROFORMA-X & XI regarding Financial Standing and not under Holiday List/ Delisted/ Blacklisted/Debarred in OIL respectively along with the technical bid.

6.2.10 Bid involving a party whose name is appearing in the prevailing list of banned/blacklisted vendors of OIL INDIA LIMITED shall be rejected outright.

6.2.11 Bids from such parties shall not be considered for award of contract but rejected outright, against whom restriction is imposed by Government of India (GOI) or due clearance is not granted by DGH/GOI. No correspondence whatsoever shall be entertained in this regard.

6.2.12 Bidders have to submit a duly filled CHECKLISTS FOR BEC-BRC enclosed as BRS-1, along with the technical bid.

7 PURCHASE PREFERENCE CLAUSE

7.1 Purchase Preference to MSE Bidders

Purchase Preference allowed as per Government Guidelines in Vogue and PPP [Public Procurement policy] for Micro and Small Enterprises is not applicable for this tender (being works contract tender).

7.2 Purchase Preference Policy (Linked with Local Content) (PP- LC)

7.2.1 PURCHASE PREFERENCE POLICY (PP-MII): Purchase preference under Public Procurement (Preference to Make in India) Order, 2017 of Department for Promotion of Industry and Internal Trade (DPIIT), Govt. of India and as amended time to time with modifications as notified vide MoPNG Order No. FP-20013/2/2017-FP-PNG-Part (4) (E-41432) dated 26th April 2022 (including subsequent amendments thereof, if any) shall not be applicable in this tender. As the Evaluated Bid Value will be used for ranking of the bidders and the EBV calculated is dependent on both the quoted price as well as the quoted quantity of biogas to be produced, PP-LC will not be applicable.

8 AWARD OF CONTRACT

The bidder whose evaluated bid cost is the lowest will be selected for the award of contract as per Para 6.1.12

9 DOCUMENT AUTHENTICITY UNDERTAKING

Bidders should note that Company (OIL) may verify authenticity of all the documents /certificates/ information submitted by the bidder(s) against the tender. In case at any stage of tendering process or Contract execution etc., if it is established that bidder has submitted forged documents/ certificates information towards fulfilment of any of the tender/contract conditions, Company shall immediately reject the bid of such bidder(s) or cancel/terminate the contract besides taking action as per OIL's Banning Policy, available in the OIL's website. Accordingly, service provider/vendor to submit the Undertaking of authenticity of information/ documents submitted as Proforma-VI.

10 COMPLIANCE OF THE COMPETITION ACT, 2002

The bidder shall strictly comply with the provisions of the Competition Act, 2002, more particularly, Section-3 of the Act. Any violation of the provisions of the Act shall attract penal action under the Act.

END OF SECTION-III

Section - IV General Conditions of Contract

Table of Contents

1 APPLICABILITY, DEFINITION & INTERPRETATION 59
1.1 Applicability 59
1.2 Definition & Interpretation 59
2 CONTRACT DOCUMENT 62
2.1 Governing language 62
2.2 Entire Agreement 62
2.3 Amendment in CONTRACT 62
3 WAIVERS AND AMENDMENTS 63
3.1 Waivers 63
3.2 Change Program 63
4 CONTRACT TIMELINE 63
4.1 Effective Date of Contract 63
4.2 Date of Commencement of Operation 63
4.3 Duration of the contract 63
5 SCOPE OF WORK/CONTRACT 63
6 GENERAL OBLIGATION OF CONTRACTOR 64
6.1 Requirements 64
7 GENERAL OBLIGATION OF COMPANY 64
7.1 Requirements 64
8 DUTIES AND POWER /AUTHORITY 65
8.1 OIL's site representative/engineer 65
8.2 CONTRACTOR's representative 65
9 PERSONNEL TO BE DEPLOYED BY CONTRACTOR 66
9.1 Requirements 66
10 PERFORMANCE SECURITY 66
10.1 Requirements 66
11 SIGNING OF CONTRACT 68
12 CLAIMS, TAXES & DUTIES 68
12.1 Claims 68
12.2 Notice of claims 69
12.3 Taxes 69
12.4 Goods and Services Tax 70
13 CUSTOMS DUTY, IF APPLICABLE 75
14 INSURANCE 75

14.1 General 75
14.2 Deductible 76
14.3 Waiver of subrogation 77
14.4 Loss Payee Clause 77
14.5 Additional Assured 77
14.6 Certificate of Insurance 77
14.7 Policy Lapse 78
14.8 On account payment to OIL in case of claim 78

15 LIABILITY 79
15.1 General Conditions 79

16 LIMITATION OF LIABILITY 80

17 LIABILITY OF UNION GOVERNMENT OF INDIA 81

18 CONSEQUENTIAL DAMAGE 81

19 RISK PURCHASE 81

20 INDEMNITY AGREEMENT 82

21 INDEMNITY APPLICATION 82

22 ROYALTY PATENTS 82

23 WARRANTY AND REMEDY OF DEFECTS 83

24 SUBCONTRACTING/ASSIGNMENT 83

25 RECORDS, REPORTS AND INSPECTION 83

26 CONFIDENTIALITY, USE OF CONTRACT DOCUMENTS AND INFORMATION 84

27 REMUNERATION AND TERMS OF PAYMENT 85
27.1 General conditions 85

28 PAYMENT OF COMMISSION/FEE/REMUNERATION OF INDIAN AGENT / CONSULTANT / REPRESENTATIVE / RETAINER / ASSOCIATE OF FOREIGN PRINCIPAL (APPLICABLE IN ICB TENDERS ONLY) 87

29 DETAILS OF STATUTORY PAYMENTS LIKE EPF AND ESI, ETC 87

30 TIMELY MOBILIZATION AND LIQUIDATED DAMAGES 88

31 FORCE MAJEURE 88

32 SET-OFF 89

33 WITHHOLDING 90

34 APPLICABLE LAWS 91

35 LABOUR LAWS 92

36 STATUTORY REQUIREMENTS 93

37 GENERAL HEALTH, SAFETY & ENVIRONMENT (HSE) GUIDELINES 93

38 POLLUTION AND CONTAMINATION 94

39 STATUTORY VARIATION/NEWLY ENACTED LAW 94

40 SEVERABILITY 96

41 COMMISSION OF MISCONDUCT / SUBMISSION OF FRAUDULENT DOCUMENT BY THE BIDDER / CONTRACTOR AND BANNING THEREOF 96

42 SETTLEMENT OF DISPUTES 96

42.1 Resolution of Dispute through SAC 96

42.2 Arbitration (Applicable for Suppliers/Contractors other than PSU and MSME) 97

42.3 Arbitration (applicable in case of Contract awarded on Public Sector Enterprise) 99

42.4 Arbitration (Applicable to Micro, Small and Medium Enterprise) 99

42.5 Exclusions 99

43 COMPLETION OF CONTRACT 100

44 TERMINATION 100

44.1 General Conditions 100

45 TO DETERMINE THE CONTRACT 102

46 WITHOUT DETERMINING THE CONTRACT 102

47 ERRING/DEFAULTING AGENCIES 102

48 MISCELLANEOUS PROVISIONS 102

1 APPLICABILITY, DEFINITION & INTERPRETATION

1.1 Applicability

All clauses in the General Conditions of Contract [GCC] shall apply to all transactions except as otherwise stated in the Special Conditions of Contract [SCC] and/or BEC-BRC. Furthermore, in the event if there is any conflict between the principal text of the Agreement and the Appendixes, the Principal text will prevail.

1.2 Definition & Interpretation

In the contract (as hereinafter defined) the following words and expressions shall have the meaning hereby assigned to them except where the context otherwise requires.

1.2.1 **COMPANY/OIL/Operator:** Shall mean Oil India Limited [OIL] a public sector undertaking, incorporated under COMPANY's Act 1956 having its registered office at Duliajan-786602, Assam, India and includes its successor and permitted assigns.

1.2.2 **CONTRACTOR:** Shall mean the person or persons, firm or COMPANY or corporation incorporated in India or abroad, who has been awarded with the contract and includes contractor's legal representatives, his successors and permitted assigns.

1.2.3 **Contract:** Shall mean a written agreement between the COMPANY and the CONTRACTOR for execution of the services/works including all contract documents and subsequent amendments, if any.

1.2.4 **Site:** Shall mean the place in which the operations/services are to be carried out or places approved by OIL for the purposes of the CONTRACT together with any other places designated in the CONTRACT as forming part of the site.

1.2.5 **COMPANY's Site Representative/Engineer**: Shall mean the person or the persons appointed by the COMPANY from time to time to act on its behalf at the site for overall co-ordination, supervision and project management at site.

1.2.6 **Sub-Contract:** Shall mean order/ contract placed by the CONTRACTOR for any portion of the CONTRACT or work sublet with necessary written consent of COMPANY on third party. Such sub-letting shall not relieve the CONTRACTOR from any obligation, duty or responsibility under the CONTRACT.

1.2.7 **Sub-Contractor:** Shall mean any person or firm or COMPANY (other than CONTRACTOR) to whom any part of the work has been entrusted by CONTRACTOR, with written consent of

OIL or the persons appointed by OIL, successors and permitted assigns of such persons, firm or COMPANY.

1.2.8 **Contractor's Representative:** Shall mean such person/or persons duly appointed representative at the site and base as the CONTRACTOR may designate in writing to the COMPANY as having authority to act for the CONTRACTOR in matters affecting the work and to provide the requisite services.

1.2.9 **Contract Price/Value:** Shall mean the sum accepted or the sum calculated in accordance with the rates accepted in tender and/or the contract rates as payable to the CONTRACTOR for the entire execution and completion of the services/works, including amendments/modification/change order issued by the COMPANY.

1.2.10 **Firm price:** The prices will remain unchanged, except for statutory changes, during currency of the CONTRACT unless specifically agreed to in writing by COMPANY.

1.2.11 **Service/Works/Operations:** Shall mean and include all items and things to be supplied/done and all work/Service to be performed by the CONTRACTOR as specified in the Scope of Work under this CONTRACT and shall also include all extra, additional, altered or substituted works/services as required for the purpose of successful execution of the Contract.

1.2.12 **Equipment/Materials/Goods:** Shall mean and include any equipment, machinery, instruments, stores, goods which CONTRACTOR is required to provide to the COMPANY for/under the CONTRACT and amendments thereto.

1.2.13 **Drawings:** Shall mean and include all Engineering sketches, general arrangements/ layout drawings, sectional plans, all elevations, photographs, etc. related to the CONTRACT together with modification and revision thereto.

1.2.14 **Specifications:** Means and includes all technical specifications, provision attached and referred to in the tender/contract document regarding method and manner of performing the services and qualities of the service/materials to be provided under the contract and also as modified by the COMPANY/its site representative during the execution of contract in the best interest of service.

1.2.15 **Engineer In-charge (EIC):** Shall mean the person designated from time to time by the COMPANY and shall include those who are expressly authorized by the COMPANY to act for and on its behalf for operation of the contract.

1.2.16 **Inspectors:** Shall mean any person or outside Agency nominated by COMPANY to inspect equipment, materials and services, if any, in the CONTRACT (stage wise as well as final) as per the terms of the CONTRACT.

1.2.17 **Tests:** Shall mean such process or processes to be carried out by the CONTRACTOR as are prescribed in the CONTRACT, considered necessary by the COMPANY or their representative to ascertain quality, workmanship, performance and efficiency of equipment or services thereof.

1.2.18 **Approval:** Shall mean and include the written consent duly signed by COMPANY or their authorized official in respect of all documents, drawings or other particulars in relation to the CONTRACT.

1.2.19 **Day:** Shall mean a calendar day of twenty –four (24) consecutive hours beginning at 00:00 hours with reference to local time at the site.

1.2.20 **Month:** Shall mean a calendar month as per Gregorian calendar.

1.2.21 **Year:** Shall mean calendar year as per Gregorian calendar.

1.2.22 **Working day:** Means any day which is not declared to be holiday by the COMPANY.

1.2.23 **Bid/offer:** Shall mean the proposal/Offer along with supporting documents submitted by the bidder in response to the tender or enquiry in accordance with the terms of Tender or Enquiry, for consideration by COMPANY, prior to award of contract.

1.2.24 **Guarantee:** Shall mean the period and other conditions governing the warranty/guarantee of the services as provided in the CONTRACT.

1.2.25 **Mobilization:** Shall mean rendering the equipment fully manned and equipped as per CONTRACT and ready to begin work at site designated by the COMPANY and accepted by the COMPANY after inspection.

1.2.26 **De-mobilization:** Shall mean the removal of all items forming part of the Mobilization from the site of the COMPANY and inspection and acceptance thereafter by the COMPANY including compliance of requirement in relation to re-export of imported equipment/materials under concessional duty scheme in accordance with relevant notification from Customs Authorities.

1.2.27 **Wilful Misconduct:** Shall mean intentional disregard of good and prudent standards of performance or proper conduct under the Contract with knowledge that it is likely to result in any injury to any person or persons or loss or damage of property of the Company or Third Party.

1.2.28 **Gross Negligence:** Shall mean any act or failure to act (whether sole, joint or concurrent) by a person or entity which was intended to cause, or which was in reckless disregard of or unjustifiable indifference to, avoidable and harmful consequences such person or entity

knew, or should have known, would result from such act or failure to act. Notwithstanding the foregoing, Gross negligence shall not include any action taken in good faith for the safeguard of life or property.

1.2.29 **Criminal Negligence:** Shall mean that the crime happened negligently, there was duty of care upon the Person but inadvertently due to his negligence, the duty was breached, which causes harm to the people in the form of death or serious injury.

1.2.30 **GST Legislations:** 'GST legislations' means 'any or all of the following legislations as may be applicable to the CONTRACTOR and OIL:

a) The Central Goods & Services Tax Act, 2017
b) The Integrated Goods & Services Act, 2017
c) The Union Territory Goods & Services Tax Act, 2017
d) The respective State Goods & Service Tax Acts'
e) The Goods and Services (Compensation to States) Act, 2017
f) The Customs Act and the Customs Tariff Act
g) Any other applicable Act related to GST

2 CONTRACT DOCUMENT

2.1 Governing language

The governing language for the CONTRACT shall be English. All CONTRACT documents and all correspondence and communication to be given and all other documentation to be prepared and supplied under the CONTRACT shall be written in English and the CONTRACT shall be construed and interpreted in accordance with English language.

2.2 Entire Agreement

The CONTRACT constitutes the entire agreement between OIL and the CONTRACTOR with respect to the subject matter of the CONTRACT and supersedes all communication, negotiations and agreement (whether written or oral) of the parties with respect thereto made prior to the date of this agreement, unless such communication(s) expressly forms part of the contract or included by reference.

2.3 Amendment in CONTRACT

No Amendment of the Contract shall be valid unless it is in writing, is dated, expressly refers to the Contract, and is signed by a duly authorized representative of each party thereto. OIL shall not be bound by any printed conditions, provisions in the CONTRACTOR's BID, forms of acknowledgement of CONTRACT, invoice and other documents which purport to impose any condition at variance with

or supplement to CONTRACT.

3 WAIVERS AND AMENDMENTS

3.1 Waivers

It is fully understood and agreed that none of the terms and conditions of this contract shall be deemed waived by either party unless such waiver is executed in writing only by the duly authorized representatives of both the parties. The failure of either party to execute any right shall not act as a waiver of such right by such party.

3.2 Change Program

It is agreed that CONTRACTOR shall carry out work in accordance with the completion program (e.g. Drilling Programme) to be furnished by the COMPANY, which may be changed from time to time by reasonable modifications in the program as COMPANY sees fit. COMPANY's instruction in this regard shall be final and binding.

4 CONTRACT TIMELINE

4.1 Effective Date of Contract

The contract shall become effective as of the date COMPANY notifies the CONTRACTOR in writing that it has been awarded the contract. This date of issuance of Letter of Award (LOA) by the COMPANY will be the Effective Date of Contract. All terms and conditions of the contract shall come into force with the date of issuance of LOA.

4.2 Date of Commencement of Operation

The date on which the mobilization is completed in all respects and CONTRACTOR is ready to commence operation as per the contract provision [Certified by the COMPANY's representative] will be treated as the date of Commencement of Operation.

4.3 Duration of the contract

The contract shall be valid for a period as defined in the LOA and Special Conditions of Contract [SCC].

5 SCOPE OF WORK/CONTRACT

Scope of the CONTRACT shall be as defined in the CONTRACT, specifications, drawings and Appendices.

6 GENERAL OBLIGATION OF CONTRACTOR

6.1 Requirements

CONTRACTOR shall, in accordance with and subject to the terms and conditions of this Contract:

6.1.1 Perform the work described in the Terms of Reference/Scope of Work. The CONTRACTOR shall execute the work with professional competence and in an efficient and workman like manner.

6.1.2 Except as otherwise provided in the Terms of Reference and the special Conditions of the contract, employ all labours/personnel as required to perform the work.

6.1.3 Perform all other obligations, work and services which are required by the terms of this contract, or which reasonably can be implied from such terms as being necessary for the successful and timely completion of the work.

6.1.4 Comply with all applicable statutory obligations specified in the contract.

6.1.5 CONTRACTOR shall be deemed to have satisfied himself before submitting their bid as to the correctness and sufficiency of its bid for the services required and of the rates and prices quoted, which rates and prices shall, except insofar as otherwise provided, cover all its obligations under the contract.

6.1.6 CONTRACTOR shall be deemed, prior to submitting their bids, to have satisfied themselves about the weather conditions, working culture in the area, socio- political environment, safety & security aspects, law & order situation and law of the land, and obtain for themselves all necessary information as to the risks, contingencies and all other circumstances, which may influence or affect the various obligations under the Contract.

6.1.7 CONTRACTOR shall give or provide all necessary supervision during the performance of the services and as long thereafter within the warranty period as COMPANY may consider necessary for the proper fulfilling of CONTRACTOR's obligations under the contract.

7 GENERAL OBLIGATION OF COMPANY

7.1 Requirements

COMPANY shall, in accordance with and subject to the terms and conditions of this contract:

7.1.1 Pay CONTRACTOR in accordance with terms and conditions of the contract.

7.1.2 Allow CONTRACTOR access, subject to normal security and safety procedures, to all areas as required for orderly performance of the work as specified in the Scope of Works of the contract or work connected therewith.

7.1.3 Perform all other obligations required of COMPANY by the terms of this contract.

8 DUTIES AND POWER /AUTHORITY

8.1 OIL's site representative/engineer

The duties and authorities of OIL's site representative/engineer are to act on behalf of OIL for:

a) Overall supervision, co-ordination and Project Management at site

b) Proper and optimum utilization of equipment and services.

c) Monitoring of performance and progress

d) Commenting/ countersigning on reports made by the CONTRACTOR's representative at site in respect of works, receipts, consumption etc. after satisfying himself with the facts of the respective cases.

e) He shall have the authority, but not obligation at all times and any time to inspect/test/examine/ verify any equipment machinery, instruments, tools, materials, personnel, procedures and reports etc. directly or indirectly pertaining to the execution of the work. However, this shall not construe to imply an acceptance by the inspector.

f) Hence, the overall responsibility of quality of work shall rest solely with the CONTRACTOR.

g) Each and every document emerging from site in support of any claim by the CONTRACTOR has to have the countersignature/ comments of the OIL's representative/engineer without which no claim shall be entertained by the OIL.

8.2 CONTRACTOR's representative

a) The CONTRACTOR's representative shall have all the powers requisite for the performance of the Service/Works, subject to holding due authorisation from the CONTRACTOR.

b) Representative(s) shall liaise with OIL's representative/engineer for the proper co-ordination and timely completion of the works and on any matter pertaining to the works.

c) Representative(s) shall extend full co-operation to OIL's representative/inspector/engineer in the manner required by them for supervision/inspection/observation of equipment, material, procedures, performance, reports and records pertaining to works.

d) To have complete charge of CONTRACTOR's personnel engaged in the performance of the work and to ensure compliance of rules and regulations and safety practice.

9 PERSONNEL TO BE DEPLOYED BY CONTRACTOR

9.1 Requirements

CONTRACTOR warrants that it shall provide competent, qualified and sufficiently experienced personnel to perform the work correctly and efficiently.

9.1.1 The CONTRACTOR should ensure that their personnel observe all statutory safety requirement including those prescribed by the COMPANY. Upon COMPANY's written request, CONTRACTOR, entirely at its own expense, shall remove immediately any personnel of the CONTRACTOR determined by the COMPANY to be unsuitable and shall promptly replace such personnel with personnel acceptable to the COMPANY. Replacement personnel should be mobilized within 15 days from the date of issuance of notice without affecting the operation of the COMPANY.

9.1.2 The CONTRACTOR shall be solely responsible throughout the period of the contract for providing all requirements of their personnel including but not limited to, their transportation to & from Duliajan/field site, enroute/ local boarding, lodging, personal protective gear & medical attention etc. COMPANY shall have no responsibility or liability in this regard.

9.1.3 However, COMPANY shall provide available medical assistance/facilities to CONTRACTOR's Personnel in case of emergency at its own establishment on chargeable basis.

9.1.4 CONTRACTOR's key personnel shall be fluent in English language (both writing and speaking).

10 PERFORMANCE SECURITY

10.1 Requirements

10.1.1 On receipt of notification of award from the COMPANY, the CONTRACTOR shall furnish the Performance Security to COMPANY within **30 (Thirty)** days from the date of issue of LOA for an amount specified in the Forwarding Letter and Letter of Award (LOA) as per Proforma-Form and must be in the form of Insurance Surety Bond or Bank Draft/ Cashier's cheque/Banker's cheque*/NEFT/RTGS/Electronic fund transfer to designated account of OIL#

or Fixed Deposit Receipt (account OIL INDIA LIMITED) or irrevocable Bank Guarantee or irrevocable Letter of Credit (LC) from:

a. Any schedule Indian Bank or Any Branch of an International bank situated in India and registered with Reserve Bank of India as scheduled foreign bank in case of domestic CONTRACTOR/service provider.

OR

b. Any scheduled bank in India or from international bank who has its branch in India registered with Reserve Bank of India, in case of foreign CONTRACTOR/service provider.

OR

c. Any foreign Bank which is not a Scheduled Bank in India, provided the Bank Guarantee issued by such Bank is counter-guaranteed by any Branch situated in India of any Scheduled Bank incorporated in India.

Note: Bank Guarantee issued by a Scheduled Bank of India at the request of some other Non-Schedule Bank of India shall not be acceptable.

10.1.2 Bank Guarantee issued by a Bank, amongst others, must contain the following particulars of such bank:

Full address Branch Code
Code Nos. of the authorized signatory with full name and designation. Phone Nos.
Fax Nos.
E-mail address.

10.1.3 The domestic CONTRACTOR/service provider(s) will have to submit the Bank Guarantee from any of the scheduled banks and on non- judicial stamp paper of requisite value as per the Indian Stamp Act, purchased in the name of the issuing banker.

10.1.4 The foreign CONTRACTOR/service provider(s) will submit the Bank Guarantee from Banks of Indian origin situated in their country. In case no such bank of Indian origin is situated in their country, the Bank Guarantee may be submitted from the bankers as specified above.

10.1.5 The Performance Security shall be denominated in the currency of the contract.

10.1.6 The Performance Security specified above must be valid for the entire duration of the Contract and claim period should be valid for a minimum of 03 (three) months beyond the contract period. The Performance Security will be discharged by COMPANY not later than 30 days following its expiry of claim period. In the event of any extension of the Contract period, Bank Guarantee should be extended by CONTRACTOR by the period equivalent to the extended Period.

10.1.7 The Performance Security shall be encashed by COMPANY on account of CONTRACTOR's failure to fulfil its obligations under the Contract and/or non- performance/un-satisfactory performance of the Contractor. Company shall not be required to proof any loss or damage on account of Contractor's non- performance/un-satisfactory performance.

10.1.8 The Performance Security will not accrue any interest during its period of validity or extended validity.

10.1.9 Failure of the successful Bidder to comply with the requirements of clause 10 shall constitute sufficient grounds for annulment of the award. In such an eventuality, action will be initiated as per the Banning Policy of OIL in vogue.

Subject to credit in OIL's account within prescribed time

* The validity of Bank Draft/Cashier's/Banker's cheque (as applicable) should not be less than 3 months.

In the event CONTRACTOR fails to honour any of the commitments entered into under this agreement, and /or in the event of termination of the contract under provisions of Integrity Pact and /or in respect of any amount due from the CONTRACTOR to OIL, OIL shall have unconditional option under the guarantee to invoke the above bank guarantee and claim the amount from the bank. The bank shall be obliged to pay the amount to OIL on demand.

11 SIGNING OF CONTRACT

The successful bidder is required to sign a formal detailed contract with OIL within a maximum period of 60 days of date of LOA. Until the contract is signed, the LOA **as well as GCC & SCC as prescribed in the Tender**, shall remain binding amongst the two parties. In the event of failure on the part of the successful Bidder to sign the contract, OIL reserves the right to terminate the LOA issued to the successful Bidder and invoke the Performance Security if submitted by the successful Bidder. Such CONTRACTOR shall be put on holiday as per the Banning Policy of OIL [available at www.oil-india.in].

12 CLAIMS, TAXES & DUTIES

12.1 Claims

CONTRACTOR agrees to pay all claims, taxes and fees for equipment, labour, materials, services and supplies to be furnished by it hereunder and agrees to allow no lien or charge resulting from such claims to be fixed upon any property of COMPANY. COMPANY may, at its option, pay and discharge any liens or overdue charges for CONTRACTOR's equipment, labour, materials, services and supplies under this CONTRACT and may thereupon deduct the amount or amounts so paid from any sum due, or thereafter become due, to CONTRACTOR hereunder.

12.2 Notice of claims

CONTRACTOR or COMPANY, as the case may be, shall promptly give the other, notice in writing of any claim made or proceeding commenced for which that party is entitled to indemnification under the CONTRACT. Each party shall confer with the other concerning the defence of any such claims or proceeding, shall permit the other to be represented by counsel in defence thereof, and shall not affect settlement of or compromise any such claim or proceeding without the other's written consent.

12.3 Taxes

12.3.1 CONTRACTOR, unless specified otherwise in the CONTRACT, shall bear all tax liabilities, duties, Govt. levies etc. including GST and customs duty, Corporate and personnel taxes levied or imposed on the CONTRACTOR on account of payments received by it from the COMPNAY for the work done under this CONTRACT. It shall be the responsibility of CONTRACTOR to submit to the concerned Indian authorities, the returns and all other concerned documents required for this purpose and to comply in all respects with the requirements of the laws in this regard, in time.

12.3.2 Tax levied on CONTRACTOR as per the provisions of Indian Income Tax Act and any other enactment/rules on income derived/payments received under the contract will be on CONTRACTOR's account.

12.3.3 CONTRACTOR shall be responsible for payment of personal taxes, if any, for all the personnel deployed in India by CONTRACTOR.

12.3.4 The CONTRACTOR shall furnish to the COMPANY, if and when called upon to do so, relevant statement of accounts or any other information pertaining to work done under the contract for submitting the same to the Tax authorities, on specific request from them in accordance with provisions under the law. CONTRACTOR shall be responsible for preparing and filing the return of income etc. within the prescribed time limit to the appropriate authority.

12.3.5 Prior to start of operations under the contract, the CONTRACTOR shall furnish the COMPANY with the necessary documents, as asked for by the COMPANY and/ or any other information pertaining to the contract, which may be required to be submitted to the Income Tax authorities at the time of obtaining "No Objection Certificate" for releasing payments to the CONTRACTOR.

12.3.6 Corporate income tax will be deducted at source from the invoice at the specified rate of income tax as per the provisions of Indian Income Tax Act as may be in force from time to time and COMPANY will issue TDS Certificate to the CONTRACTOR as per the provisions of Income Tax Act.

12.3.7 Corporate and personnel taxes on CONTRACTOR shall be the liability of the CONTRACTOR and the COMPANY shall not assume any responsibility on this account.

12.3.8 All local taxes, levies and duties, sales tax, octroi, etc. on purchases and sales made by CONTRACTOR shall be borne by the CONTRACTOR.

12.3.9 CONTRACTOR shall provide all the necessary compliances/ invoice/documents for enabling OIL to avail Input tax credit benefits in respect of the payments of GST which are payable against the CONTRACT. The CONTRACTOR should provide tax invoice issued under GST legislations for the goods and Services (indicating GST). Payment towards the components of GST shall be released by OIL only against appropriate documents i.e.: Tax Invoice/Bill of entry for availing input tax credit (as applicable).

12.3.10 The tax invoices as per above provisions should contain all the particulars as required under the invoicing rules under the GST legislations, including, but not limited to the following:

a) Name, Address and the GST Registration Number (under the relevant Tax Rules) of the Service Provider (CONTRACTOR)

b) Name and Address and GST Registration Number of the Service Receiver (Address of OIL)

c) Description, Classification and Value of taxable service/goods and the amount of applicable tax (CGST, SGST, IGST, UTGST and cess)

12.3.11 In case of imported goods, CONTRACTOR/supplier is required to provide original Bill of Entry or copy of Bill of Entry duly attested by Custom authority.

12.3.12 The CONTRACTOR should mention the Place of supply in the invoice raised under GST Law.

12.3.13 OIL would not accept any invoice without its GSTIN mentioned on the invoice

Note: CONTRACTOR who is under composition levy of the GST legislation would raise Bill of supply instead of Tax invoice, which will have GSTIN of supplier as well as OIL.

12.4 Goods and Services Tax

12.4.1 In view of GST Implementation from 1st July 2017, all taxes and duties including Excise Duty, CST/VAT, Service tax, Entry Tax and other indirect taxes and duties have been submerged in GST. Accordingly reference of Excise Duty, Service Tax, VAT, Sales Tax, Entry Tax or any other form of indirect tax except of GST mentioned in the bidding document shall be ignored.

Bidders are required to submit copy of the GST Registration Certificate while submitting the bids wherever GST (CGST & SGST/UTGST or IGST) is applicable.

12.4.2 "GST" shall mean Goods and Services Tax charged on the supply of material(s) and services. The term "GST" shall be construed to include the Integrated Goods and Services Tax (hereinafter referred to as "IGST") or Central Goods and Services Tax (hereinafter referred to as "CGST") or State Goods and Services Tax (hereinafter referred to as "SGST") or Union Territory Goods and Services Tax (hereinafter referred to as "UTGST") depending upon the import/interstate or intrastate supplies, as the case may be. It shall also mean GST compensation Cess, if applicable.

12.4.3 Quoted price/rate(s) should be inclusive of all taxes and duties, except **GST (i.e. IGST or CGST and SGST/UTGST applicable in case of interstate supply or intra state supply respectively and cess on GST if applicable) on the final service**. However, GST rate (including cess) to be provided in the respective places in the Price Bid .Please note that the responsibility of payment of GST (CGST & SGST or IGST or UTGST) lies with the Supplier of Goods/Services (Service Provider) only .Supplier of Goods/Services (Service Provider) providing taxable service shall issue an Invoice/Bill, as the case may be as per rules/regulation of **GST**. Further, returns and details required to be filled under GST laws & rules should be timely filed by Supplier of Goods/Services (Service Provider) with requisite details.

12.4.4 Bidder should also mention the **Harmonised System of Nomenclature (HSN)** and **Service Accounting Codes (SAC)** at the designated place in SOR.

12.4.5 Where the OIL is entitled to avail the input tax credit of GST:

OIL will reimburse the GST to the Supplier of Goods/Services (Service Provider) at actual against submission of Invoices as per format specified in rules/ regulation of GST to enable OIL to claim input tax credit of GST paid. In case of any variation in the executed quantities, the amount on which the GST is applicable shall be modified in same proportion. Returns and details required to be filled under GST laws &rules should be timely filed by supplier with requisite details.

The input tax credit of **GST** quoted shall be considered for evaluation of bids, as per evaluation criteria of tender document.

12.4.6 Where the OIL is not entitled to avail/take the full input tax credit of GST:

OIL will reimburse GST to the Supplier of Goods/Services (Service Provider) at actual against submission of Invoices as per format specified in rules/ regulation of GST subject to the ceiling amount of GST as quoted by the bidder. In case of any variation in the executed quantities (If directed and/or certified by the In-Charge) the ceiling amount on which GST is applicable will be modified on pro-rata basis.

The bids will be evaluated based on total price including **GST**.

12.4.7 Payments to Service Provider for claiming GST amount will be made provided the above formalities are fulfilled. Further, OIL may seek copies of challan and certificate from Chartered Accountant for deposit of GST collected from OIL.

12.4.8 Contractor/Contractor shall be required to issue tax invoice in accordance with GST Act and/or Rules so that input credit can be availed by OIL. In the event that the contractor / Contractor fails to provide the invoice in the form and manner prescribed under the GST Act read with GST Invoicing Rules there under, OIL shall not be liable to make any payment on account of GST against such invoice.

12.4.9 GST shall be paid against receipt of tax invoice and proof of payment of GST to government. In case of non-receipt of tax invoice or non-payment of GST by the contractor/Contractor, OIL shall withhold the payment of GST.

12.4.10 GST payable under reverse charge mechanism for specified services or goods under GST act or rules, if any, shall not be paid to the contractor/Contractor but will be directly deposited to the government by OIL.

12.4.11 Where OIL has the obligation to discharge GST liability under reverse charge mechanism and OIL has paid or is /liable to pay GST to the Government on which interest or penalties becomes payable as per GST laws for any reason which is not attributable to OIL or ITC with respect to such payments is not available to OIL for any reason which is not attributable to OIL, then OIL shall be entitled to deduct/ setoff / recover such amounts against any amounts paid or payable by OIL to Contractor / Supplier.

12.4.12 Notwithstanding anything contained anywhere in the Agreement, in the event that the input tax credit of the GST charged by the Contractor / Contractor is denied by the tax authorities to OIL for reasons attributable to Contractor / Contractor, OIL shall be entitled to recover such amount from the Contractor / Contractor by way of adjustment from the next invoice. In addition to the amount of GST, OIL shall also be entitled to recover interest at the rate prescribed under GST Act and penalty, in case any penalty is imposed by the tax authorities on OIL.

12.4.13 TDS under GST, if applicable, shall be deducted from contractor's/Contractor's bill at applicable rate and a certificate as per rules for tax so deducted shall be provided to the contractor/Contractor.

12.4.14 The CONTRACTOR will be under obligation for charging correct rate of tax as prescribed under the respective tax laws. Further the CONTRACTOR shall avail and pass on benefits of all exemptions/concessions available under tax laws. Any error of interpretation of applicability of taxes/ duties by the CONTRACTOR shall be to CONTRACTOR's account.

12.4.15 It is the responsibility of the bidder to quote the correct GST rate. The classification of goods/services as per GST (Goods & Service Tax) Act should be correctly done by the contractor to ensure that input tax credit on GST (Goods & Service Tax) is not lost to the OIL on account of any error on the part of the contractor.

12.4.16 In case, the quoted information related to various taxes, duties & levies subsequently proves wrong, incorrect or misleading, OIL will have no liability to reimburse the difference in the

duty/tax, if the finally assessed amount is on the higher side and OIL will have to right to recover the difference and in case the rate of duty/taxes finally assessed is on the lower side.

12.4.17 Notwithstanding anything mentioned elsewhere in the Bidding Document the aggregate liability of OIL towards Payment of Taxes & Duties shall be limited to the volume of GST declared by the bidder in its bid & nothing shall be payable extra except for the statutory variation in taxes & duties.

12.4.18 Further, it is the responsibility of the bidders to make all possible efforts to make their accounting/IT system GST compliant in order to ensure availability of Input Tax Credit (ITC) to Oil India Ltd.

12.4.19 GST liability, if any on account of supply of free samples against any tender shall be to bidder's account.

12.4.20 In case of statutory variation in GST, other than due to change in turnover, payable on the contract value during contract period, the Supplier of Goods/ Services (Service Provider) shall submit a copy of the 'Government Notification' to evidence the rate as applicable on the Bid due date and on the date of revision.

12.4.21 Beyond the contract period, in case OIL is not entitled for input tax credit of GST, then any increase in the rate of GST beyond the contractual delivery period shall be to Service provider's account whereas any decrease in the rate GST shall be passed on to the OIL.

12.4.22 Beyond the contract period, in case OIL is entitled for input tax credit of GST, then statutory variation in applicable GST on supply and on incidental services, shall be to OIL's account.

12.4.23 Claim for payment of GST/ Statutory variation, should be raised within two [02] months from the date of issue of 'Government Notification' for payment of differential (in %) GST, otherwise claim in respect of above shall not be entertained for payment of arrears.

12.4.24 The base date for the purpose of applying statutory variation shall be the Bid Opening Date.

12.4.25 The CONTRACTOR will be liable to ensure to have registered with the respective tax authorities, wherever applicable and to submit self- attested copy of such registration certificate(s) and the CONTRACTOR will be responsible for procurement of material in its own registration (GSTIN) and also to issue its own Road Permit/ E-way Bill, if applicable etc.

12.4.26 In case the bidder is covered under Composition Scheme under GST laws, then bidder should quote the price inclusive of the GST (CGST & SGST/UTGST or IGST). Further, such bidder should mention "Cover under composition system" in column for GST (CGST & SGST/UTGST or IGST) of price schedule.

12.4.27 OIL will prefer to deal with registered supplier of goods/services under GST. Therefore, bidders are requested to get themselves registered under GST, if not registered yet. However, in case any unregistered bidder is submitting their bid, their prices will be loaded with applicable GST while evaluation of bid. Where OIL is entitled for input credit of GST, the same will be considered for evaluation of bid as per evaluation methodology of tender document.

12.4.28 Procurement of Specific Goods: Earlier, there is no tax incidence in case of import of specified goods (i.e. the goods covered under List-34 of Customs Notification no. 12/2012-Cus dated. 17.03.2012 as amended). Customs duty is not payable as per the policy. However, under GST regime, IGST Plus GST compensation cess (if applicable) would be leviable on such imports. Bidders should quote GST as inclusive considering IGST component for the imported Materials portion while quoting their prices on destination basis. However, GST rate to be specified in the price bid format.

12.4.29 Documentation requirement for GST

The Contractor will be under the obligation for invoicing correct tax rate of tax/duties as prescribed under the GST law to OIL, and pass on the benefits, if any, after availing input tax credit.

Any invoice issued shall contain the following particulars:

a) Name, address and GSTIN of the supplier;

b) Serial number of the invoice;

c) Date of issue;

d) Name, address and GSTIN or UIN, if registered of the recipient;

e) Name and address of the recipient and the address of the delivery, along with the State and its code,

f) HSN code of goods or Accounting Code of services[SAC];

g) Description of goods or services;

h) Quantity in case of goods and unit or Unique Quantity Code thereof;

i) Total value of supply of goods or services or both;

j) Taxable value of supply of goods or services or both taking into discount or abatement if any;

k) Rate of tax (IGST,CGST, SGST/ UTGST, cess);

l) Amount of tax charged in respect of taxable goods or services (IGST,CGST, SGST/UTGST, cess);

m) Place of supply along with the name of State, in case of supply in the course of interstate trade or commerce;

n) Address of the delivery where the same is different from the place of supply and

o) Signature or digital signature of the supplier or his authorised representative.

GST invoice shall be prepared in triplicate, in case of supply of goods, in the following manner:

a) The original copy being marked as ORIGINAL FOR RECIPIENT;

b) The duplicate copy being marked as DUPLICATE FOR TRANSPORTER and

c) The triplicate copy being marked as TRIPLICATE FOR SUPPLIER.

In case of any advance given against any supplies contract, the supplier of the goods shall issue Receipt Voucher containing the details of details of advance taken along with particulars as mentioned in clause no. (a), (b), (c), (d), (g), (k), (l), (m) & (o) above.

12.4.30 Anti-profiteering clause

As per Clause 171 of GST Act it is mandatory to pass on the benefit due to reduction in rate of tax or from input tax credit to the consumer by way of commensurate reduction in prices. The Supplier of Goods / Services may note the above and quote their prices accordingly.

12.4.31 In case the GST rating of Contractor on the GST portal / Govt. official website is negative / black listed, then the bids may be rejected by OIL. Further, in case rating of bidder is negative / black listed after award of work for supply of goods / services, then OIL shall not be obligated or liable to pay or reimburse GST to such Contractor and shall also be entitled to deduct / recover such GST along with all penalties / interest, if any, incurred by OIL.

13 CUSTOMS DUTY, IF APPLICABLE

13.1.1 CONTRACTOR shall be responsible to import the equipment/tools/spares/ consumables etc. required for execution of the contract. The CONTRACTOR shall undertake to complete all the formalities as required under the Customs Act/Foreign Trade Policy (FTP) and indemnify OIL from all the liabilities of Customs in this regard.

13.1.2 CONTRACTOR will be solely responsible for payment of all applicable Customs Duty and to comply all Rules and Regulations. Total Contract Price/Value is inclusive of all Customs Duty, if not mentioned otherwise elsewhere in the Contract.

13.1.3 Above clause is to be read with Customs Duty Clause in SCC, if any.

14 INSURANCE

14.1 General

The Contractor shall at its own expense arrange secure and maintain insurance with reputed insurance companies to the satisfaction of the Company as follows:

a) The Contractor shall, at his own expense, arrange appropriate comprehensive insurance (All-risks insurance cover with suitable limit as per International Standard) to cover all risks assumed by the Contractor under this Contract in respect of its equipment, tools including but not limited to well equipment & tools, any other belongings and personnel during the entire period of this Contract including extensions thereof.

b) The Contractor shall also carry adequate insurance cover against damage/loss to third party/person/property.

c) The Contractor at his cost shall arrange, secure and maintain insurance as may be necessary and to its full value for all such amounts to protect the works-in- progress from time to time and the interest of Company against all risks as detailed herein subject to the satisfaction of the Company and irrespective of acceptance of the Work.

d) Sum assured should not be less than Estimated Contract Value as per the LOA/Contract in case of Projects/Works Contracts. In case of annualized contract One year Estimated Contract Value.

e) The responsibility to maintain adequate insurance coverage at all times during the period of the Contract shall be that of the Contractor alone and OIL will have no liability on this account. The Contractor's failure in this regard shall not relieve him of any of his responsibilities & obligations under the Contract.

f) All costs on account of insurance liabilities covered under the Contract will be to the Contractor's account.

14.2 Deductible

14.2.1 The Contractor shall take policy with minimum deductible as per IRDA prescribed for the policy(ies) that portion of any loss not covered by the insurance provided for in this article solely by reason of a deductible provision in such insurance policies that shall be the account of the Contractor.

14.2.2 The Contractor shall require all of its sub-Contractor to provide such of the foregoing insurance coverage as Contractor is obliged to provide under this Contract and inform the Company about the coverage prior to the commencement of agreements with its sub-Contractors.

14.2.3 All insurance taken out by Contractor or their sub-contractor shall be endorsed to provide that the underwriters waive their rights of recourse on the Company and to the extent of the liabilities assumed by Contractor under this Contract.

14.3 Waiver of subrogation

All insurance policies of the Contractor and its Sub-Contractor with respect to the operations conducted hereunder as set forth in clauses hereof, shall be endorsed by the underwriter in accordance with the following policy wording:

"The insurers hereby waive their rights of subrogation against Oil India Limited or any of their employees or their affiliates and assignees."

14.4 Loss Payee Clause

The Insurance Policies should mention the following in Loss Payee Clause:

"In respect of Insurance claims in which OIL's interest is involved, written consent of OIL will be required".

14.5 Additional Assured

"Oil India Limited" is to be included as Additional Assured in the Insurance Policies (except in case of Workmen's Compensation/Employer's Liability insurance).

14.6 Certificate of Insurance

Before commencing performance of the CONTRACT, CONTRACTOR shall furnish OIL with certificates of insurance indicating:

a) Kinds and amounts of insurance as required herein

b) Details of coverage

c) Insurance corporation or companies carrying the aforesaid coverage

d) Effective and expiry dates of policies

e) That OIL shall be given thirty (30) days written advance notice of any material change in the policy

f) Waiver of subrogation endorsement has been attached to all policies.

Note: An undertaking by the service provider has to be mandatorily provided during the Mobilisation time that they have taken all the Insurance provisions as per the contract and as the Law and Insurance Regulation.

14.7 Policy Lapse

14.7.1 If any of the above policy expire or/are cancelled during the term of this CONTRACT and CONTRACTOR fails for any reason to renew such policies, OIL in no case shall be liable for any loss/damage occurred during the term when the policy is not effective. Furthermore, a penal interest @ 1% of the Total contract value shall be charged towards not fulfilling of the contractual obligations. Notwithstanding above, should there be a lapse in any insurance required to be taken by the Contractor for any reason whatsoever, loss/damage claims resulting therefrom shall be to the sole account of Contractor.

14.7.2 The Contractor on demand from the Company shall furnish the Insurance Policy having detail terms and conditions, with respect to any Certificate of Insurance submitted to the Company.

14.8 On account payment to OIL in case of claim

In case any loss or damage happen and where Company's interest is involved, The Company reserves the right to recover the loss amount from the Contractor prior to final settlement of the claim.

14.8.1 The CONTRACTOR shall at all times during the currency of the contract provide, pay for and maintain the following insurance amongst others:

a) **Employees Compensation (EC) Policy or Employer's Liability Policy insurance** as required by the laws of the country of origin of the employee.

b) **Commercial General Liability Insurance:** Commercial General Public Liability Insurance covering liabilities including contractual liability for bodily injury, including death of persons, and liabilities for damage of property. This insurance must cover all operations of CONTRACTOR required to fulfil the provisions under this Contract.

c) **Comprehensive General Automotive Liability:** Automobile Public Liability Insurance covering owned, non-owned and hired automobiles used in the performance of the work hereunder, with bodily injury limits and property damage limits shall be governed by Indian Insurance Regulations.

d) **Carrier's Legal Liability Insurance:** Carrier's Legal Liability Insurance in respect of all CONTRACTOR's items to be transported by the CONTRACTOR to the site of work, for physical loss or destruction of or damage to goods or merchandise, while in transit.

e) **Public Liability Act Policy:** Public Liability Act Policy, if applicable, covering the statutory liability arising out of accidents occurring during the currency of the contract due to handling hazardous substances as provided in the Public Liability Insurance Act 1991 and the Rules framed there under. In case there is no usage of hazardous substance, the Contractor should provide an **undertaking** during mobilization as per format enclosed regarding non-inclusion of hazardous substances within the ambit of the contract.

f) **Pradhan Mantri Suraksha Bima Yojana (PMSBY) and Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY):** CONTRACTOR shall, ensure that all his/its personnel deployed under this contract have obtained additional insurance coverage under the Pradhan Mantri Suraksha Bima Yojana (PMSBY) and Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY) through the participating banks and submit the proof of such insurance coverage to the satisfaction of OIL.

g) Note: This will be applicable for only Indian citizens and within the prescribed age group defined under the scheme for the insurance coverage.

h) **Any other insurance policy set forth in the SCC**

15 LIABILITY

15.1 General Conditions

15.1.1 Except as otherwise expressly provided herein, neither COMPANY nor its servants, agents, nominees, CONTRACTORs, or sub- CONTRACTORs shall have any liability or responsibility whatsoever to whomsoever for loss of or damage to the equipment and/or loss of or damage to the property of the CONTRACTOR and/or their CONTRACTORs or sub-CONTRACTORs, irrespective of how such loss or damage is caused and even if caused by the negligence of COMPANY and/or its servants, agent, nominees, assignees, CONTRACTORs and sub-CONTRACTORs.

15.1.2 The CONTRACTOR shall protect, defend, indemnify and hold harmless COMPANY from and against such loss or damage and any suit, claim or expense resulting there from. Neither COMPANY nor its servants, agents, nominees, assignees, CONTRACTORs, sub-CONTRACTORs shall have any liability or responsibility whatsoever for injury to, illness, or death of any employee of the CONTRACTOR and/or of its CONTRACTORs or sub-CONTRACTOR irrespective of how such injury, illness or death is caused and even if caused by the negligence of COMPANY and/or its servants, agents nominees, assignees, CONTRACTORs and sub-CONTRACTORs. CONTRACTOR shall protect, defend, indemnify and hold harmless COMPANY from and against such liabilities and any suit, claim or expense resulting there from.

15.1.3 The CONTRACTOR hereby agrees to waive its right of recourse and further agrees to cause its underwriters to waive their right of subrogation against COMPANY and/or its underwriters, servants, agents, nominees, assignees, CONTRACTORs and sub-CONTRACTORs for loss or damage to the equipment of the CONTRACTOR and/or its sub-CONTRACTORs and/or their employees when such loss or damage or liabilities arises out of or in connection with the performance of the contract limited to the CONTRACTOR's liabilities agreed to under this Contract.

15.1.4 The CONTRACTOR hereby further agrees to waive its right of recourse and agrees to cause its underwriters to waive their right of subrogation against COMPANY and/or its underwriters, servants, agents, nominees, assignees, CONTRACTORs and sub-CONTRACTORs

for injury to, illness or death of any employee of the CONTRACTOR and of its CONTRACTORs, sub-CONTRACTORs and/or their employees when such injury, illness or death arises out of or in connection with the performance of the contract limited to the CONTRACTOR's liabilities agreed to under this Contract.

15.1.5 Except as otherwise expressly provided herein, neither CONTRACTOR nor its servants, agents, nominees, CONTRACTORs or sub- CONTRACTORs shall have any liability or responsibility whatsoever to whomsoever for loss of or damage to the equipment and/or loss or damage to the property of the COMPANY and/or their CONTRACTORs or sub-CONTRACTORs, irrespective of how such loss or damage is caused and even if caused by the negligence of CONTRACTOR and/or its servants, agents, nominees, assignees, CONTRACTORs and sub-CONTRACTORs. The COMPANY shall protect, defend, indemnify and hold harmless CONTRACTOR from and against such loss or damage and any suit, claim or expense resulting there from.

15.1.6 Except as otherwise expressly provided herein, neither CONTRACTOR nor its servants, agents, nominees, assignees, CONTRACTORs, sub- CONTRACTORs shall have any liability or responsibility whatsoever to whomsoever for injury or illness, or death of any employee of the COMPANY and/or of its CONTRACTORs or sub-CONTRACTORs irrespective of how such injury, illness or death is caused and even if caused by the negligence of CONTRACTOR and/or its servants, agents, nominees, assignees, CONTRACTORs and sub- CONTRACTORs. COMPANY shall protect, defend indemnify and hold harmless CONTRACTOR from and against such liabilities and any suit, claim or expense resulting there from.

15.1.7 The COMPANY agrees to waive its right of recourse and further agrees to cause its underwriters to waive their right of subrogation against CONTRACTOR and/or its underwriters, servants, agents, nominees, assignees, CONTRACTORs and sub-CONTRACTORs for loss or damage to the equipment of COMPANY and/or its CONTRACTORs or sub-CONTRACTORs when such loss or damage or liabilities arises out of or in connection with the performance of the contract.

15.1.8 The COMPANY hereby further agrees to waive its right of recourse and agrees to cause it underwriters to waive their right of subrogation against CONTRACTOR and/or its underwriters, servants, agents, nominees, assignees, CONTRACTORs and sub-CONTRACTORs for injury to, illness or death of any employee of the COMPANY and of its CONTRACTORs, sub-CONTRACTORs and/or their employees when such injury, illness or death arises out of or in connection with the performance of the Contract.

16 LIMITATION OF LIABILITY

a) Notwithstanding any other provisions herein to the contrary, except only in cases of Wilful misconduct and/or criminal acts and/or criminal negligence, neither the CONTRACTOR nor the COMPANY (OIL) shall be liable to the other, whether in Contract, tort, or otherwise, for any consequential loss or damage, loss of use, loss of production, or loss of profits or interest costs, provided however that this exclusion shall not apply to any obligation of the CONTRACTOR to pay

Liquidated Damages to the COMPANY and/or COMPANY's right to forfeit the Performance Bank Guarantee(s) in terms of the contract.

b) Notwithstanding any other provisions incorporated elsewhere in the contract, the aggregate liability of the CONTRACTOR in respect of this contract, whether under Contract, in tort or otherwise, shall not exceed 100% of the Contract Price (if not specified otherwise in SCC), provided however that this limitation shall not apply to the cost of repairing or replacing defective equipment by the CONTRACTOR, or to any obligation of the CONTRACTOR to indemnify the COMPANY with respect to Intellectual Property Rights.

c) COMPANY shall indemnify and keep indemnified CONTRACTOR harmless from and against any and all claims, costs, losses and liabilities in excess of the aggregate liability amount in terms of clause (b) above.

17 LIABILITY OF UNION GOVERNMENT OF INDIA

It is expressly understood and agreed upon by and between CONTRACTOR and OIL INDIA LIMITED, and that OIL INDIA LIMITED is entering into this agreement solely on its own behalf and not on behalf of any other person or entity. In particular, it is expressly understood and agreed that Union of India is not a party to this agreement and has no liabilities, obligations or rights, whatsoever hereunder. It is expressly understood and agreed that OIL INDIA LIMITED is an independent legal entity with power and authority to enter into contracts solely on its own behalf under the applicable laws of India and general principles of the Contract law. The bidder/CONTRACTOR expressly agrees, acknowledges and understands that OIL INDIA LIMITED is not an agent, representative or delegate of the Union of India. It is further understood and agreed that Union of India is not and shall not be liable for any acts, omissions, commissions, breaches or other wrongs arising out of the contract. Accordingly, bidder/ CONTRACTOR hereby expressly waives, releases and foregoes any and all actions or claims, including cross claims, impleader claims or counter claims against the Union of India arising out of this contract and covenants not to sue the Union of India as to any manner, claim, cause of action or thing whatsoever arising of or under this agreement.

18 CONSEQUENTIAL DAMAGE

Except as otherwise expressly provided, neither party shall be liable to the other for special, indirect or consequential damages resulting from or arising out of the contract, including but without limitation, to loss or profit or business interruptions, howsoever caused and regardless of whether such loss or damage was caused by the negligence (either sole or concurrent) of either party, its employees, agents or sub- CONTRACTORs.

19 RISK PURCHASE

In the event, CONTRACTOR's failure to provide the services as per the Contractual scope, terms and conditions, COMPANY (OIL) reserves the right to hire the services from any other source at the

CONTRACTOR's risk & cost and the difference in cost shall be borne by the CONTRACTOR. Further, OIL shall retain the right of forfeiture of Performance Bank Guarantee and any other action as deemed fit. In certain operational situations OIL reserves the right to take over the site including the service equipment at the risk and cost of the CONTRACTOR.

20 INDEMNITY AGREEMENT

a) Except as provided hereof CONTRACTOR agrees to protect, defend, indemnify and hold COMPANY harmless from and against all claims, suits, demands and causes of action, liabilities, expenses, cost, liens and judgments of every kind and character, without limit, which may arise in favour of CONTRACTOR's employees, agents, CONTRACTORs and sub-CONTRACTORs or their employees or in favour of any third party(is) on account of bodily injury or death, or damage to personnel/property as a result of the operations contemplated hereby, regardless of whether or not said claims, demands or causes of action arise out of the negligence or otherwise, in whole or in part or other faults.

b) Except as provided hereof COMPANY agrees to protect, defend, indemnify and hold CONTRACTOR harmless from and against all claims, suits, demands and causes of action, liabilities, expenses, cost, liens and judgments of every kind and character, without limit, which may arise in favour of COMPANY's employees, agents, CONTRACTORs and sub-CONTRACTORs or their employees or in favour of any third party(is) on account of bodily injury or death, or damage to personnel/property as a result of the operations contemplated hereby, regardless of whether or not said claims, demands or causes of action arise out of the negligence or otherwise, in whole or in part or other faults.

21 INDEMNITY APPLICATION

The indemnities given herein above, whether given by COMPANY or CONTRACTOR shall be without regard to fault or to the negligence of either party even though said loss, damage, liability, claim, demand, expense, cost or cause of action may be caused, occasioned by or contributed to by the negligence, either sole or concurrent of either party.

22 ROYALTY PATENTS

Each party shall hold harmless and indemnify the other from and against all claim and proceedings for or on account of any patent rights, design, trademark or other protected rights arising from any use of materials, equipment, processes, inventions and methods, which have not been imposed on the attending party by the terms of the contract or the specifications forming part thereof.

23 WARRANTY AND REMEDY OF DEFECTS

a) CONTRACTOR warrants that they shall perform the work in a first class, workmanlike, and professional manner and in accordance with their highest degree of quality, efficiency and current state of the art technology/industry practices and in conformity with all specifications, standards and drawings set forth or referred to in the Terms of Reference and with instructions and guidance, which COMPANY may, from time to time, furnish to the CONTRACTOR.

b) Should COMPANY discover at any time during the tenure of the Contract or till the Unit/equipment/tools are demobilised from site or base camp (if applicable) that the work does not conform to the foregoing warranty, CONTRACTOR shall after receipt of notice from COMPANY, promptly perform any and all corrective work required to make the services conform to the Warranty. Such corrective Work shall be performed entirely at CONTRACTOR's own expenses. If such corrective Work is not performed within a reasonable time, the COMPANY, at its option may have such remedial Work performed by others and charge the cost thereof to CONTRACTOR subject to a maximum of the contract value payable for the defective work which needs corrective action which the CONTRACTOR must pay promptly. In case CONTRACTOR fails to perform remedial work, or pay promptly in respect thereof, the performance security shall be forfeited.

24 SUBCONTRACTING/ASSIGNMENT

a) CONTRACTOR shall not subcontract, transfer or assign the contract, or any part under this contract, to any third party(ies). Except for the main services under this contract, CONTRACTOR may sub-contract the petty support services subject to COMPANY's prior written approval. However, CONTRACTOR shall be fully responsible for complete execution and performance of the services under the Contract.

b) Consequent upon of placement of contract, if successful bidder(s)(other than Micro/Small Enterprise) is procuring materials/services from their sub-vendor, who is a Micro or Small Enterprise registered with District Industry Centres or Khadi and Village Industries Commission or Khadi and Village Industries Board or Coir Board or National Small Industries Corporation or Directorate of Handicrafts and Handloom or any other body specified by Ministry of MSME with prior consent in writing of the purchasing authority/Engineer in Charge the details like Name, Registration No., Address, Contact No., details of material and value of procurement made, etc. of such enterprises shall be furnished by the CONTRACTOR at the time of submission of invoice/bill.

25 RECORDS, REPORTS AND INSPECTION

The CONTRACTOR shall, at all times during the currency of the contract, permit the COMPANY and its authorized employees and representatives to inspect all the Work performed and to witness and check all the measurements and tests made in connection with the said work. The CONTRACTOR

shall keep an authentic, accurate history and logs including safety records of each service item with major items consumed, which shall be open at all reasonable times for inspection by the COMPANY's designated representatives and its authorized employees. The CONTRACTOR shall provide the COMPANY's designated representatives with a daily written report, on form prescribed by the COMPANY showing details of operations during the preceding 24 hours and any other information related to the said services requested by the COMPANY whenever so requested. The CONTRACTOR shall not, without COMPANY's written consent allow any third person(s) access to the said information or give out to any third person information in connection therewith.

26 CONFIDENTIALITY, USE OF CONTRACT DOCUMENTS AND INFORMATION

a) CONTRACTOR shall not, without COMPANY's prior written consent, disclose the contract, or any provision thereof, or any specification, plan, drawing pattern, sample or information furnished by or on behalf of COMPANY in connection therewith, to any person other than a person employed by CONTRACTOR in the performance of the contract. Disclosure to any such employed person shall be made in confidence and shall extend only, as may be necessary for purposes of such performance with prior permission from COMPANY. However, nothing hereinabove contained shall deprive the CONTRACTOR of the right to use or disclose any information which is:

   I. possessed by the CONTRACTOR, as evidenced by the CONTRACTOR's written records, before receipt thereof from the COMPANY which however the CONTRACTOR shall immediately inform to COMPANY; or
   II. required to be disclosed by the CONTRACTOR pursuant to an order of a court of competent jurisdiction or other governmental agency having the power to order such disclosure, provided the CONTRACTOR uses its best efforts to provide timely notice to COMPANY of such order to permit COMPANY an opportunity to contest such order subject to prior permission from COMPANY.

b) CONTRACTOR shall not, without COMPANY's prior written consent, make use of any document or information except for purposes of performing the contract.

c) Any document supplied to the CONTRACTOR in relation to the contract other than the Contract itself remain the property of COMPANY and shall be returned (in all copies) to COMPANY on completion of CONTRACTOR's performance under the Contract if so, required by COMPANY.

d) During the currency of the Contract, COMPANY and its employees, agents, other CONTRACTORs, sub-CONTRACTORs (of any tier) and their employees etc. may be exposed to certain confidential information and data of the CONTRACTOR. Such information and data held by the COMPANY, its employees, agents, other CONTRACTORs, sub-CONTRACTORs (of any tier) and their employees in the strictest Confidence and shall not be disclosed to any other party except on a need to know basis.

However, the above obligation shall not extend to information which:

I. is, at the time of disclosure, known to the public which CONTRACTOR shall immediately inform COMPANY.
II. is lawfully becomes at a later date known to the public through no fault of CONTRACTOR subject to CONTRACTOR's undertaking that no information has been divulged by them to the public.
III. is lawfully possessed by CONTRACTOR before receipt thereof from COMPANY which should be immediately informed to COMPANY.
IV. is developed by CONTRACTOR independently of the information disclosed by COMPANY which should be shared with the COMPANY.
V. CONTRACTOR is required to produce before competent authorities or by court order subject to prior permission from COMPANY.

27 REMUNERATION AND TERMS OF PAYMENT

27.1 General conditions

27.1.1 COMPANY shall pay to the CONTRACTOR during the term of the Contract the amount due from time to time calculated according to the rates of payment set and in accordance with other provisions hereof. No other payments shall be due from COMPANY unless specifically provided for in the Contract. All payments will be made in accordance with the terms hereinafter described.

27.1.2 Request for payment/part payment to third party i.e. other than the party on whom the contract has been awarded will not be entertained by OIL under any circumstances.

27.1.3 MANNER OF PAYMENT: All payments due by COMPANY to CONTRACTOR hereunder shall be made at CONTRACTOR’s designated bank. Bank charges, if any will be on account of the CONTRACTOR.

27.1.4 Payment of any invoices shall not prejudice the right of COMPANY to question the validity of any charges therein, provided COMPANY within one year after the date of payment shall make and deliver to CONTRACTOR written notice of objection to any item or items the validity of which COMPANY questions.

27.1.5 INVOICES: Mobilization charges will be invoiced only upon completion of mobilization as certified by COMPANY representative and CONTRACTOR is ready at site for starting the services/ operation. Payment of mobilization charges shall be made within 45 days following the date of receipt of undisputed invoices by COMPANY.

27.1.6 CONTRACTOR shall send invoice to COMPANY on the day following the end of each month for all daily or monthly charges due to the CONTRACTOR.

27.1.7 CONTRACTOR will submit 02 (Two) sets of all invoices duly super scribed `Original' and `copy' as applicable to the COMPANY for processing payment. Separate invoices for the charges payable under the contract shall be submitted by the CONTRACTOR for foreign currency and Indian currency.

27.1.8 Payment of monthly invoices, if undisputed, shall be made within 30 days following the date of receipt of invoice by COMPANY.

27.1.9 COMPANY shall within 30 days of receipt of the invoice notify the CONTRACTOR of any item under dispute, specifying the reasons thereof, in which event, payment of the disputed amount may be withheld until settlement of the dispute, but payment shall be made of any undisputed portion on or before the due date. This will not prejudice the COMPANY's right to question the validity of the payment at a later date as envisaged in clause no. 27.1.4 above.

27.1.10 The acceptance by CONTRACTOR of part payment on any billing not paid on or before the due date shall not be deemed a waiver of CONTRACTOR's rights in any other billing, the payment of which may then or thereafter be due.

27.1.11 Payment of Final demobilization charges shall be made if applicable within 45 days on receipt of invoice by COMPANY accompanied by the following documents from the CONTRACTOR:

I. Audited account up to completion of the Contract.
II. Tax audit report for the above period as required under the Indian Tax Laws.
III. Documentary evidence regarding the submission of returns and payment to taxes for the expatriate personnel engaged by the CONTRACTOR or by its sub- CONTRACTOR.
IV. Proof of re-export of all items including the unutilized spares and consumables (excepting consumables consumed during the contract period) and also cancellation of re-export bond if any.
V. Any other documents as required by applicable Indian Laws.

27.1.12 In case, no demobilization charges are payable, the documents mentioned above will have to be submitted by the CONTRACTOR before release of the final payment by the COMPANY. A certificate from Chartered Accountant on (I), (II) & (III) above will suffice.

27.1.13 CONTRACTOR shall maintain complete and correct records of all information on which CONTRACTOR's invoice is based up to 02 (two) years from the date of last invoice. Such records shall be required for making appropriate adjustments or payments by either party in case of subsequent audit query/objection.

28 PAYMENT OF COMMISSION/FEE/REMUNERATION OF INDIAN AGENT / CONSULTANT / REPRESENTATIVE / RETAINER / ASSOCIATE OF FOREIGN PRINCIPAL (APPLICABLE IN ICB TENDERS ONLY)

The Commission/Fee/remuneration of the Indian agent / consultant /associate / representative /retainer, if any, will be paid within 30 days of the payment of invoice made to the CONTRACTOR, The amount of commission/fee/remuneration as a percentage of invoice value as per contract provisions will be deducted by COMPANY/OIL from the monthly invoices of the CONTRACTOR and paid to the Indian agent / consultant / representative / retainer / associate.

29 DETAILS OF STATUTORY PAYMENTS LIKE EPF AND ESI, ETC

Wherever applicable, the CONTRACTOR (including those engaging 'International Workers') shall have itself registered under Employees' Provident Fund and Miscellaneous Provisions Act, 1952 and Employees' State Insurance Act, 1948 and follow the relevant statutory provisions including Rules made there-under concerning contractual workers.

The CONTRACTOR shall be required to submit the following documents/details to the Corporation:

I. Copy of PF-ECR duly stamped by the designated Bank, along with a print of the digitally signed PDF data sheet of the ECR, as proof of payment, each month, details of this PDF data sheet shall be verified by the appropriate authority (i.e. Payment Making Authority) in the COMPANY from the official website of EPFO (http://www.epfindia.gov.in).

II. Copy of the online challan endorsed/stamped by the designated bank as proof of receipt of payment towards monthly contribution of ESI contribution.

III. Copy of Return of contribution in respect of ESI for each contribution period of the six months i.e. for the contribution period ended 30th Sept and the contribution period ended 31st March.

IV. As an Annexure to each EPF-ECR and ESI Challan(s), CONTRACTOR shall also furnish the following Certificates:

1) The furnished information is correct to the best of his knowledge.
2) In case any discrepancies or irregularities is /are noticed in this undertaking, then OIL is free to inform the PF/ESIC Authorities.
3) Before the completion of contract, CONTRACTOR shall serve one-month notice to all his contractual workers, informing that their services will be terminated.
4) Within one month on completion/expiry of the contract, CONTRACTOR shall pay all the dues/ terminal dues such as leave with wages, bonus (if applicable), Gratuity (if applicable), to all his contractual workmen, failing which CONTRACTOR's Bank Guarantee/ Security Deposit may be withheld by OIL.

COMPANY may verify the deposit of statutory contribution made by the CONTRACTORs with the EPFO/ESI authorities, where deemed necessary. However, before making payment of the last bill/invoice of the CONTRACTOR, the COMPANY may verify the details/status of the payment towards EPF/ESI made by the CONTRACTOR from the authorities/official website of EPF/ESI (i.e. http://www.epfindia.gov.in and http://www.esic.in). In case the information furnished by the CONTRACTOR is found to be incorrect the COMPANY shall take appropriate action against the CONTRACTOR in accordance with law.

The CONTRACTOR agrees and undertakes to indemnify OIL for any liabilities arising out of declarations made by him in future on violation or provisions of the EPF Act 1952 and ESI Act 1948.

30 TIMELY MOBILIZATION AND LIQUIDATED DAMAGES

a) Time is the essence of this Contract. If the CONTRACTOR fails to mobilize and deploy the required manpower/equipment and/or fails to commence the operation within the period specified as specified under mobilization clause under SCC, OIL shall have, without prejudice to any other right or remedy in law or contract including sub clause (b) below, the right to terminate the contract.

b) If the contractor is unable to mobilize/deploy and commence the operation within the period specified in sub clause (a) above, it may request OIL for extension of the time with unconditionally agreeing for levy and recovery of LD. Upon receipt of such a request, OIL may at its discretion, extend the period of mobilization and shall recover from the CONTRACTOR, as an ascertained and agreed Liquidated Damages, a sum equivalent to @ 0.5% of contract value including mobilization cost, per week or part thereof of delay subject to maximum of 7.5% of the Contract Price.

c) The parties agree that the sum specified above is not a penalty but a genuine pre-estimate of the loss/damage which will be suffered by OIL on account of delay on the part of the CONTRACTOR and the said amount will be payable without proof of actual loss or damage caused by such delay.

d) LD will be calculated on the basis of Total Contract value [(if not specified otherwise in SCC] excluding duties and taxes, where such duties/taxes have been shown separately in the contract. However, the applicable GST on the LD shall have to be borne by the CONTRACTOR. Accordingly, the liquidated damages shall be recovered from the CONTRACTOR along with applicable GST.

31 FORCE MAJEURE

a) In the event of either party being rendered unable by `Force Majeure' to perform any obligation required to be performed by them under the contract, the relative obligation of the party affected by such `Force Majeure' will stand suspended as provided herein. The term force majeure as employed herein shall mean Acts of God such as earthquake, hurricane, typhoon, flood, volcanic activity etc.; war (declared /undeclared); riot, revolts, rebellion, terrorism, sabotage by persons

other than the CONTRACTOR's Personnel; fires, explosions, ionising radiation or contamination by radio-activity or noxious gas, if not caused by CONTRACTOR's fault; declared epidemic or disaster; acts and regulations of respective Govt. of the two parties, namely the COMPANY and the CONTRACTOR and civil commotions, lockout not attributable to the CONTRACTOR.

b) Upon occurrence of such cause, the party claiming that it has been rendered unable as aforesaid thereby, shall notify the other party in writing within 72 (Seventy-Two) hours of the alleged beginning and ending thereof, giving full particulars and satisfactory evidence in support of its claim.

c) Should 'force majeure' condition as stated above occurs and should the same be notified within 72 (Seventy-two) hours after its occurrence the `force majeure' rate (if specified in the SCC of the Contract) shall apply for the first 15 (fifteen) days for each such occasion.

d) Either party shall have the right to terminate the Contract if such `force majeure' conditions continue beyond successive 60 (Sixty) days [or exclusively mentioned in the SCC of the Contract] with prior written notice of 15 days, provided termination of the Contract does not result into safety hazard to the life and property on account of withdrawal of operations or the operation is at critical stage. COMPANY shall have the absolute right to decide whether any safety hazard exists, or operation is at critical position and decision of the COMPANY shall binding upon the CONTRACTOR.

e) Should either party decide not to terminate the Contract even under such condition, no payment would apply after expiry of fifteen (15) days force majeure period. [or exclusively mentioned in the SCC of the Contract]

f) Time for performance of the relative obligation suspended by Force Majeure shall then stand extended by the period for which such cause lasts.

g) If however, relative obligation of the party affected by such 'Force Majeure' is limited to part of the obligation(s), the contract shall not be terminated and the parties shall continue to perform their respective obligations, which are not affected by the 'force majeure' condition, provided the obligations affected by the 'force majeure' do not preclude the parties in performing the obligations not affected by such conditions.

32 SET-OFF

Any sum of money due and payable to the CONTRACTOR (including Performance Security refundable to them) under this or any other Contract, whether in progress or in future, may be appropriated by OIL and set-off against any claim of OIL (or such other person or persons contracting through OIL) for payment of a sum of money arising out of this contract or under any other contract made by the CONTRACTOR with OIL (or such other person or persons contracting through OIL).

33 WITHHOLDING

COMPANY may withhold or nullify the whole or any part of the amount due to CONTRACTOR, after informing the CONTRACTOR of the reasons in writing, on account of subsequently discovered evidence in order to protect COMPANY from loss on account of:

a) For non-completion of jobs assigned as per Scope of Work/Terms of Reference.

b) Defective work not remedied by CONTRACTOR.

c) Claims by COMPANY's recognized sub-CONTRACTOR of CONTRACTOR or others filed or on the basis of reasonable evidence indicating probable filing of such claims against CONTRACTOR.

d) Failure of CONTRACTOR to pay or provide for the payment of salaries/ wages, contributions, taxes or enforced savings with-held from wages etc with respect to personnel engaged by the CONTRACTOR.

e) Failure of CONTRACTOR to pay the cost of removal of unnecessary debris, materials, tools, or machinery.

f) Any failure by CONTRACTOR to fully reimburse COMPANY under any of the indemnification provisions of this Contract. If, during the progress of the work CONTRACTOR shall allow any indebtedness to accrue for which CONTRACTOR, under any circumstances in the opinion of COMPANY, may be primarily or contingently liable or ultimately responsible and CONTRACTOR shall, within five days after demand is made by COMPANY, fail to pay and discharge such indebtedness, then COMPANY may during the period for which such indebtedness shall remain unpaid, with-hold from the amounts due to CONTRACTOR, a sum equal to the amount of such unpaid indebtedness.

g) Withholding will also be effected on account of the following:

   i. Order issued by a Court of Law or statutory authority in India.
   ii. Income-tax deductible at source according to law prevalent from time to time in the country.
   iii. Any obligation of CONTRACTOR which by any law prevalent from time to time to be discharged by COMPANY in the event of CONTRACTOR's failure to adhere to such laws.
   iv. Any payment due from CONTRACTOR in respect of unauthorised imports.

h) When all the above grounds for withholding payments are removed, payment shall thereafter be made for amounts so with-held.

i) COMPANY reserves the right to disburse or deposit the amount so withheld to the concerned person(s) or agency or government authority, as the case may be, besides nullifying such amount on account of loss suffered by the COMPANY against 33 b, 33 c, 33 f & 33 g above.

34 APPLICABLE LAWS

a) The Contract shall be deemed to be a Contract made under, governed by and construed in accordance with the laws of India for the time being in force and shall be subject to the sole and exclusive jurisdiction of Courts situated in Dibrugarh (or the Place where the contract is executed) and Principal Bench of Gauhati High Court (or the High Court under whose territorial jurisdiction, the place of execution of contract falls).

b) This Agreement including all matter connected with this Agreement, shall be governed by the laws of India (both substantive and procedural) for the time being in force and shall be subject to exclusive jurisdiction of Courts, mentioned hereinabove. Foreign companies, operating in India or entering into Joint ventures in India, shall also be governed by the laws of India and shall be subject to sole and exclusive jurisdiction of above Courts.

c) The CONTRACTOR shall ensure full compliance of various Indian Laws and Statutory Regulations, as stated below, to the extent applicable, as stated below, but not limited to, in force from time to time and obtain necessary permits/ licenses etc. from appropriate authorities for conducting operations under the Contract:

i. The Mines Act 1952
ii. The Oil Mines Regulations, 1984
iii. The Employees' Compensation Act, 1923
iv. The Code of Wages, 2019
v. The Contract Labour (Regulation & Abolition) Act, 1970 and the rules framed there under
vi. The Employees Pension Scheme, 1995
vii. The Interstate Migrant Workmen Act., 1979 (Regulation of employment and conditions of service).
viii. The Employees Provident Fund and Miscellaneous Provisions Act, 1952

- Goods and Service Tax Act
- Customs & Excise Act & Rules
- Factories Act, 1948
- Industrial Disputes Act, 1947
- Payment of Gratuity Act, 1972

- Environmental Protection Act, 1986 & other pollution control Acts.

Note: The above Acts are only indicative and not exhaustive. The Acts shall include the rules and regulations framed thereunder.

35 LABOUR LAWS

a) CONTRACTOR shall comply with the provisions of various labour related laws, including but not limited to the Code of Wages, 2019, Employee Provident Fund and Miscellaneous Provisions Act 1952, COMPANY's Liability Act 1938, Employees' Compensation Act 1923, Industrial Disputes Act 1947, the Maternity Benefit Act 1961 and Contract Labour (Regulation and Abolition) Act 1970, Employment of Children Act 1938, Employees' State Insurance Act, 1948 or any modifications/amendment thereof or any other law relating thereto and rules made there under from time to time.

b) No Labour below the age of eighteen [18] years shall be employed on the work.

c) CONTRACTOR shall not pay less than what is provided under law to labourers engaged by him on the work.

d) CONTRACTOR shall at his expense comply with all labour laws and keep the COMPANY indemnified in respect thereof.

e) CONTRACTOR shall pay equal wages for men and women in accordance with applicable Labour laws.

f) If the CONTRACTOR is covered under the Contract Labour (Regulation and Abolition) Act, he shall obtain a license from licensing authority [i.e. office of the Labour Commissioner] by payment of necessary prescribed fee and the deposit, if any, before starting the work under the Contract. Such fee/deposit shall be borne by the CONTRACTOR.

g) CONTRACTOR must obtain the PF Code from the concerned PF Authority under Employees Provident Fund and Miscellaneous Provisions Act, 1952. Similarly, CONTRACTOR must obtain ESI Code under Employees State Insurance Act.

h) CONTRACTOR being the employer of the labours/personnel to be engaged under the contract shall be liable to pay gratuity to the labours/personnel as per the provision of the Payment of Gratuity Act, 1972 and accordingly, shall keep the COMPANY indemnified in respect thereof. If, however, COMPANY requires to pay gratuity to such labour(s) as per the direction of the competent authority under the Act, COMPANY shall recover such amount from the outstanding dues payable to the CONTRACTOR under the contract or any other contract(s).

i) CONTRACTOR shall furnish to Engineer in Charge the distribution return of the number & description, by trades of the work people employed on the works. CONTRACTOR shall also submit on the 4th& 19th of every month to Engineer in Charge a true statement showing in respect of the 2nd half of the preceding month & the 1st half of the current month (1) the accidents that occurred during the said fortnight showing the circumstances under which they happened and the extent of damage and injury caused by them and (2) the number of female workers who have

been allowed Maternity Benefit as provided in the Maternity Benefit Act 1961 on Rules made there under and the amount paid to them.

j) Engineer in Charge shall on a report having been made by an inspecting officer as defined in Contract Labour (Regulation and Abolition) Act 1970 have the power to deduct from the money due to the CONTRACTOR any sum required or estimated to be required for making good the loss suffered by a worker or workers by reason of non-fulfilment of the conditions of the Contract for the benefit of workers, non-payment of wages or of deductions made from his or their wages which are not justified by the terms of the Contract or non- observance of the said regulations.

k) The CONTRACTOR shall indemnify the COMPANY against any payments to be made under and for the observance of the provisions of the aforesaid acts without prejudice to his right to obtain indemnity from his sub-CONTRACTOR.

36 STATUTORY REQUIREMENTS

During the tenure of this CONTRACT nothing shall be done by the CONTRACTOR in contravention of any law, act and/or rules/regulations, thereunder or any amendment

37 GENERAL HEALTH, SAFETY & ENVIRONMENT (HSE) GUIDELINES

a) It will be solely the CONTRACTOR's responsibility to fulfil all the legal formalities with respect to the Health, Safety and Environmental aspects of the entire job (namely, the person employed by him, the equipment, the environment, etc.) under the jurisdiction of the district of that state where it is operating. Ensure that all sub-CONTRACTORs hired by CONTRACTOR comply with the same requirement as the CONTRACTOR himself and shall be liable for ensuring compliance all HSE laws.

b) It will be entirely the responsibility of the Contractor/his supervisor/representative to ensure strict adherence to all HSE measures and statutory rules during operation in OIL's installations and safety of workers engaged by him. The crew members will not refuse to follow any instruction given by company's Installation Manager/Safety Officer/Engineer/Official/ Supervisor/Junior Engineer for safe operation.

c) Any compensation arising out of the job carried out by the Contractor whether related to pollution, Safety or Health will be paid by the contractor only.

d) Any compensation arising due to accident of the Contractor's personnel while carrying out the job, will be payable by the contractor.

e) When there is a significant risk to health, environment or safety of a person or place arising because of a non-compliance of HSE Measures Company shall have the right to direct the contractor to cease work until the non-compliance is corrected.

38 POLLUTION AND CONTAMINATION

The CONTRACTOR shall be liable for all surface and sub-surface pollution to the extent caused by CONTRACTOR and resulting from CONTRACTOR's operation/service or spillage or dumping of solvents/additive substances or pollutants, which the CONTRACTOR brings to the Site for use in connection with Work to be performed under this Contract.

Notwithstanding anything to the contrary contained herein, it is agreed that except on the ground of wilful misconduct or criminal misconduct, COMPANY shall release, indemnify and hold CONTRACTOR and its sub-CONTRACTORs harmless from any and all claims, judgments, losses, expenses and any costs related thereto (including but not limited to Court costs and "Attorney's fees") for:

a) Damage to or loss of any reservoir or producing formation; and/ or

b) Damage to or loss of any well; and/ or

c) Any other subsurface damage or loss; and/ or

d) Any property damage or loss or personal injury or death arising out of or in connection with a blowout, fire explosion and loss of well control regardless of cause.

39 STATUTORY VARIATION/NEWLY ENACTED LAW

a) All duties, taxes except otherwise specified in the Contract as applicable on the closing date of bid submission as per relevant acts and rules shall be in CONTRACTOR's account. Variation in case of custom duty on CIF value declared by the bidder shall be to COMPANY account.

b) In the event of introduction of any new legislation or any amendment or enforcement of any Act or Law, rules or regulations of Government of India or State Government(s) or Public Body, which becomes effective after the date of submission of Price Bid or revised price bid, if any, for this CONTRACT and which results in increased/decreased cost of the works under the CONTRACT through increased/decreased liability of taxes and/or duties, required to be paid by the CONTRACTOR, (other than personnel and Corporate taxes), the Parties shall agree to a revision in pricing to reflect such change subject to the production of documentary proof to the satisfaction of the COMPANY/CONTRACTOR as applicable to the extent which directly is attributable to such introduction of new legislation or change or amendment as mentioned above and adjudication by the competent authority (applicable when disputed by COMPANY) & the courts wherever levy of such taxes/duties are disputed by COMPANY/CONTRACTOR.

c) Any increase in net amount of the duties and taxes (i.e. the amount of taxes/duties payable minus eligible credit of taxes/duties paid on input services/inputs) after the contractual completion/mobilization date during the extended period will be to the CONTRACTOR's account, where delay in completion /mobilization period is attributable to the CONTRACTOR. However, any decrease in net amount of the duties and taxes (i.e. the amount of taxes/duties payable minus eligible credit of taxes/duties paid on input services/inputs) after the contractual completion/mobilization date will be to COMPANY's account.

d) The Contract Price and other prices given in the Schedule of Prices are based on the applicable tariff as indicated by the CONTRACTOR in the Schedule of Prices. In case this information subsequently proves to be wrong, incorrect or misleading, COMPANY will have no liability to reimburse/pay to the CONTRACTOR the excess duties, taxes, fees, if any finally levied/imposed by the concerned authorities. However, in such an event, COMPANY will have the right to recover the difference in case the rate of duty/tax finally assessed is on the lower side.

e) Notwithstanding the provision contained in Clause-39. a to 39.d above, the COMPANY shall not bear any liability in respect of:

   i. Personal taxes on the personnel deployed by CONTRACTOR, his sub-CONTRACTOR/sub-sub-CONTRACTORs and Agents etc.

   ii. Corporate taxes and Fringe benefit taxes in respect of CONTRACTOR and all of their sub-CONTRACTORs, agents etc.

   iii. Other taxes & duties including Customs Duty and GST in addition to new taxes etc. in respect of sub-CONTRACTORs, vendors, agents etc. of the CONTRACTOR.

   iv. Any liability on the CONTRACTOR, which was accrued under the old law or contract, which the CONTRACTOR is obligated to pay either to the COMPANY or to the Government Authority.

f) In order to ascertain the net impact of the amendment/ revisions/enactment of various provisions of taxes/duties, the CONTRACTOR is liable to provide following disclosure to COMPANY:

   i. Details of each of the input services used in relation to providing service to COMPANY including estimated monthly value of input service and GST tax amount.

   ii. Details of Inputs (material/consumable) used/required for providing service to COMPANY including estimated monthly value of input and GST paid/payable on purchase of inputs.

g) The above provisions would be applicable only in case of variation in rate of taxes and duties on supply of services to OIL and not applicable on taxes and duties on input (goods and services) towards such services.

h) Any claim or reduction on account of change in law shall be accompanied with undertaking that the provisions of anti- profiteering clause under GST Act have been complied with.

40 SEVERABILITY

Should any provision of this agreement be found to be invalid, illegal or otherwise not enforceable by any court of law, such finding shall not affect the remaining provisions hereto and they shall remain binding on the parties hereto.

41 COMMISSION OF MISCONDUCT / SUBMISSION OF FRAUDULENT DOCUMENT BY THE BIDDER / CONTRACTOR AND BANNING THEREOF

The information and documents furnished by the bidder/CONTRACTOR in respect of the tender/contract are accepted by COMPANY to be true and genuine. However, if it comes to the notice of the COMPANY anytime either during the pendency of the tender or after award of the contract or after completion the contract that a Bidder/CONTRACTOR furnished fraudulent document/false information in relation to the subject tender/contract or committed any misconduct, appropriate action shall be taken against the Bidder/CONTRACTOR for debarment/banning of the bidder/CONTRACTOR from participating in any future tender of the COMPANY in terms of the COMPANY's Banning Policy, 2017 besides making the CONTRACTOR liable for other penal action including termination of ongoing contract(s) at his/her risk and peril. In such event, the Performance Security in respect of ongoing contract(s) shall be forfeited by the COMPANY.

42 SETTLEMENT OF DISPUTES

If dispute of any kind whatsoever shall arise between the company and the contractor in connection with or arising out of the contract, including without prejudice to the generality of the foregoing, any question regarding its existence, validity or termination, or the execution of the facilities, whether during the progress of the facilities or after their completion and whether before or after the termination, abandonment or breach of the contract, the parties shall seek to resolve any such dispute or difference by mutual consultation. If the parties fail to resolve any such dispute or difference by mutual consultation, then the dispute may be settled through Settlement Advisory Committee (SAC). In the event, a dispute remains unsettled then Arbitration/ other remedies available under the applicable laws may be availed by the Contractor.

42.1 Resolution of Dispute through SAC

a) OIL has framed the Conciliation Rules 2020 in conformity with Part III of the Arbitration and Conciliation Act 1996 as amended from time to time for speedier, cost effective and amicable settlement of disputes through conciliation.

b) If the parties fail to resolve such a dispute or difference by mutual consultation as per clause no. 42, the dispute, if the parties agree, may be referred to conciliation in accordance with OIL Conciliation Rules 2020 as amended from time to time. A copy of the said Rules has been made available on OIL's Website i.e. www.oil-india.com

c) Where the invitation for conciliation has been accepted by the other party, the parties shall attempt to settle such dispute(s) amicably under OIL conciliation Rules 2020.

d) Parties shall invoke arbitration clauses only after exhausting the option of conciliation as an Alternative Dispute Resolution Mechanism. For the purpose of this clause, the option of conciliation shall be deemed to have been exhausted, even in case of rejection of conciliation by any of the parties.

42.2 Arbitration (Applicable for Suppliers/Contractors other than PSU and MSME)

a) Except as otherwise provided elsewhere in the contract, if any dispute, difference, question or disagreement arises between the parties hereto or their respective representatives or assignees, in connection with construction, meaning, operation, effect, interpretation of the contract or breach thereof which parties are unable to settle mutually through Conciliation/Mediation, the same shall be referred to Arbitration.

b) A party wishing to commence arbitration proceeding shall invoke an Arbitration Clause by giving 30 days' notice to the other party. The notice invoking arbitration shall specify all the points of dispute with details of the amount claimed to be referred to arbitration at the time of invocation of arbitration and not thereafter. If the claim is in foreign currency, the claimant shall indicate its value in Indian Rupee for the purpose of constitution of the arbitral tribunal.

c) The number of arbitrators and the appointing authority will be as under: Claim amount (excluding claim for interest and counter claim, if any).

Claim amount {excluding claim for interest and counter claim, if any)	Number of Arbitrator	Appointing Authority
Up to Rs. 25.00 Lakh	Not applicable	Not applicable
Above Rs. 25.00 Lakh Up to Rs. 5 Crore	Sole Arbitrator from the panel of Arbitrators' List maintained by OIL	Mutually to be decided by the Parties.

d) The Parties agree that dispute involving claims below Rs. 25 lakhs and above Rs. 5 crores shall not be subject matter of Arbitration but subject to the exclusive jurisdiction of the Court(s) situated at New Delhi.

e) The parties agree that they shall appoint only those persons as arbitrators who accept the conditions of the arbitration clause. No person shall be appointed as Arbitrator or Presiding Arbitrator who does not accept the conditions of the arbitration clause.

f) If any of the Arbitrators so appointed dies, resigns, becomes incapacitated or withdraws for any reason from the proceedings, it shall be lawful for the concerned party/arbitrators to appoint another person in his place in the same manner as aforesaid. Such person shall proceed with the reference from the stage where his predecessor had left if both parties consent for the same; otherwise, he shall proceed de novo.

g) Parties agree and undertake that neither shall be entitled for any pre- reference or pendente-lite interest on its claims. Parties agree that any claim for such interest made by any party shall be void. Parties agree that a claim for any such interest shall not be considered and shall be void. The Arbitrator or Tribunal shall have no right to award pre-reference or pendent-lite interest in the matter.

h) The arbitral tribunal shall complete the proceedings, make and publish the award within time stipulated in the Arbitration and Conciliation Act, 1996(as amended from time to time)

i) If after commencement of the arbitration proceedings, the parties agree to settle the dispute mutually or refer the dispute to conciliation, the arbitrators shall put the proceedings in abeyance until such period as requested by the parties. Where the proceedings are put in abeyance or terminated on account of mutual settlement of dispute by the parties, the fees payable to the arbitrators shall be determined as under:

    i. 20% of the fees if the claimant has not submitted a statement of claim.

    ii. 40% of the fees if the pleadings are complete.

    iii. 60% of the fees if the hearing has commenced.

    iv. 80% of the fees if the hearing is concluded but the award is yet to be passed.

j) Each party shall be responsible to make arrangements for the travel and stay etc. of the arbitrator appointed by it. Claimant shall also be responsible for making arrangements for travel and stay of the Presiding Arbitrator and the expenses incurred shall be shared equally by the parties. In the case of sole arbitrator, both parties shall equally share all expenditures that may be required to be incurred.

k) The fees and other administrative/secretarial expenses of the arbitrator(s) shall not exceed the model fee as stipulated in the Schedule of the Act and such expenses shall be equally borne by the parties.

l) The seat and venue of the arbitration proceeding shall be New Delhi.

42.3 Arbitration (applicable in case of Contract awarded on Public Sector Enterprise)

a) If the Parties fail to resolve such a dispute or differences by Mutual Consultation/Good Faith Discussions, such disputes or difference shall be taken up by either party for resolution through Administrative Mechanism for Resolution of CPSEs Disputes (AMRCD) as mentioned in DPE Office Memorandum No. 05/0003/2019-FTS-10937 dated 14.12.2022 issued by Department of Public Enterprises, Ministry of Heavy Industries and Public Enterprises, Government of India and its further clarifications, modifications and amendments, issued from time to time.

b) A party wishing to commence arbitration proceedings shall invoke Arbitration Clause and refer the dispute(s) to AMRCD with a copy to the other party. The notice invoking arbitration shall specify all the points of dispute with details of the amount claimed to be referred to arbitration at the time of invocation of arbitration and not thereafter.

c) Upon such reference, the dispute shall be decided by the Competent Authority appointed under the AMRCD, whose decision shall bind the parties finally and conclusively. The parties in the dispute will share equally the cost of the arbitration as intimated by the Arbitrator.

42.4 Arbitration (Applicable to Micro, Small and Medium Enterprise)

In the event of any dispute or difference relating to, arising from, or connected with the Contract, efforts shall be made to resolve the dispute(s) amicably by mutual consultation and in case such dispute(s) cannot be resolved through mutual consultation, then same shall be resolved through the procedure as prescribed in Section-18 of the Micro, Small and Medium Enterprises Development Act, 2006.

42.5 Exclusions

Parties agree that following matters shall not be referred to conciliation or arbitration:

a) Any claim, difference or dispute relating to, connected with or arising out of OIL's decision to initiate any proceedings for suspension or debarment or banning, or decision to suspend or to ban or to debar business dealings with the bidder/CONTRACTOR and/or with any other person involved or connected or dealing with bid / contract / bidder / CONTRACTOR.

b) Any claim, difference or dispute relating to, connected with or arising out of OIL's decision under the provisions of Integrity Pact executed between OIL and the Bidder/CONTRACTOR.

c) Any claim, difference or dispute relating to, connected with or arising out of OIL's decision to comply with any order or directive of any statutory or government authority.

43 COMPLETION OF CONTRACT

Unless otherwise terminated under the provisions of any other relevant Clause or extended through written communication, this Contract shall be deemed to have been completed at the expiry of the Period specified in the contract or period of defect liability, as provided for under the Contract, whichever is later.

44 TERMINATION

44.1 General Conditions

44.1.1 Termination on expiry of the contract: This Agreement shall be deemed to have been automatically terminated on the expiry of the contract period unless OIL has exercised its option to extend this contract in accordance with the provisions, if any, of this contract.

44.1.2 Termination of contract for death: If the CONTRACTOR is an individual or a proprietary concern and the individual or the proprietor dies or if the CONTRACTOR is a partnership concern and one of the partners dies then unless, the COMPANY is satisfied that the legal heir of the individual or the proprietary concern or the surviving partners are capable of carrying out and completing Contract, the COMPANY is entitled to cancel the Contract for the uncompleted part without being in any way liable for any compensation payment to the estate of the deceased CONTRACTOR and/or to the surviving partners of the CONTRACTOR's firm on account of the cancellation of Contract. The decision of the COMPANY in such assessment shall be final & binding on the parties. In the event of such cancellation, the COMPANY shall not hold the estate of the deceased CONTRACTOR and/or the surviving partners of CONTRACTOR's firm liable for any damages for non-completion of the Contract.

44.1.3 Termination on account of Force Majeure: Unless the contract provides otherwise, either party shall have the right to terminate this Contract on account of Force Majeure as set forth in Article-31.0 above.

44.1.4 Termination on account of insolvency: In the event that the CONTRACTOR or its collaborator or its guarantor at any time during the term of the Contract, becomes insolvent or makes a voluntary assignment of its assets for the benefit of creditors or is adjudged bankrupt or under the process of insolvency or liquidation, then the COMPANY shall, by a notice in writing have the right to terminate the Contract and all the CONTRACTOR's rights and privileges hereunder, shall stand terminated forthwith.

However, COMPANY shall be at liberty to give the Receiver or Liquidator or Insolvency Professional Manager, as appointed by the Competent Court/Tribunal, the option of carrying out the Contract subject to its technical & financial competence and his providing a guarantee for due and faithful performance of the Contract.

44.1.5 Termination for Unsatisfactory Performance: If the COMPANY considers that, the performance of the CONTRACTOR is unsatisfactory, or not as per the provision of the Contract, the COMPANY shall notify the CONTRACTOR in writing and specify in detail the cause of dissatisfaction. The COMPANY shall have the option to terminate the Contract by giving 15 days' notice in writing to the CONTRACTOR, if CONTRACTOR fails to comply with the requisitions contained in the said written notice issued by the COMPANY. In the event CONTRACTOR rectifies its non-performance to the satisfaction of the COMPANY, the option of termination may not be exercised by the COMPANY. If, however, CONTRACTOR repeats non-performance subsequently, COMPANY shall exercise the option to terminate contract by giving 07 days' notice. Such CONTRACTOR shall be put on holiday as per the Banning Policy of OIL [available at www.oil-india.in].

44.1.6 Termination due to change of ownership and Assignment: In case the CONTRACTOR's rights and/or obligations under this Contract and/or the CONTRACTOR's rights, title and interest to the equipment/ material, are transferred or assigned without the COMPANY's written consent, the COMPANY may at its option, terminate this Contract. COMPANY shall not be however under any obligation to accord consent to the CONTRACTOR for change of ownership & assignment of the contract.

If at any time during the term of this Contract, breakdown of CONTRACTOR's equipment results in CONTRACTORs being unable to perform their obligations hereunder for a period of 15 successive days, COMPANY at its option, may terminate this Contract in its entirely or partially to the extent non-performance, without any further right or obligation on the part of the COMPANY, except for the payment of money then due. No notice shall be served by the COMPANY under the condition stated above.

44.1.7 Termination for delay in mobilization: CONTRACTOR is required to mobilize complete equipment along with crew for commencement of services at the specified site within the maximum allowed number of days from the date of LOA/Notice for Mobilization as specified in the special conditions of contract. If the CONTRACTOR (successful bidder) fails to complete the mobilization as above, OIL shall have, without prejudice to any other clause of the CONTRACT, the right to terminate the contract.

Notwithstanding any provisions herein to the contrary, the Contract may be terminated at any time by the COMPANY on giving 30 (thirty) days written notice to the CONTRACTOR due to any other reason not covered under the above 98 from **44.1.1** to **44.1.7** and in the event of such termination the COMPANY shall not be liable to pay any cost or damage to the CONTRACTOR except for payment of services as per the Contract up to the date of termination.

44.1.8 Consequence of Termination: In all cases of termination herein set forth, the relative obligations of the parties to the Contract shall be limited to the period up to the date of termination. Notwithstanding the termination of this Contract, the parties shall continue to be bound by the provisions of this Contract that reasonably require some action or forbearance after such termination.

Upon termination of this Contract, CONTRACTOR shall return to COMPANY all of COMPANY's properties, which are at the time in CONTRACTOR's possession.

In the event of termination of contract, COMPANY will issue Notice of termination of the contract with date or event after which the contract will be terminated. The contract shall then stand terminated, and the CONTRACTOR shall demobilize their personnel & materials.

Demobilization charges shall not be payable by COMPANY in case of Article from **44.1.4 to 44.1.6**

45 TO DETERMINE THE CONTRACT

In such an event (i.e. termination under Article No. 44.1.4 to 44.1.7 above), the contract shall stand terminated and shall cease to be in force from the date of such notification by the COMPANY. Thereafter the CONTRACTOR shall stop forthwith any of the work then in progress, except those work which the COMPANY may, in writing, require to be done to safeguard any property or work, or installations from damages, and the COMPANY may take over the remaining unfinished work of the CONTRACTOR and complete the same through a fresh CONTRACTOR or by other means, at the risk and cost of the CONTRACTOR, and any of its sureties if any, shall be liable to the COMPANY for any excess cost occasioned by such work having to be so taken over and completed by the COMPANY over and above the cost at the rate/cost specified in the schedule of quantities and rates/prices.

46 WITHOUT DETERMINING THE CONTRACT

In such an event (i.e. termination under Article No. 44.1.4 to 44.1.7 above), the COMPANY may take over the work of the CONTRACTOR or any part thereof and complete the same through a fresh CONTRACTOR or by other means, at the risk and cost of the CONTRACTOR. The CONTRACTOR and any of its sureties are liable to the COMPANY for any excess cost over and above the cost at the rates specified in the schedule of quantities and rates/prices, occasioned by such work having been taken over and completed by the COMPANY.

47 ERRING/DEFAULTING AGENCIES

Erring and defaulting agencies like bidder, CONTRACTOR, supplier, vendor, service provider will be dealt as per OIL's Banning Policy dated 6th January 2017 available in OIL's website: www.oil-india.com. Moreover, OIL reserves the right to take legal or any other action on the basis of merit of the case.

48 MISCELLANEOUS PROVISIONS

CONTRACTOR shall give notices and pay all fees at their own cost required to be given or paid by any National or State Statute, Ordinance, or other Law or any regulation, or bye-law of any local or other duly constituted authority as may be in force from time to time in India, in relation to the

performance of the services and by the rules & regulations of all public bodies and companies whose property or rights are affected or may be affected in any way by the services.

CONTRACTOR shall conform in all respects with the provisions of any Statute, Ordinance of Law as aforesaid and the regulations or bye-law of any local or other duly constituted authority which may be applicable to the services and with such rules and regulation, public bodies and Companies as aforesaid and shall keep COMPANY indemnified against all penalties and liability of every kind for breach of any such Statute, Ordinance or Law, regulation or bye-law.

During the tenure of the Contract, CONTRACTOR shall keep the site where the services are being performed reasonably free from all unnecessary obstruction and shall store or dispose of any equipment and surplus materials and clear away and remove from the site any wreckage, rubbish or temporary works no longer required. On the completion of the services, CONTRACTOR shall clear away and remove from the site any surplus materials; rubbish or temporary works of every kind and leave the whole of the site clean and in workmanlike condition to the satisfaction of the COMPANY.

Key personnel cannot be changed during the tenure of the Contract except due to sickness/death/resignation of the personnel or any other justified situation in which case the replaced person should have equal experience and qualification, which will be again subject to prior approval, by the COMPANY.

Format for Undertaking

UNDERTAKING REGARDING NON-INCLUSION OF HAZARDOUS SUBSTANCES

[as per GCC Clause No. 14.12 (v)]

[On company's Letter Head]

To,
ED (OGEL)
OGEL Office
NBCC Center, 6th Floor,
Ma Anandmayee Marg,
Okhla Industrial Area Phase-1,
New Delhi - 110020

Dear Sir,

This has reference to your Tender No. ..... Dated ..... 20___ on the subject .....

We.....(Name of the Company) confirm that no hazardous substance as stipulated in the Public Liability Insurance Act 1991 and the Rules framed thereunder will be handled during the performance of the aforesaid Tender/Contract.

It is hereby also confirmed that we will hold OIL harmless in case of any claim on us under the Public Liability Act Policy covering the statutory liability arising out of accidents occurring during the currency of the contract due to handling hazardous substances as provided in the Public Liability Insurance Act 1991 and the Rules framed thereunder.

Signature

(Name & Designation of Authorized person)

END OF SECTION-IV

Section-V Special Conditions of Contract

Table of Contents

1 INTRODUCTION 108
1.1 Definitions & Interpretation 108
1.2 Intent of Contract 111
1.3 Proposed Location 112
1.4 Site Visit 113

2 GENERAL REQUIREMENTS 114
2.1 Statutory And Other Requirement 114
2.2 Services during Execution 116
2.3 Temporary Facilities 119
2.4 Documentation 120
2.5 Applicable Codes, Standards and Regulations 122
2.6 GENERAL QUALITY ASSURANCE PLAN (QAP) 122
2.7 Mechanical Completion 124
2.8 Commissioning & Stabilization 125
2.9 Consumables 125
2.10 Project Monitoring, Planning and Submission of Detailed Project Schedule 126

3 SCHEDULE OF PAYMENT FOR EPC 127
3.1 General Requirement 128
3.2 Payments against EPC Works 129
3.3 Payment Terms for Operation and Maintenance 130
3.4 Payment against O&M Works 131

4 INSURANCE 132
4.1 During Execution of Project 132
4.2 During O&M Period (Insurance by Owner) 132
4.3 During O&M Period (Insurance by Contractor) 133

5 TRANSPORTATION & CUSTOM CLEARANCE 134
5.1 Transportation 134
5.2 Custom Clearance 134

6 TIME FOR COMMENCEMENT AND COMPLETION 134

7 DEFECT LIABILITY PERIOD (DLP) 135

8 PRICE DISCOUNT 136
8.1 Delay in Completion of Work & Services 136

9 CONTRACT CUM EQUIPMENT PERFORMANCE BANK GUARANTEE (CPBG) 136
9.1 PBG For EPC work 136
9.2 BG For Comprehensive O&M Contract Works 136

10 GUARANTEED PRODUCTION 137

11 PERFORMANCE GUARANTEE TEST RUN 138

11.1 Performance Test 138
11.2 Requirement for successful completion of the PGTR 149
11.3 Price Discount on PGTR failure 150
11.4 Test Results and Report 150
11.5 Availability Test 151

12 GUARANTEE AND PRICE DISCOUNT 152

12.1 Performance during PGTR 152
12.2 Performance during O&M Period 154

13 QUALITY OF FOM 155

13.1 General Requirements 155

14 ENERGY CONSUMPTION 155

14.1 General requirements 155

15 SPARES 156

15.1 Spare Parts & Tools 156
15.2 Mandatory Spares 158
15.3 O&M Spares 158

16 OWNER'S REPRESENTATIVE AT SITE: 158

17 PAINTS, CONSUMABLES 158

18 THIRD PARTY INSPECTION 158

19 OPERATION AND MAINTENANCE MANUALS 159

19.1 Erection Manuals 159
19.2 Submission and Approval of Drawings 159
19.3 Test Reports 160
19.4 Field Quality Plan 160

20 HSE POLICY 160

21 SUBMISSION OF INVOICE 160

22 PLACE OF ARBITRATION 160

23 ORDER OF PRECEDENCE 160

24 INFORMATION TO BE PROVIDED 161

1 INTRODUCTION

The plant should be designed to process 200 TPD of Source Segregated organic fraction of municipal solid waste (organic fraction 80% and baove), However, the capacity utilization factor is as follows

a) 1st year 50%
b) 2nd year 65%
c) 3rd year 80%
d) 4th year 95%
e) 5th year onwards 100%

1.1 Definitions & Interpretation

Acts/Codes shall mean, but not limited to as described in clause 2.5, including the latest amendments, and/or replacements

Applicable Laws shall mean any statute, law, regulation, ordinance, rule, judgment, order, decree, restriction, directive, governmental authorizations, requirements of Applicable Permits and any agreements, decisions, acts, instructions, requirements, directions and notifications of the competent authority having jurisdiction over the matter in question, whether in effect as of the date of Contact Agreement or thereafter.

Bid and Bid Document shall mean the proposal submitted by the Bidder in response to this ITB in accordance with the terms and conditions hereof.

Bidder shall mean the Bidding Entity or the Bidding Consortium which has submitted a proposal, in response to this ITB to Owner.

Bidding Entity shall mean a single entity, whether a firm or a Company.

BIS shall mean Bureau of Indian Standards.

Bidding Consortium shall mean a consortium of entities, being firms, companies or Governmental entities which have submitted a proposal in response to this ITB.

Company means Oil India Limited

Commencement of the Work shall mean the contractor shall initiate the assigned work by submitting the Project Schedule/ submitting the basic engineering drawings & documents / filing the applicable statutory applications such as the Consent to Establish (CTE) etc.

COMMISSIONING means Commissioning of the unit will be considered once commissioning tests are completed, trial operation including the reliability run is completed and the biogas generation is established from MSW feedstock at rated full load or part load, as per the feedstock made available by the Owner.

Contractor means the person or the persons, firm or Company or corporation whose tender has been accepted by the Employer and includes the Contractor's legal Representatives, his successors and permitted assigns.

CAPEX Total capital cost of project

CBG means Compressed Biogas

CH_4 means Methane gas

DISCOM means 'Concerned Distribution Utility of the State'.

DEVELOPER means the Company responsible for Design, Engineering, Financing, Construction, Procurement, Installation, Commissioning and Operation & Maintenance (O&M) of the Biogas/ CBG Project based on SSOF-MSW segregation plant followed by a separate dry and wet waste processing line executed at single location and for the same plant in India.

Effective Date / Zero Date shall mean the date of issue of Fax/ Letter of Intent

Engineering, Procurement and Construction Contractor (EPC) shall mean the firm / company or party on whom the Letter of Intent / Work Order for faithful execution of the work mentioned herein is placed and shall include his / her / their heirs, legal representatives and successors and permitted assigns.

EPCOM means Engineering, procurement, Commissioning and Operation & maintenance

ETP means Effluent treatment plant

EST means Environmentally Sound Technology

FOM means Fermented Organic Manure

FQAP means Field Quality assurance plan

HAZOP means Hazard and Operability Study

HSE means Health, safety & environmental

KW/MW means Kilo Watt/Mega Watt

KWh means Kilowatt Hours

LFOM means Liquid Fermented Organic Manure

Mechanical completion means as defined in clause 2.7

MSW means UnSource Segregated Municipal solid waste

Major facilities mean as listed at clause 2.23

Mobilization means commencement of work for the project

NM^3 means Normal cubic meter

NABAL means National accreditation Board

O&M shall mean Operation & Maintenance of CBG project which inter alia, includes provisions of manpower, spares, special tools, cranes or such materials/equipment that may be required for maintaining the CBG facility operational.

Operator shall mean the person or the persons, firm or Company or corporation whose tender has been accepted for operation & maintenance by the Owner and includes the Contractor's legal Representatives, his successors and permitted assigns.

OPEX Total Operation & maintenance cost of Plant

OEC means Outside Expert Committee

Project shall mean the Development, Design, Engineering, Supply, Procurement and Construction, Commissioning 200 TPD SSOF-MSW Based Compressed Biogas Plant in Sambalpur, Odisha.

Project Life means the operational life of CBG plant and all associated equipment and the same shall not be less than 25 years.

Prudent Utility Practice means accepted international/Indian practice(s), standard(s), engineering and operation considerations, taking into account the conditions prevalent at Site including manufacturer's recommendations generally followed in the operation and maintenance of facilities similar to the CBG plant

PMC means Project Management consultant

PLC/SCADA means Supervisory control & data acquisition

PPE means Personal Protective Equipment

Performance Guarantee Test Run (**PGTR**) means procedure as defined in General Technical Specification Clause 9

MQAP means Manufacturing Quality assurance plan

SSOF-MSW means Source Segregated Organic Fraction of municipal solid waste

Stabilization Period shall be considered achieved once biogas generation is established using MSW feedstock of minimum 100 TPD and up to the quantity of feedstock made available by Sambalpur Municipal Corporation (SMC), subject to a maximum plant capacity of 200 TPD, continuously for a minimum period of 7 days, with all sections including pre-treatment, hydrolyser, digester, purification, compression, and effluent treatment systems operating successfully.

Time Period for Commissioning refers to clause 6

Time Schedule shall mean the period by which the work shall be completed as agreed herein between the Owner and the Contractor

TPD means Ton per day

Temporary facilities mean as defined at clause 2.3

1.2 Intent of Contract

1.2.1 The scope of the proposal comprises of the design, engineering, manufacture, assembly, testing at Manufacturer's works, packaging into properly sized units and shipping, comprehensive marine cum erection insurance, transport, delivery to site, receipt, handling and storage at site, erection, testing and commissioning and putting into operation of the Complete Compressed Bio-Gas plant with auxiliaries as detailed in the accompanied specification including 10 (ten) year of Operation and Maintenance for 200 TPD Source Segregated Organic Fraction of Municipal Solid Waste Based Compressed Biogas (CBG) Plant in Sambalpur, Odisha.

1.2.2 It is also the intent of the contract to assign single point responsibility for the EPCOM Contract.

1.2.3 It is also the intent of the contract that all costs relating to interest and financing during construction be borne by the bidder.

1.2.4 The equipment and installation shall conform to high standards of engineering, design, and workmanship in all respects and shall be capable of performing continuous operation in satisfactory manner. The Contractor within the contract price shall provide all supplies and services including any equipment or accessories not specified herein but necessary for satisfactory operation of the CBG plant.

1.2.5 It is the responsibility of the Contractor to obtain any permit or license etc. wherever applicable for this work on behalf of the Owner.

1.3 Proposed Location

1.3.1 OIL in association with Sambalpur Municipal Corporation has identified a plot of land measuring about 10.90 acres for establishing the CBG plant. Land will be handed over to successful bidder for setting up the plant. The plot plan is attached as **Annexure- 6.**

1.3.2 The land is located at Plot No. 1649(3.45 Acre) 1790(7.45 Acrea) Kissam: Gochar, Khata No. 160(Rakhita), Mouza-Sikirdi, Tahsil: Sambalpur Sadar, Sambalpur District, Odisha.

1.3.3 Features of Project Site

Site Coordinates	21°27'30.82"N 83°55'14.03"E
Site Area	Approx. 10.90 acres
Site Location	Plot No. 1649(3.45 Acre) 1790(7.45 Acrea) Kissam: Gochar, Khata No. 160(Rakhita), Mouza-Sikirdi, Tahsil: Sambalpur Sadar, Sambalpur District
Topographic Survey	The indicative topography report of the land identified is attached at **Appendix -1**

Soil Investigation Report	The indicative Soil test reports is attached as **Appendix-2**
Nearest HT Substation(s)	Location : Near Rathi Plant, bio-Mining Site **Voltage:** 440 Volt, 3 Phase **Capacity:** 63 KVA Transformer Approximately **2KM**

1.4 Site Visit

1.4.1 The Bidder is advised to visit and examine the site of works and its surroundings. It is the Bidder's responsibility to obtain all necessary information for preparing the Bid and entering into a Contract for the required job. The costs associated with visiting the site shall be borne by the Bidder.

1.4.2 The Bidder or any of its personnel or agents shall be granted permission by the Owner to enter upon its premises and land/area for the purpose of such visits, but only upon the express conditions that the Bidder, its personnel and agents will release and indemnify the Owner and its personnel, agents from and against all liabilities in respect thereof, and will be responsible for death or injury, loss or damage to property, and any other loss, damage, costs, and expenses incurred as a result of inspection.

1.4.3 The Bidder shall not be entitled to make any claims against the Owner for non-compliance due to a lack of prerequisite information. It is the sole responsibility of the Bidder to obtain all necessary information regarding the site, surroundings, working conditions, weather, etc., before submitting the bid.

1.4.4 Bidder shall visit the site and carry out required land investigation studies before participating in the bid.

1.4.5 The Bidders, in their own interest, should inspect and examine the site and its surroundings and satisfy themselves, before submitting their tender, in respect of the site conditions including but not restricted to the following which may influence or affect the work or cost thereof under the Contract:

a) Site conditions including access to the site, existing and required roads and other means of transport/communication for use by them in connection with the works.
b) Requirement and availability of land and other facilities for their enabling works, colonies, stores and workshops etc.
c) Ground conditions including those bearing upon transportation, disposal, handling and storage of materials required for the work or obtained there from.
d) Source and extent of availability of suitable materials including water, etc. and labour (skilled and un-skilled), required for work and Laws and Regulations governing their use and employment.
e) Geological, meteorological, topographical and other general features of the site and its surroundings as are pertaining to and needed for the performance of the work.

f) The limit and extent of surface and Sub-surface water to be encountered during the performance of the work and the requirement of drainage and pumping.

g) Green Belt development as mandated by the SPCB; the Government of Odisha shall be considered while developing the site for the proposed CBG Plant.

h) All other information pertaining to and needed for the work including information as to the risks, contingencies and other circumstances which may influence or affect the work or the cost there of under this Contract.

i) Transportation & Logistic constraints etc. to the locations. The Bidders should note that information, if any, in this tender document, has been given merely to assist the Bidders and is not warranted to be complete. The Bidders should note and bear in mind that the Owner shall bear no responsibility for the lack of acquaintance of the site and other conditions or any information relating thereto, on their part. The consequences of the lack of any knowledge, as aforesaid, on the part of the Bidders shall be at their risk and cost and no charges or claims whatsoever consequent upon the lack of any information, knowledge or understanding shall be entertained or payable by the Owner.

2 GENERAL REQUIREMENTS

i) This document shall be read in conjunction with the discipline wise scope of work, detailed technical specifications, drawings and other documents included in the bidding document.

ii) The equipment covered under the scope are required for a vital installation where the continuity of service is of utmost importance. Their design, materials and manufacture shall be of highest order to ensure continuous and trouble-free operation.

iii) The equipment design must comply with the relevant provisions outlined in the Technical Specifications of the bidding document. All similar items and removable parts of similar equipment must be identical and interchangeable. All materials used should be of the best quality and capable of performing satisfactorily under the specific site climatic conditions.

iv) In the event of any discrepancies among various sections, drawings, schedules, etc., the most stringent requirement shall prevail. The Owner's decision will be final and binding on the Contractor.

2.1 Statutory And Other Requirement

2.1.1 The bidder must obtain all necessary approvals, coordination, and permissions from various agencies to ensure the smooth operation of the plant. The Bidder must secure all state-related approvals as well. All approvals related to land procurement will be the responsibility of the Owner. All approvals related to preconstruction, construction, and operation will be the responsibility of the Contractor. The selected bidder must have valid licenses and insurance for all staff and equipment required on-site. Additionally, obtaining all necessary safety-related licenses and approvals for the execution of the work will be the bidder's responsibility.

2.1.2 Below are the minimum statutory and non-statutory approvals, along with their respective responsibilities, for the CBG plant. However, if any further approvals not listed below but it is required for the smooth operation of the plant then, it can be mutually discussed whose responsibilities it is in later stage. Also, bidder may propose if any further approvals is required during bidding itself.

Sl. No.	Description
1.	Authorization under the Solid Waste Management Rules, 2016.
2.	Consent to Establish under Water Act, 1974
3.	Consent to Establish under Air Act, 1981
4.	Authorization under Rule 6 of the Hazardous and Other Wastes (Management, Handling and Transboundary Movement) Rules, 2016.
5.	NOC under Fire Force Act, 1986.
6.	Factory License under the Factories Act, 1948.
7.	Petroleum and Explosives Safety Organization (PESO) License.
8.	Approval under Static and Mobile Pressure Vessel (SMPV) Rules, 2016.
9.	Local Offices, as applicable - District Magistrate, Sub divisional Magistrate, Local Police etc.
10.	Any EIA Study, Environment Clearance (EC) and all other Statutory Approvals required from any local / state / central / any other authority for Construction as well Operation & Maintenance of the Facility
11.	The Weigh bridge should be got stamped and approved from Weights & Measures department of the state

2.1.3 The above list is indicative but not exhaustive. Any other approval which might be required as part of construction, commissioning, and operation of the plant it is the bidder's responsibility to obtain the same.

2.1.4 The bidder will take responsibility which shall also include preparation and submission of the applications along with the required documentation, co-ordination / liasoning with the respective statutory bodies, facilitating the visits by the Officials for inspection at site etc, for obtaining all necessary statutory clearances/approvals prior to construction/operation as applicable. OIL will pay/reimburse (on actuals) the required License/Statutory fees to be paid to the various Statutory Bodies, upon submission of documentary evidence. All the original copies of the approvals must be submitted to OIL.

2.1.5 Detail engineering includes preparation and submission of P&ID, design calculations, drawings, data sheets of equipment, based on the Technical Package / FEED attached in the Bid Package.

2.1.6 Facilitate in HAZOP study with the OIL, Engineering Consultant & Equipment manufacturers and submission of its report to Client / PMC for approval and implementation.

2.1.7 Obtaining approval of Engineering Documents from OIL/ PMC.

2.1.8 Approvals from Regulatory and statutory bodies.

2.1.9 All material Procurement including Bought out items / systems.

2.2 Services during Execution

2.2.1 Inspection of material at shop by TPI agency as specified in the tender.

2.2.2 FAT, SAT, calibration, testing of instruments.

2.2.3 Supply, clearing, forwarding, transportation, port handling, unloading, storage, safety, security of all materials required for successful completion of the project.

2.2.4 All works associated with;

- Construction
- Erection
- Installation
- Integration
- Mechanical Completion
- Commissioning
- PGTR and Handover

2.2.5 Safety permit clearance from the OIL/PMC and to meet all the statutory requirement and guidelines of OIL to obtain the safety and work permit for executing the job. Work permits shall be taken for every activity prior to start of the actual work. Any deviation from the safety system will lead to financial deterrent and subsequently to termination of the contractor.

2.2.6 Security of the material and stores issue/report arrangement is in the scope of CONTRACTOR.

2.2.7 All safety requirements including safety barricading of the area as per the requirement of OIL/PMC. HSE team for carrying out the work permit condition shall be provided by the contractor.

2.2.8 Obtaining permits / permission from site in-charge / OIL for necessary construction, erection and hot work as applicable.

2.2.9 Contractor shall ensure the progress of work and completed work shall obtain certification / approval from PMC for the purpose of progress reporting and invoicing.

2.2.10 Implementation of safety audit check list points during pre- commissioning audit or any safety audit internal or external.

2.2.11 Manufacturing and shop Fabrication, modification work, erection, construction, installation, testing, hook up, of all items covered in in scope of contractor.

2.2.12 All Civil works including but not limited to Land development of complete plant, Site grading/levelling, admin building, control room, Road, Construction, boundary wall development with gates etc. and other works as per scope.

2.2.13 Trial pits for finalizing the underground pipe routing and foundation requirement for equipment.

2.2.14 With a view to minimize site fabrication work, the bidders may consider prefabricated pipe work, structural, and Modular equipment/ packages as a single skid to minimize construction work at site.

2.2.15 Contractor shall submit Schedule for submission of all engineering documents and drawings during kick off meeting. This schedule will be discussed and finalized for execution.

2.2.16 Documentation including As-Built Data Folders, operating and commissioning manual. All the as build documents including Manufacturing Data Book, As built drawings of piping, equipment, Civil, Electrical & Instrumentation related diagrams. The native files of the various design software's shall also be submitted.

2.2.17 Guarantees as per General terms & conditions of the contract.

2.2.18 All tools and spares for start-up, commissioning complete as per contract document.

2.2.19 Supply of tools, mandatory spares and Operational spares as listed in Technical Bid Package and specification along with Supply of commissioning spares and materials.

2.2.20 Any other item not specified above but required for making the unit complete, safe, operable and consistent with good engineering practices.

2.2.21 Detailed Scope of Work in Sub Sections below for:

- Mechanical & Painting & Insulation
- Civil
- Electrical
- Instrumentation

2.2.22 At the end of successful PGTR and at the end of contract period of O&M during the handover of the plant, Contractor shall arrange Formal classroom and hands on training program for Owner's operating and maintenance personnel for the CBG Plant. The Training should be extensive in nature and should cover all aspect of:

- Operation

- Preventive Maintenance & Regular Maintenance
- Breakdown Maintenance
- Emergency Shutdowns & Safe Shutdowns
- Preservation of Equipment's
- Calibration of Equipment's and Instruments
- Operation and Maintenance Record Keeping
- Stores and Inventories Record

2.2.23 Performing comprehensive operation and maintenance with all consumables and spares for 10 years from date of successful commissioning. However, the first year of O&M shall not include the spares, as the same shall be covered under defect liability period. The price quoted for the first year of O&M shall not include the price of the spares, as the same shall be covered under defect liability period.

The O&M period shall be on an extendable basis for another 5 years based on the discretion of OIL.

2.2.24 This Technical Bid is issued to provide basic engineering and process details for the intended project. During the bidding stage, the contractor shall review all technical bid and other tender documents as listed in Table of Contents and understand the scope fully.

2.2.25 No deviations or variations shall be acceptable after the CONTRACT award due to contractor incorrect assumptions, scope misunderstanding or the underestimation of the Works.

2.2.26 The contractor, by endorsing technical bid, may use technical bid Data for further development during detailed design and balance engineering phase.

2.2.27 Videos and photographs shall be taken during various construction activities for the review by the OIL / PMC and maintain documentation of all the activities of the project. Contractor to prepare completion reports in compliance with contract documents and obtain approval of the client.

2.2.28 The Performance Guarantee tests shall be conducted by the contractor in accordance with parameters for PGTR as defined in technical bid package, design basis and process data sheets. With respect to the design, construction, testing, commissioning and performance guarantee test of the plant, the contractor shall ensure that all defects and deficiencies found during testing and commissioning are rectified within specified time and no additional cost to OIL. The PGTR will commence only after obtaining mechanical completion and commissioning certificate from OIL&PMC.

2.2.29 Performance Guarantee Test Run (PGTR) shall be conducted within 3 months from date of commissioning.

2.2.30 PGTR of the entire plant shall be carried out as specified in the technical document attached in the sub section.

2.2.31 OIL has the authority to inspect the plant at any point of time during construction and operation of the plant.

2.3 Temporary Facilities

2.3.1 The temporary facilities under the Contractor's scope shall include, but not limited to the following:

I. Security gate and gate house for his site facilities
II. Security fencing
III. Accommodation for contract labour.
IV. Material unloading area.
V. Warehouse facilities for various construction items.
VI. Contractor's site offices
VII. Office space for OIL & PMC construction supervision team deployed including housekeeping and drinking water facilities.
VIII. Workshop facilities
IX. Fabrication areas including shot blasting and painting areas as per requirement.
X. Construction water receipt, storage and distribution
XI. Temporary drainage systems including that for heavy rains in monsoon.

2.3.2 Construction of barricading during construction period and removal of the same after construction is over. Provision like covered shed to work in Monsoon.

2.3.3 Contractor scope of work also includes providing of temporary power supply, water and other utilities required for fabrication, construction, office& drinking water facilities etc. during execution till completion of installation and commissioning of CBG Plant and its associated facilities as defined in specification and drawings.

2.3.4 Any other work not specifically mentioned above but required to complete the work in all respects as per tender specifications drawings and instruction of OIL/PMC and to result in a fully operable and maintainable plant.

2.3.5 The scope of work as described above shall be supplementary to the scope of work mentioned under various parts of the bidding document and the cost for the same is to be considered by the contractor while bidding.

2.4 Documentation

2.4.1 Contractor to prepare a detailed list of document deliverables and present it during the detailed engineering along with submission schedule. The list will be finalized by PMC. The list shall also demarcate the critical equipment list which shall be the key deliverables for the project and the same list shall be approved by PMC/ OIL.

2.4.2 Any document which PMC may find necessary during the execution of the project would have to be provided by the contractor without any time and cost implication on the project and the same shall be updated in the list regularly.

2.4.3 The documents listed above are minimum submissions by contractor. Any other document not mentioned above but required as per project requirements shall be submitted by Contractor. Contractor shall prepare detailed list of documents to be submitted for review and shall forward it to PMC.

2.4.4 The successful vendor shall make fabrication drawings of vessel and shall submit to OIL/PMC for review before any fabrication starts. If any discrepancy is found during design and fabrication stages, the fabricator shall inform OIL/PMC immediately and shall obtain necessary approval before proceeding with that portion of the job any further. OIL/PMC review of fabrication drawings and documents must not be considered as a check and shall not relieve the fabricator of his responsibilities to supply equipment as per requisition. Fabricator shall remain responsible for conflicts between his drawings/ documents and OIL/PMC drawings/ documents.

2.4.5 All fabricators drawings submitted to OIL/PMC shall be based on purchase order and shall bear reference number and revision of the corresponding OIL/PMC drawings. In addition, it shall indicate item number, client's name, project name, fabricator's name, purchase order number, purchase requisition number, drawing number etc., all in the lower right-hand corner. All revisions shall be clearly marked by encircling with revision marks. Submission of required drawing/documents shall be the responsibility of the fabricator. In the event of the fabricator's failure to meet this requirement the supply of equipment shall be considered as incomplete.

2.4.6 Drawing index shall be prepared for each item giving serial number, description of drawing, drawing number and revision number. Updated index shall be forwarded along with each submission.

2.4.7 All drawings shall be thoroughly checked and duly signed by the fabricator. Unchecked drawings and drawings without revisions clearly marked shall be returned without review. Successive review of the same fabrication drawing shall apply only to OIL/PMC latest data sheet/ comments on the previous revision. Drawings and documents returned to the fabricator for revision shall be resubmitted at the earliest. Vendor must ensure that all the vendor documents are thoroughly checked and approved at vendor's end by vendor's competent engineer and responsible engineering office in charge, before the same are submitted to OIL/PMC for review.

2.4.8 Fabrication drawing shall be submitted in the following sequence (whichever are applicable)

I. General arrangement drawing indicating design data, fabricated equipment weight, general notes, nozzle schedule, nozzle orientation, nozzle projection, details of shell, shell head, support arrangement, etc.
II. Details of all nozzles, manholes, accessories etc.
III. Details of external clips for ladder, pipe support, stiffener ring, man way davit, lifting lugs etc.
IV. Dished end drawing
V. Tray support ring details
VI. Shell development drawing incorporating all attachments and weld seams.
VII. Bill of materials for each items showing part size, quantity, material of construction, weight etc.
VIII. For piping drawings GA and all isometrics shall be submitted with line numbers and design data.

2.4.9 As Built Documents

I. Upon successful completion of the project, Contractor shall mark up the documents & drawings as per "AS BUILT" and his engineering team shall update relevant process documents & drawing soft files.
II. The contractor shall ensure that Vendor related equipment & Packages shall also need complete as-built documents.
III. Soft copies, Native files and hard copies 3 sets of all As-Built Process documents, PFD P&ID, and datasheets, specifications, process reports, Manufacturer Data Record (MDR) and drawings are to be submitted to OIL / PMC. All software and analysis native files to be submitted along with the final documentation. The list of minimum documents required for submission with respect to each discipline shall be detailed in the subsequent sections.
IV. The submitted documents shall be reviewed by PMC/OIL and approved.
V. Soft copies of all drawings in AutoCAD (.DWG format) shall be submitted to OIL/PMC in CD/DVD as part of final documentation.

2.5 Applicable Codes, Standards and Regulations

I. ASME Sec V111 Div. 1
II. ASME Section IX
III. ASME Section V
IV. PESO guidelines
V. Indian Boiler Regulation (IBR)
VI. (IER) Indian Electricity Rules
VII. BIS (Bureau of Indian Standards) Codes
VIII. BPE (Bureau of Public Enterprise) Norms
IX. Bye-laws of Town & Country Planning Organization
X. CEA (Central Electricity Authority)
XI. Factory Law/ State Government Factory Acts
XII. Guidelines of IGBC/ GRIHA/ LEED for Green Building concept
XIII. Local Municipality or any other Authority's Bye-laws as applicable
XIV. National Building Code of India
XV. OISD Standards (If applicable)
XVI. Pollution Control Board norms.
XVII. TAC (Tariff Advisory Committee) Rules
XVIII. Indian Solid Waste Management Rules
XIX. Central Pollution Control Norms
XX. State Pollution Control Norm
XXI. All conditions of Environmental Clearances obtained for the project.
XXII. National Fire Protection Association (NFPA)
XXIII. IS: 2074: Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
XXIV. IS: 104: Ready mixed paint, brushing, Zinc Chrome, priming
XXV. IS: 2932: Enamel, synthetic, exterior (a) undercoating (b) finishing
XXVI. IS: 2629: Recommended Practice for Hot Dip Galvanizing
XXVII. ISO 12944: Paints and Varnishes-Corrosion protection of steel structures by protective paint systems
XXVIII. ASTM: American standard test method
XXIX. AWWA: American Water Works Association

2.6 GENERAL QUALITY ASSURANCE PLAN (QAP)

2.6.1 All the equipment's shall be subjected to inspection and testing as per the Manufacturers Quality Assurance Plan (MQAP) to be prepared by the contractor and approved by OIL/PMC. However, the owner reserves the right to depute its authorized representative in addition to the PMC. Contractor/vendor shall submit an Inspection & Test Plan (ITP)/Quality Assurance (QA) plan before commencement of fabrication/ manufacturing/ production. Approved QA plan along with approved equipment drawing and technical specifications shall form the basis for equipment/piping inspection.

2.6.2 Contractor shall be responsible for co-ordination of inspection activities by PMC at various Vendor works and submit weekly report on progress of manufacturing, testing, inspection and supply.

2.6.3 Heat treatment, destructive and non-destructive testing shall be carried out as per the requirement of OIL/PMC approved QAP/National/International codes & standards. However, the OIL reserves the right to witness all stage inspection, destructive lab testing, hydrostatic, mechanical and performance tests.

2.6.4 Inspection shall also include dimensional check of the equipment; its driver and auxiliaries (if any) duly mounted on the base plate and check for direction of rotation of the assembly in accordance with approved General Assembly drawings.

2.6.5 Until inspection is completed, no part of the equipment/material shall be painted, and no dispatch is permitted. No deviation shall be allowed in this regard.

2.6.6 Vendor shall notify his sub-vendor of Company's inspection and testing requirements. Acceptance of shop test shall not relieve contractor and vendor from any of their responsibilities in any way, whatsoever. However as per the requirement the contractor shall arrange for site testing also on case to case basis. All instrumentation controls and safety devices shall be calibrated and tested for satisfactory operation and settings. All the arrangements for shop testing and calibration of equipment/ instrument shall be carried out by the Contractor.

2.6.7 Motors shall be tested at the manufacturer's premises. Witness for the same shall be carried out by OIL/PMC as per the approved QAP. OIL/PMC representative shall always have access to vendor's/ manufacturer's shop as well as to sub-vendor's shop during manufacturing of the equipment and vendor/ manufacturer shall provide all requisite facilities including necessary monitoring and measuring devices to Company's representative for carrying out satisfactory inspection and witnessing the test.

2.6.8 Contractors shall arrange individual Mechanical Quality Assurance Plan (MQAPs) of all the brought out items including pipe, vessels, valves, fittings, electrical and instrumentation equipment, mechanical equipment and submit the same for PMC/ OIL approval.

2.6.9 For all the construction, mechanical completion and Commissioning Field Quality Assurance Plan (FQAP) should be prepared and submitted to OIL/PMC for approval.

2.6.10 The construction work at plant site should be carried out as per FQAP and proper records should be maintained for verification by OIL/PMC.

2.7 Mechanical Completion

2.7.1 The Contractor shall be fully responsible for the mechanical completion and the safe commissioning of individual equipment, package and system including interface. Unless otherwise specified, during commissioning of the plant, necessary spares, OEMs supervision, lubricants, consumable and tools/ tackles required are deemed included in the Contractor's scope of work.

2.7.2 Spares, chemicals, catalysts, solvents, lubricants, consumables, tools (including special tools) as required for mechanical completion, commissioning and initial fill for the entire facilities shall be procured and supplied by the Contractor as part of this bid firm scope of work. This would also include any chemicals, decontamination procedures, lubricants, consumables etc. required for flushing and / or during trial / performance run of the system. The Contractor shall also supply all consumables, catalyst, solvents chemicals & lubricants (including 12 months requirement of DLP period), etc. for the entire facilities as part of bid scope of work, before company takes over the facilities for operation.

2.7.3 Water required during construction, and commissioning activities shall be arranged by the Contractor without any time or cost implications to the OWNER. The bidder shall have a site visit and finalize the water source location. Work may commence by using the available water source and additional requirement (borewell) if needed, can be considered later and the decision of which shall be at the discretion of OIL. All permissions regarding drawing of water shall be obtained by the contractor prior to start of the job. However, in any case where in which if OIL has not provided approval for bore holes or any take away from the available water resources the contractor shall on his own has to make the water arrangements. OIL is not responsible for the availability of water for construction, commissioning, operation & maintenance. It shall be the responsibility of the contractor to arrange on his own and delay in the progress in concern to this is not acceptable.

2.7.4 Contractor shall be responsible for supply of all mandatory, operational and commissioning spare parts required during hookup, testing & commissioning, operation and maintenance. Contractor shall furnish complete list with details for such spare parts procured and keep an inventory of these parts used. All unused parts shall be handed over to the company as part of Contractor' scope of work. In case of operation and maintenance. All the spare parts and left over construction material shall be the maintained at store facility available at CBG plant.

2.7.5 Contractor should first achieve the Milestone of Mechanical Completion that means all facilities including civil, electrical, mechanical, instrumentation, architectural, safety related work is completed. All equipment and erected, all piping are complete and all electrical and instrumentation are installed and connected. Contractor should get this reviewed, Inspected and get certificate of mechanical completion from PMC/OIL. Only after obtaining the

mechanical completion certificate the project will be deemed to be considered as mechanically completed. All related physical and financial milestones will be processed only after obtaining the certificate form OIL & PMC.

2.7.6 After mechanical completion contractor would proceed one by one for individual equipment/section as per the approved procedure only after clearance form OIL/PMC. Once pre-commissioning activities are completed for the entire project. OIL /PMC will review the status and then give clearance for commissioning once it is executed to the satisfaction of OIL/PMC and if all necessary statutory and external local bodies approval is in place contractor can then proceed to commission the entire facility.

2.7.7 The time period for mechanical completion is 15 months from the date of LOA.

2.8 Commissioning & Stabilization

2.8.1 The time period for Commissioning and Stabilization is 18 months from the date of LOA.

2.8.2 Commissioning of the unit will be considered once commissioning tests are completed, trial operation including the reliability run is completed and the biogas generation is established from MSW feedstock at rated full load or part load, as per the feedstock made available by the Owner for a minimum period of 7 days with all the sections like pre-treatment, hydrolyser, digestor, purification, compression and effluent treatment are operational. Only after obtaining the commissioning certificate from PMC/ OIL project will be deemed to be considered as commissioned.

2.8.3 All related physical and financial milestones will be processed only after obtaining the certificate from OIL & PMC.

2.9 Consumables

2.9.1 Contractor shall prepare and submit list of chemicals, lubricants and Consumables for Operation, Lubrication, Process, flushing, cleaning, pre-commissioning, commissioning, passivation/decontamination if any and their schedule, during detail engineering.

2.9.2 Supply of all lubricants and consumable, chemicals till PGTR and further from PGTR to operation and maintenance period is in scope of contractor.

2.9.3 Contractor is required to Maintain minimum stock of all such lubricants and consumable for requirement of minimum Six Months and ensure to replenish them periodically and maintain a proper record of stock which should be submitted to Owner / PMC.

2.9.4 All Consumable and all kind of spares, replacement of all failed parts and equipment's during extended period of operation and maintenance will be in contractor scope.

2.10 Project Monitoring, Planning and Submission of Detailed Project Schedule

2.10.1 The Bidder shall establish a comprehensive Project Monitoring and Control System for effective planning, execution, monitoring, coordination, and timely completion of the Project within the stipulated Contract period.

2.10.2 The Bidder shall, within Thirty (30) days from the date of issuance of Letter of Award (LOA)/Notification of Award (NOA), prepare and submit a Detailed Project Schedule to the Owner/Engineer-in-Charge for review and approval.

2.10.3 The Detailed Project Schedule shall be prepared exclusively using Primavera P6 Project Management Software and shall form the basis for planning, monitoring, coordination, progress review, delay analysis, resource management, and execution control of the Project.

2.10.4 The schedule shall cover the complete scope of work under the Contract and shall be fully resource-loaded, logically linked, and aligned with the contractual completion period and milestone requirements.

2.10.5 The schedule shall clearly identify critical path activities, key milestones, activity interdependencies, construction sequencing, procurement timelines, commissioning activities, statutory approvals, utility integration, biological stabilization, and Performance Guarantee Test Run (PGTR) activities.

2.10.6 The schedule shall include activity-wise start dates, finish dates, duration, predecessors, successors, float/slack, manpower deployment, equipment deployment, procurement tracking, long lead item monitoring, baseline schedule, recovery schedule, and planned progress S-Curves.

2.10.7 The Detailed Project Schedule shall include detailed planning for Project Management & Mobilization, Engineering Activities, Procurement Activities, Logistics & Transportation, Civil & Structural Works, Mechanical Works, Electrical Works, Instrumentation & Automation Works, Feedstock Handling & Segregation System, Utility & Offsite Systems, Pre-Commissioning & Commissioning Activities, Biological Commissioning Activities, PGTR Activities, Training & Documentation, and Statutory & Regulatory Compliance activities.

2.10.8 The Project Schedule shall clearly identify all major milestones including engineering completion, procurement completion, delivery of critical equipment, civil completion, mechanical completion, electrical completion, completion of statutory approvals, release of electrical connection from DISCOM, pre-commissioning, commissioning, first feedstock

charging, first gas generation, commencement and successful completion of PGTR, and final acceptance of the Plant.

2.10.9 The Bidder shall identify critical path activities and milestone dependencies and shall submit manpower deployment histograms, equipment deployment schedules, procurement tracking reports, and planned versus actual progress S-Curves.

2.10.10 The Bidder shall review, update, and submit the revised Detailed Project Schedule on a monthly basis throughout the Contract period along with Monthly Progress Reports (MPR).

2.10.11 The monthly updated schedule shall include planned versus actual progress, percentage completion of activities, status of engineering/procurement/construction/commissioning activities, delay analysis, impact on milestones, revised forecast completion dates, and recovery action plans.

2.10.12 The updated schedule and Monthly Progress Report (MPR) shall be submitted on or before the 7th day of every succeeding month.

2.10.13 In case of any delay or slippage from the approved Project Schedule, the Bidder shall immediately deploy additional manpower, machinery, resources, parallel working fronts, and other corrective measures required to recover delays and maintain contractual completion timelines at no additional cost to the Owner.

2.10.14 The Bidder shall participate in weekly and monthly review meetings with the Owner/Consultant/PMC and shall present updated schedules, progress status, bottlenecks, mitigation measures, procurement status, milestone achievement status, and recovery plans.

2.10.15 Review, comments, or approval of the Project Schedule by the Owner/Engineer-in-Charge shall not relieve the Bidder from its contractual obligations and responsibilities towards timely and successful completion of the Project.

3 SCHEDULE OF PAYMENT FOR EPC

The Bidders are to note that this will be a "Lum-sum Turnkey (LSTK) Project" where the payment will be affected on a lumpsum basis for each of the Schedules. The payment will be released as per following Payment Terms on a periodic (quarterly) basis. The total amount of payment to be made shall not exceed the quoted Price. All related physical and financial milestones will be processed only after obtaining the certificate from OIL & PMC. The Owner and Contractor shall make necessary adjustments on payment to be released as the work proceeds based on the actual progress of the works. Bidder has to accept the same without any deviation. Tenders with any deviation on payment terms will be considered as non-responsive and will be summarily rejected.

A "detailed break-up of the Payment Schedule" for Civil, Mechanical, Electrical & Instrumentation Works shall be submitted by the Contractor after Award of Work for approval of the Engineer-in-charge. The decision of the Engineer-in charge shall be binding on the Contractor.

3.1 General Requirement

3.1.1 The bidder must calculate the price for various schedules, covering design, procurement, manufacture, construction, fabrication, transportation, erection, handling, installation, trial, testing, commissioning, and PGTR of the system. This is to ensure a continuous desired discharge of CBG, its transmission to Owner, and the disposal of effluents, all in full compliance with the technical bid of the tender document.

3.1.2 As this is a turnkey project, the system design must adhere to the minimum technical parameters specified in the Technical Specifications. These requirements are mandatory for all bidders.

3.1.3 The lump sum price quoted by the bidders must include all cost components. This encompasses safety observations, statutory rules and regulations, and other requirements as per the general and special conditions of the contract.

3.1.4 Quoted prices should also cover all government levies, taxes, duties, rents, compensation, environmental and ecological maintenance charges, royalties, restoration costs, including service taxes, and any other compensations necessary for the successful completion of the project.

3.1.5 The quoted price should encompass all cost components, including the use and hire charges for miscellaneous items such as lubricants, fuel consumables, labour, plants, machinery, equipment, tools and tackles, jigs, fixtures, barricades, etc.

3.1.6 **The quoted prices should be firm and there is no provision of escalation.**

3.1.7 If any activities in any schedule or sub-schedules are found to be repeating or recurring in other schedules or sub-schedules, Owner/PMC will have the discretion to decide under which schedule or sub-schedule the payment should be made. The contractor has no right to contest or claim against any decision made by the Owner.

3.1.8 For works where payment is based on the actual work done or on a pro-rata basis, the work must be fully completed for the portion for which payment is requested. The final quantity for items paid based on actual work done will be determined according to **Payment Terms** of the tender. Payment will be released on a pro-rata basis for the work completed, in

accordance with the requirements specified here and elsewhere in the tender, up to the percentage ceiling mentioned for the corresponding schedule or sub-schedule.

3.1.9 If the actual work carried out on-site exceeds the quantity specified in the approved document, payment will still be limited to the percentage ceiling mentioned for the corresponding schedule or sub-schedule. The contractor will not be eligible for any additional payment due to variations in the actual work done compared to the billing quantity fixed in the approved document. However, the contractor must complete the work for the actual quantities required to fulfil the corresponding schedule or sub-schedule. Payment will only be released after the work is completed as instructed and to the satisfaction of the Owner.

3.1.10 The percentage mentioned against each of the schedule and sub schedule in "Detailed Break up of Payment Schedule" will be firm and no changes in this regard will be acceptable. The payment against any of the schedule or sub schedule will be limited to the percentage ceiling mentioned against the corresponding schedule or sub schedule as applicable irrespective of the quantities of the work carried out in actual.

3.1.11 The contractor shall carry out all the activities as per the actual requirements and quantities to the satisfaction of the Owner. Any increase in the quantities will not be attributable to any payment variations as this being a LSTK project and the percentage mentioned against each of the schedule or sub-schedule will remain firm irrespective of the quantities. And no extra claim or payment will be made to contractor for any additional work carried out which Owner/PMC feel necessary or required or mentioned anywhere in the tender even in the slightest context for completion of the project must be carried out by the contractor.

3.1.12 Also, any of the activities if not covered in the schedules and sub- schedules mentioned below is deemed to be considered or incorporated as those works which are required for achieving the mechanical completion of that corresponding section in which the work is carried out.

3.1.13 The works are to be completed in all respects (excluding PGTR) within a period of 18 (Eighteen) months from the date of issue of Letter of Award (LOA).

3.1.14 Running or on-account bills should be submitted by the Contractor once in a month inclusive of all the works in the schedules defined below:

3.2 Payments against EPC Works

Sl. No.	Description	Payment % of the Contract value
1)	**Approval of Drawings and Documentation**	**Maximum 3% of the Total Contract Value excluding O&M**
A.	On completion of Basic Engineering Package (BEP)	15%
B.	On completion of Structural Design & Drawing of Civil Units	35%
C.	On completion of Detailed Engineering of Mechanical Works	30%
D.	On completion of Detailed Engineering of Electrical & Instrumentation Works	20%
Note: The percentage are of 1.A. to 1.D. of Price Schedule - 1		
E.	On providing services for obtaining permissions/ clearances from various Agencies on Pro Rate basis	100%
Note: The percentage is 100% of 1.E. of Price Schedule -1		
2)	**Civil Works**	**Maximum 40% of the Total Contract Value excluding O&M**
A.	On pro-rata basis against Monthly Running Bills	75%
B.	On completion of civil Work	15%
C.	On completion of Commissioning	5%
D.	On Completion of PGTR Test	5%
3)	**Mechanical, Electrical, Instrumentation Works**	
A.	On supply of Machinery / Equipment's on pro-rata basis against Monthly Running Bills	75%
B.	On completion of Mechanical completion	15%
C.	On completion of Commissioning	5%
D.	On Completion of PGTR Test	5%

3.3 Payment Terms for Operation and Maintenance

3.3.1 Payment for the operation and maintenance of the facility will be made on a **monthly basis**, based on the value quoted by the bidder. This stage will commence only after the completion of all activities outlined in the construction phase, in accordance with the approved design, documents, codes, tender specifications, and regulatory/statutory requirements.

3.3.2 The operation and maintenance (O&M) of the project is planned for 10 years from the date of successful PGTR completion and the handover of the facility to Owner, as per the tender specifications. The O&M contract may be extended for up to 5 additional years, based on

mutual agreement between Owner and the contractor. However, Owner is not obligated to extend the O&M contract, and the decision to do so rests solely with **Owner**.

3.4 Payment against O&M Works

Sl. No.	Description	Payment % of the Contract value
1)	**Against Monthly Running Bill**	100% of Running Bill Value

3.4.1 Payment will be made on a monthly pro-rata basis, i.e., 1/12 of the yearly amount quoted for the respective year in the tender document. This will be done upon submission of the bill, along with certification by the Owner engineer-in-charge, and the following documents: operation logbooks, hindrance register, calibration reports/records, details of activities carried out with data for each instrument, analyser, checklist of PLC control system, field instruments, control valves & On-Off valves, manpower logbook, etc.

3.4.2 The contractor must ensure the reporting (including generation of reports) of plant operations on a daily basis, weekly MIS reports, real-time data updates, monthly reconciliation, quarterly reconciliation, and monthly reports to the owner in a format agreed upon by the owner or their representatives. Reports should include, but are not limited to:

- Online measurements
- Product specifications
- Laboratory Analysis Results
- Statistical analysis deducing performance of CBG.
- Details of malfunctioning, start-up & shutdown, breakdown, repairs, replacements etc.
- Chemical consumption & inventory
- Utility & power consumption
- Preventive & corrective maintenance record and schedules
- Utilization of spares & inventory
- HSE violations etc.,

3.4.3 Payments for O&M services will be made according to the Purchase Order. The Purchaser reserves the right to invoke part or the full amount of the bank guarantee in case of poor performance or inadequate operation and maintenance of the CBG plant/unit by the Vendor at any stage of the O&M contract. The Owner's decision in this matter will be final and binding on the Vendor.

3.4.4 Detailed descriptions of activities to be carried out against each of the schedules and sub-schedule mentioned is provided below. Contractor to perform all the activities mentioned against the respective schedules and sub-schedule and ensure that the work is completed as per the requirements and satisfaction of Owner/PMC. Any other activity which is not

specifically mentioned against any schedule but if it's required for proper completion of the work or any work which OIL/PMC deem necessary during the progression of the work shall be carried out by the contractor. No deviation regarding this will be acceptable.

4 INSURANCE

4.1 During Execution of Project

The Insurance during execution period till stabilization of the Plant should be arranged by the Contractor as per clause no 14 of GCC.

4.2 During O&M Period (Insurance by Owner)

4.2.1 The following Insurance during Operation and Maintenance period shall be arranged by the Owner.

4.2.2 The Owner will regularly take out an insurance policy for fire and allied perils, including earthquake, flood, storms, cyclone, tempest, and any other risks deemed necessary during the O&M contract period. In the event of any loss or claim covered under the policy, the O&M contractor must immediately inform the OWNER and assist in filing the claim with the insurance company. The contractor must then submit all required documents to the OWNER for onward submission to the insurance company and take all necessary measures to protect the Owner's interests for the settlement of such claims.

4.2.3 The Contractor shall replace any damaged equipment resulting from events covered under such insurance policies without waiting for the settlement of the insurance claim. This replacement will be based on an estimation duly approved by the Owner. The Owner will issue a Letter of Authorization (LOA) or Purchase Order (PO), where applicable, to proceed with the repairs or replacement. Upon settlement of such claims by the insurance company, the Owner will bear any additional costs of replacement or repair that exceed the insurance claim amount. If the insurance company rejects the claim, the Contractor will bear the entire cost of replacement or repair, and any amount provided by the Owner for these purposes must be refunded by the Contractor.

4.2.4 The Owner will also take an insurance policy for theft and burglary. In the event of a claim, the Contractor must replace any damaged equipment resulting from events covered under such insurance policies without waiting for the settlement of the insurance claim. This replacement will be based on an estimation duly approved by the Owner. The Owner will issue a Letter of Authorization (LOA) or Purchase Order (PO), where applicable, to proceed with the repairs or replacement. Upon settlement of such claims by the insurance company,

the Contractor will bear any additional costs of replacement or repair that exceed the insurance claim amount.

4.2.5 In the event of a claim for fire (not attributable to Force Majeure), theft, or burglary, the Owner will reimburse the contractor up to the amount received from the insurance company. Any additional costs for replacement or repair beyond the settled insurance claim will be borne by the Contractor. If the insurance company rejects the claim, the Contractor will bear the entire cost of replacement or repair.

4.3 During O&M Period (Insurance by Contractor)

Operator shall provide or obtain and maintain in force throughout the period of O&M the following insurance coverage:

4.3.1 The Contractor must provide insurance to cover third-party liability, along with an undertaking indemnifying the Owner from any such claims.

4.3.2 The Contractor must also have a workmen's compensation and/or group personal accident insurance policy covering all its employees and workers, including sub-operators.

4.3.3 The Contractor is responsible for ensuring minimum machine downtime. Regardless of whether the Contractor takes out a Machine Breakdown (MBD) insurance policy, it is the Contractor responsibility to operate and maintain the CBG Plant and all associated equipment at their own cost for the quoted O&M period. The Owner will pay only the agreed O&M charges. Any replacement, repair, or modification of any item or equipment must be carried out by the Operator at their own cost for the quoted O&M period. The Owner will not be responsible for any breakdown or failure of any equipment for any reason, except for Force Majeure, Fire & Allied Perils Events, or extraneous reasons.

4.3.4 The scope, type, and form of insurance cover mentioned elsewhere in this bid for the scope of the project for the quoted O&M period will be superseded by this clause.

5 TRANSPORTATION & CUSTOM CLEARANCE

5.1 Transportation

5.1.1 The Contractor shall at its own risk and expense transport all the plant equipment and the Contractor's Equipment to the Site by the mode of transport that the Contractor judges most suitable under all the circumstances

5.1.2 The Contractor shall be responsible for obtaining, if necessary, approvals from the authorities for transportation of the plant and Equipment and the Contractor's Equipment to the Site. The Owner shall use its best endeavours in a timely and expeditious manner to assist the Contractor in obtaining such approvals, if requested by the Contractor. The Contractor shall indemnify and hold harmless the Owner from and against any claim for damage to roads, bridges or any other traffic facilities that may be caused by the transport of the plant and Equipment and the Contractor's Equipment to the Site.

5.1.3 The Contractor has to comply with the provisions of carriage by Road Act 2007 Govt. of India and its rules and its further amendments (if any).

5.2 Custom Clearance

5.2.1 The Contractor shall, at its own expense, handle all imported plant equipment and Contractor's Equipment at the point(s) of import and shall handle any formalities for customs clearance including liability for port charges, if any, subject to the Owner's obligations, provided that if applicable laws or regulations require any application or act to be made by or in the name of the Owner, the Owner shall take all necessary steps to comply with such laws or regulations.

6 TIME FOR COMMENCEMENT AND COMPLETION

6.1.1 The following shall be the schedule for completion of work,

Description of Milestones	Completion Time from the Date of LoA
Design, engineering, manufacture, testing, transport and delivery at site, loading, unloading, handling at site, storage, construction, erection, testing, commissioning for 200 TPD of Source Segregated Organic Fraction of Municipal Solid Waste based Compressed Biogas plant	**18 Months**
Completion of PGTR and O&M Takeover	**21 Months** (18+3)

Operation and maintenance of overall system	**10 (Ten)** years from the date of Stabilization and O&M takeover

6.1.2 The Contractor shall commence work on the Facilities as per the date of start as stated in the Notification of award and shall thereafter proceed with the Facilities in accordance with the time schedule specified in the Contract Agreement. If the Contractor commits default in the commencement of work within 30 days of issue of Letter of Acceptance, the Owner shall without prejudice to any other right or remedy be at liberty to cancel the Contract and forfeit the earnest money/Performance Guarantee.

6.1.3 The Contractor shall attain Completion of the Facilities within the time stated in the Contract or within such extended time to which the Contractor shall be entitled hereof.

6.1.4 Key Milestones: Notwithstanding anything mentioned elsewhere in the tender, the contractor shall adhere to the "Key Milestone Schedule" submitted along with the technical bid. It shall be considered by OIL as the basis for levying price discount on account of delay in the implementation of the Project, in case the bidder is awarded the Contract.

Sl. No.	Description of Milestones	Completion Time from the Date of LoA	Cumulative time Period in Months from LoA
1	Mechanical Completion of all Project Works	Within 15 Months	15
2	Commissioning and stabilization	Within 3 Months	18
3	Completion of PGTR	Within 3 months	21

7 DEFECT LIABILITY PERIOD (DLP)

7.1.1 The Defect Liability Period (DLP) will be 12 months from the date of successful completion of PGTR test. During this period, the contractor is responsible for ensuring the operation of all equipment and facilities at 100% performance parameters, as specified in the Performance Guarantee Test Run (PGTR) clause of the tender. If any defect is identified during the DLP, the contractor must repair or replace the defective item at their own expense, without causing any delay or additional cost to the owner.

7.1.2 If any parts (excluding spares or consumables) or equipment need to be replaced, the DLP for those items will be extended for one year from the date of replacement. For parts replaced in the 10th year of operation and maintenance (O&M), the DLP will be extended for one year from the time of replacement.

7.1.3 If the contractor fails to repair or replace the equipment, the owner will have the right to undertake the repairs or replacements at the contractor's risk and expense. The costs incurred will be deducted from the contractor's running bills or any other payments due for this or any other job under Owner. Additionally, the performance bank guarantee will be encashed according to the applicable rules.

8 PRICE DISCOUNT

8.1 Delay in Completion of Work & Services

The clause no. 30.0 GCC is partially modified as under:
In the event of the Contractors default in timely completion within the stipulated period, the Contractor shall be liable for price discount @ 0.5% of the Contract value, per week or part thereof of delay subject to maximum ceiling of 7.5% of Contract value.

9 CONTRACT CUM EQUIPMENT PERFORMANCE BANK GUARANTEE (CPBG)

9.1 PBG For EPC work

Within 30 days of receipt of the Letter of Award / Notification of Award/Purchase order, PBG @ 10 % of purchase order value exclusive of taxes (i.e. 10 % of EPC contract value) excluding Operations & Comprehensive Maintenance portion must be submitted by the contractor as per format attached as Annexure- 8. The Performance Bank Guarantee shall be valid for a duration of 90 days plus 33 months as per (Considering 21 Months for commissioning, stabilization & PGTR and 12 months of Defect liability period). The claim period of the Performance Bank Guarantee (BG) shall be further 12 months beyond the validity of the BG.

Notes:

- Any delay in successful completion of PGTR of the facilities beyond 6 months from the date of commissioning, PBG validity shall be extended accordingly for the delay period.
- The PBG for EPC phase as mentioned above shall be released after completion of defect liability period subject to submission & acceptance of PBG for Operations and Comprehensive Maintenance phase.
- The bank guarantee shall have claim period of 12 months beyond BG expiry date.

9.2 BG For Comprehensive O&M Contract Works

9.2.1 The Bidder shall submit a Bank Guarantee one month prior to commencement of Comprehensive Operations and maintenance (O&M) period for an amount equivalent to 10% (ten percent) of cumulative annual awarded value of O&M charges for the first three years period (Excluding taxes) as per the format attached as Annexure-9. This PBG for cumulative

3 years period as mentioned above shall be valid and remain in force till 90 days beyond the completion of first three years of operation and comprehensive Maintenance (O&M) period of the contract and will be released subject to acceptance and submission of PBG for Operations and Comprehensive Maintenance phase for Next 3 years (4th to 6th year and so on up to 10 years) by the contractor. The bank guarantee shall have claim period of 12 months beyond BG expiry date.

9.2.2 Offers of bidders failing to agree to the above PBG terms shall be taken as rejection criteria.

10 GUARANTEED PRODUCTION

The bidder must ensure that the injection of Biogas at the purification point should be more than the guaranteed value by the bidder (in his offer), after expending the produced biogas for hot water generation facility. Additionally, the methane (CH_4) loss from raw biogas at the inlet of the gas purification system to the purified compressed biogas (CBG) at the outlet of the purification system should not exceed 3%.

Guaranteed Parameters

Sl. No.	Description	Details
A.	**SSOF-MSW processing capacity**	200 TPD
B.	**CBG Requirement**	
1.	Methane Recovery	≥97%
2.	Methane Purity	≥97%
3.	CBG Standard	As per IS 16087
4.	CBG injection pressure to the CGD	**Up to 45 bar (g)** (at battery limit /terminal point at boundary for injection into CGD network)
C.	**FOM Requirement**	
5.	FOM Standard	The quality of FOM produced shall meet the following: a) Moisture % by weight: Not more than 30% b) Electrical Conductivity: Based on the Input feedstock c) Heavy Metals Content: Based on the Input feedstock d) All other parameters: Shall be as per Gazette Notification No. 1459 dated 27.03.2025 issued by Ministry of Agriculture and Farmers

Sl. No.	Description	Details
		Welfare regarding inclusion of Fermented Organic manure (FOM) under fertilizer (Inorganic, organic or mixed) (control) act 1985.

- Purity of CBG as per table below:

Sl. No.	Contents	Unit	Requirement
1	Methane	% mol	≥97
2	Carbon dioxides	% mol	≤3
3	Moisture	mg/m^3	≤5
4	Total Sulphur	mg/m^3	≤10
5	Oxygen	% mol	≤0.5

11 PERFORMANCE GUARANTEE TEST RUN

The Performance Guarantee Test Run (PGTR) is a crucial contractual requirement that must be completed before taking over the CBG plant. Its primary goal is to measure the plant's performance against expected benchmarks over a test period, ensuring that the plant operates as intended. Additionally, this test aims to verify the reliability and durability of the plant's operations.

This procedure sets out the following:

1. **Performance Test:** These are the procedures and evaluations conducted to measure the plant's performance against the Guaranteed Performance Levels.
2. **Availability Test**: This test is performed together with Performance test to evaluate the plant's availability during PGTR.

11.1 Performance Test

11.1.1 General

The purpose of the Performance Test is for the Contractor to demonstrate, under controlled and sustained conditions, that each system, component, and the entire CBG plant meets the Guaranteed Performance Levels specified in the Contract. Contractor can offer the PGTR test at any time after the satisfactory stabilization **without waiting for 3 months**.

The PGTR will be conducted continuously for 30 days following completion of the Commissioning and Stabilization of the Plant, at rated full load or part load, as per the feedstock made available by the Owner.

11.1.2 Definitions

- Feedstock (FS): This refers to SSOF-municipal solid waste.
- Organic Fraction (OF): This pertains to the organic solid waste suitable for anaerobic digestion, which is recovered from SSOF-municipal solid waste (MSW).
- Total Solids (TS): This refers to the total dry matter in the organic fraction (OF).
- Volatile solids or Bio-degradable Solids (VS): These are the volatile solids in the total solids (TS).
- Quality Factor (QF) is the ratio of Volatile Solids to Feedstock delivered to the bunker.
- RBG refer to Raw Biogas with a methane content of 40-60%.
- CBG refer to purified biogas with a methane content ≥ 97%.

11.1.3 Codes and Standards

Sl. No.	Parameter tested	Method of Test Standard
1.	Total solids of feedstock	ASTM E 1756
2.	Ash content of feedstock	ASTM E 1755
3.	Methane, carbon dioxide, nitrogen, oxygen in biogas	IS 15130 (Part 3)
4.	Moisture in biogas	IS 15641 (Part 2)
5.	Total sulphur (including H_2S) in biogas	ISO 6326-3

11.1.4 Design Conditions

The following are the design reference conditions of the feed stock (waste nominal composition fixed in tender documents) for which the contractor has to guarantee the CBG quantity produced.

S. No.	Particulars	Values (SSOF- MSW)	UoM
1	Feedstock (FS) quantity to the Plant (at the Infeed Bunker)	200	TPD
2	Rejects / Recyclables / Metals / Inert / Grit	20 (Variation 10% to 32%)	%
A	Rejects (Textiles / Wood / Stems / Horticultural Waste / Sanitary Napkins / Diapers / Bio-degradable not suitable for AD process etc)	11 (Variation 6% to 15%)	%

	B	Recyclables (Plastics / Paper / Glass / Leather / Rubber / E-waste etc)	6 (Variation 3% to 10%)	%
	C	Metals	1 (Variation 0% to 3%)	%
	D	Inert / Grits	2 (Variation 1% to 4%)	%
3		Organic Fraction OF (Bio-degradable Materials suitable for AD process - Food Waste / Kitchen Waste / Green Waste etc)	80 (Variation 68% to 90%)	%
	A	Total Solids (TS) in Organic Fraction (as % of OF)	28	%
	B	Moisture in Organic Fraction (as % of OF)	72	%
	C	Volatile Solids (VS) in TS of Organic Fraction (as % of TS)	82	%
4		Volatile Solids (VS) quantity to the Plant (at the Infeed Bunker)	36.736	TPD
5		Quality Factor (VS/FS)	18.368%	%

Note: Bidder shall furnish the correction curve / factors accordingly taking into feedstock quality variations. Correction curves shall be furnished for the following by the Bidder in his offer:

a) RBG at the Inlet to Biogas Cleaning & Upgradation System (net of the RBG used for Hot Water Generator) Vs QF (QF ranging from 12 to 26%).

b) CBG at the Outlet of Biogas Cleaning & Upgradation System (net of the RBG used for Hot Water Generator) Vs QF (QF ranging from 12 to 26%).

11.1.5 Sampling / Measurement Locations

Below are the locations where the samples are to be collected and measurements / readings to be taken for the performance testing.

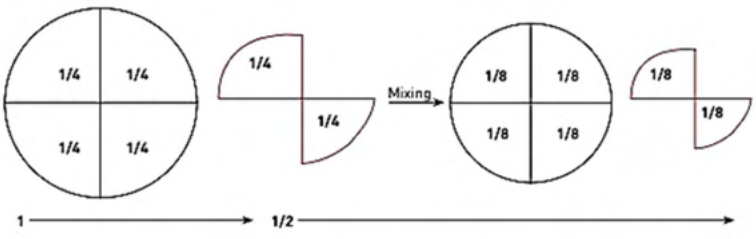
Sl. No.	Samples / Measurement	Location	Methodology
1.	Samples of Feedstock to the Plant	At Infeed bunker	Testing in Lab
2.	Samples of Organic Slurry to Hydrolysis Tanks / Digestors	From Slurry Feeding Tank / at Slurry Feed Pump discharge to the Hydrolysis Tanks / Digestors	Testing in Lab
3.	Total Feedstock to the Plant per Day (in TPD)	Weighbridge	Record daily weighbridge readings for all incoming waste vehicles

4.	Raw Biogas Production & Quality Measurement	Inlet to Cleaning & Upgrading System	a) Calculate the cumulative RBG flow through flow meter at the end of each day's operations. b) By using online gas analyser measure the RBG quality
5.	CBG Production & Quality Measurement	After CBG Compressor Discharge	a) Calculate the cumulative CBG quantity through flow meter at the end of each day's operations. b) By using online gas analyser measure the CBG quality
6.	Power Consumption	At Plant Power Meter	Record daily electricity consumption.

11.1.6 Feedstock Sample Collection & Preparation

Below is the procedure for preparing samples from the received municipal solid waste (MSW) feedstock.

Steps	Activities to Perform
Step-1 : Sample Collection	• Collect four samples, each approximately 5 kg, from four random points (from surface and underneath of the waste pile) in the Infeed Bunker / Vehicles. • Samples shall be collected by the contractor in the presence of the Owner's Representative.
Step-2 : Mixing and Sample Preparation	• Combine all the four samples together and mix it thoroughly to make a 20 kg collected sample. • Using the Quartering & Coning Technique (as described in Step-3), prepare a final 5 kg sample. • Send this 5 kg sample to the laboratory for testing. • Ice boxes shall be used for storage and transport of the samples to the lab.
Step-3: Quartering & Coning Technique	• Thoroughly mix samples from all heterogeneous sampling points. • Form the mixed sample into a uniform heap. • Divide the heap into four equal portions using perpendicular lines. • Remove waste from opposing corners of the divided heap, leaving half of the original sample.

Steps	Activities to Perform
	• Thoroughly mix the remaining portions and repeat the quartering process until the sample size is reduced to a desired size of 5 kg. 
Step-4: Data Records	• The sampling procedure should be performed continuously throughout the PGTR test duration. Each sample's date and time of collection must be recorded, and the sample should be tracked with an identification number before being sent to the testing laboratory. The results of each sample should be documented and correlated with the corresponding collection date.

11.1.7 Feedstock Testing

The following shall be tested for Feedstock.

Steps	Activities to Perform
Step-1 : Physical Composition / Characterization	• Carrying out the Testing of each sample for Physical Composition i.e., Categorization into Major Fractions in the Laboratory (Type of each waste component and its percentage) as per the Table given below.
Step-2 : Physical Analysis	• Carrying out the Testing of Organic Fraction (Bio digestible) of each sample for Physical Analysis in the Laboratory - As Received Basis (ARB) as per the Table given below. Perform these tests according to standard testing procedures.
Step-3 : Quality Factor (QF) Calculation	• Calculate the Quality Factor (QF) of the Feedstock based on the test results.

11.1.8 Physical Composition / Characterisation Table Format:

Physical Composition of Municipal Solid Waste (MSW)									
S. No.	Component / Particulars	Unit	Result						Remarks
			<70mm screen		>70 mm screen		Total for the Sample		
			kg	%	kg	%	kg	%	
A	**Organic Fraction (Bio digestible)**								
1	Food Waste / Vegetables / Fruits / Kitchen Waste								
2	Leaves / Flowers / Green Waste								
3	Mango Seeds / Palm Seeds								
4	Others (If any bio digestible)								
	Total (A)								
B	**Refuse Derived Fuel**								
1	Organic Fraction (Non-Bio digestible)								
i	Coconuts (Whole/Shells)								
ii	Wood / Stems / Horticultural Waste								
2	Clothes / Rags / Textiles								
3	Sanitary Napkins / Pads / Diapers								
4	Others (If any incinerable / combustible)								
	Total (B)								
C	**Recyclables**								
1	Plastics / Thermocol / Synthetics								
2	Rubber / Leather								
3	Paper / Cardboard								
4	Glass								
5	E-waste (Batteries etc)								
6	Others (If any recyclables)								
	Total (C)								

Physical Composition of Municipal Solid Waste (MSW)									
S. No.	Component / Particulars	Unit	Result						Remarks
			<70mm screen		>70 mm screen		Total for the Sample		
			kg	%	kg	%	kg	%	
D	**Metals**								
1	Ferrous								
2	Non-Ferrous								
	Total (D)								
E	**Grit / Inert**								
1	Sand/ Ash / Soil / Inert								
2	Stone / Brick								
	Total (E)								
	Total (A+B+C+D+E)								
F	**Bulk Density**	**kg/ m^3**							

11.1.9 Physical Analysis Table Format:

Physical Analysis of Organic Fraction (Bio digestible) - As Received Basis (ARB)						
Sl.No.	Component / Particular	Unit	Result			Remarks
			<70mm screen	>70 mm screen	Total for the Sample	
1	Bulk Density	kg/m^3				
2	Total Moisture	%				
3	Total Solids	%				
4	Volatile Solids	%				

11.1.10 Organic Slurry Sample Collection & Preparation

Steps	Activities to Perform
Step-1 : Sample Collection	• Collect four samples, each approximately 5 litre, from Slurry Feeding Tank / at Slurry Feed Pump discharge to the Hydrolysis Tanks / Digestors (at an interval of 10 minutes) • Samples shall be collected by the contractor in the presence of the Owner's Representative.
Step-2 : Mixing and Sample Preparation	• Combine all the four samples together and mix it thoroughly to make a 20 litre sample. • After mixing collect a 5 litre final sample. • Send this 5-litre sample to the laboratory for testing

Steps	Activities to Perform
	• Ice boxes shall be used for storage and transport of the samples to the lab.
Step-3: Data Records	• The sampling procedure should be performed continuously throughout the PGTR test duration. Each sample's date and time of collection must be recorded, and the sample should be tracked with an identification number before being sent to the testing laboratory. The results of each sample should be documented and correlated with the corresponding collection date.

11.1.11 Organic Slurry Testing

The following shall be tested for Organic Slurry.

Steps	Activities to Perform
Step-1 : Physical Analysis	• Carrying out the Testing of Organic Slurry of each sample for Physical Analysis in the Laboratory as per the Table given below. Perform these tests according to standard testing procedures.

11.1.12 Physical Analysis Table Format

Physical Analysis of Organic Slurry				
Sl.No.	**Component / Particular**	**Unit**	**Result**	**Remarks**
			Total for the Sample	
1	Bulk Density	kg/m^3		
2	Total Moisture	%		
3	Total Solids	%		
4	Volatile Solids	%		

11.1.13 Daily Measurements and Calculations Records

The following shall be recorded daily with regards to the Performance Test.

A. Organic Recovery Measurement

Organic Recovery = B/A

Whereas,

A - Organics content in the MSW at the inlet to the infeed bunker

B - Organics content in the slurry at the inlet to the hydrolysis tank

Table 1: Organic Recovery Measurement table

Date / Day	Volatile Solids in the MSW (at infeed bunker)	Volatile Solids in the Slurry (at inlet to the hydrolysis tank)	Organics Recovery (%)
	A	B	B/A
1			
2			
.			
30			
Average			

B. RBG Production Performance Measurement

Note: RBG guaranteed for the corresponding QF shall be as per the correction curves furnished by the Contractor.

Table 2: RBG Production Performance Measurement table

Date / Day	Feedstock Received			VS in Feedstock Received	QF	RBG Guaranteed Vs Actual					
						RBG Guaranteed	RBG Produced/ Actual	Short Fall	RBG Guaranteed per Tonne of VS	RBG Produced per Tonne of VS	Short Fall
	TPD	TS%	VS%	TPD	%	Nm3/D	Nm3/D	Nm3/D	Nm3/T	Nm3/T	Nm3/T
1											
2											
.											
30											
Average											

C. CBG Production Performance & Utilities Consumption Measurement

Note: CBG guaranteed for the corresponding QF shall be as per the correction curves furnished by the Contractor

Table 3: CBG Production Performance & Utilities Consumption Measurement table

Date / Day	Feedstock Received			Total Rejects	Processed Waste	QF	CBG Guaranteed Vs Actual			Utilities	
							CBG Guaranteed	CBG produced/ Actual	Short Fall	Power consumption	Water Consumption
	TPD	TS%	VS%	TPD	TPD	%	TPD	TPD	TPD	kWh/day	m^3 / day
1											
2											
.											
30											

Average					

D. RBG Quality Measurement

Table 4: RBG Quality Measurement table

Date / Day	Raw Biogas Composition							Raw Biogas to Cleaning & Upgradation System
	CH_4 (%)	CO_2 (%)	O_2 (%)	H_2S (PPM)	N_2 (%)	Moisture (%)	Actual Produced (Nm3/D)	CH4 in RBG (Nm3/D)
1								
2								
.								
.								
30								
Average								

E. CBG Quality & CH4 Recovery Measurement

Table 5: CBG Quality & CH4 Recovery Measurement

Date / Day	CBG Composition						CBG		CH4 Recovery	
	CH_4 (%)	CO_2 (%)	O_2 (%)	H_2S (PPM)	N_2 (%)	Moisture (%)	Actual Produced (Nm3/D)	CH4 in CBG (Nm3/D)	CH4 in RBG (Nm3/D)	CH4 Recovery (%)
1										
2										
.										
30										
Average										

11.1.14 Measuring Parameter of ETP Plant

After successful completion of the appropriate Start-up and Operational Testing, and after relevant test protocols have been submitted by the Contractor and accepted by the Owner/Owner's Representative, the Contractor shall be allowed to prepare the Plant Performance Guarantee Test runs of the Plant.

The Contractor shall inform the Owner /Owner's Representative when the Plant is ready for the Performance Guarantee Tests and confirm that all necessary instrumentation is installed and verified. The Performance Guarantee Tests shall commence within ten (10) days of this notification.

The contractor must meet the following KPI's discharge effluent standards for the plant to successful completion of the PGTR. The contractor must collect sufficient samples to test the following parameters every seven days throughout the duration of the PGTR.

Sl. No.	Parameter	Unit	Treated Effluent Parameter
1.	Colour and Odor		Note A
2.	Suspended Solids (SS), max	mg/l	100
3.	Particle Size Of SS		Shall pass 850 micron IS Sieve
4.	pH value		5.5 to 9.0
5.	Temperature	Deg. C	Notes B & C
6.	Oil & Grease, max	mg/l	10
7.	Total Residual Chlorine, max	mg/l	1
8.	Ammoniacal Nitrogen (as N), max	mg/l	50
9.	Total Kjeldahl Nitrogen (as	mg/l	100
10.	Free ammonia (as NH.3), Max.	mg/l	5
11.	Biochemical Oxygen demand [3. days at 27 deg. C), Max.	mg/l	30
12.	Chemical Oxygen Demand, Max.	mg/l	250
13.	Arsenic (as As), Max	mg/l	0.2
14.	Mercury (as Hg), Max	mg/l	0.01
15.	Lead (as Pb), Max	mg/l	0.1
16.	Cadmium (as Cd), Max	mg/l	1
17.	Hexavalent Chromium (as Cr+6), Max.	mg/l	1
18.	Total chromium as Cr.), Max.	mg/l	2
19.	Copper (as Cu) mg/l, Max.	mg/l	3
20.	Zinc (AS Zn.), Max.	mg/l	5
21.	Selenium (as Se.), Max.	mg/l	0.05
22.	Nickel (as Ni), Max.	mg/l	3
23.	Cyanide (as CN), Max.	mg/l	0.2
24.	Fluoride (as F), Max	mg/l	2
25.	Dissolved Phosphates (as P), Max.	mg/l	5
26.	Sulphide (as S), Max.	mg/l	2
27.	Phenolic compounds (as C6H50H), Max	mg/l	1
28.	Radioactive Materials		
	(a) Alpha emitter	micro curie/ml	10^{-7}

Sl. No.	Parameter	Unit	Treated Effluent Parameter
	(b) Beta emitter	micro curie/ml	10^{-6}
29.	Bio-assay test	mg/l	90 % survival of fish after 96 hours in 100 % effluent
30.	Manganese (as Mn)	mg/l	2
31.	Iron (as Fe)	mg/l	3
32.	Vanadium (as V)	mg/l	0.2
33.	Nitrate Nitrogen (as	mg/l	10
34.	Total Dissolved Solids-Inorganic (IDS), Max	mg/l	2100
35.	Chloride (as Cl), Max	mg/l	1000
36.	Sulphate (as S04), Max	mg/l	1000
37.	Pesticides		Absent
38.	*Faecal Coliforms	MPN/100 ml	Notes E & F

Note - A: All efforts should be made to remove colour & unpleasant odour as far as practicable.

Note - B: Shall not exceed 5°C above the receiving water temperature.

Note - C: Shall not exceed 40 deg. C at the point of in any section of the stream with in 15m downstream from the effluent outlet.

Note - E: Desirable 1000 MPN/100 ml for discharge.

Note - F: Maximum permissible 10000 MPN/100 ml for discharge.

* Coliforms parameter will be measures at the ETP outlet, if any traces are found then counter measurement has to done on the waste reception.

11.1.15 Reporting:

The EPC contractor shall prepare a test report promptly after completion of each test. The report shall include data as recorded including valid calibration certificates (not older than six (6) months for temporary performance test instrumentation) and the correction calculations for adjustments to the reference conditions based on the correction curves and/or equations.

11.2 Requirement for successful completion of the PGTR

Before commencing the PGTR, the contractor must obtain written confirmation from the Owner following the mechanical completion of the project (refer to the project timeline). Upon receiving written approval from the Owner, the contractor shall conduct a Pre-Startup Safety Review prior to commencing the PGTR.

The Performance Test will be considered as successfully completed if the following conditions are met during the testing period:

Sl. No.	Parameter	Unit	Data
1.	CBG Production	TPD	≥ guaranteed performance value
2.	Raw Biogas Production	TPD	≥ guaranteed performance value
3.	CBG Quality		
•	CH_4	mole %	≥ 97
•	CO_2	mole %	<3
•	O_2	mole %	<0.5
•	H_2S	mg/m^3	<3.7
•	Moisture	mg/m^3	<5
4.	Methane Recovery	%	> 97
5.	Organics Recovery	%	≥ guaranteed performance value(to be demonstrated)
6.	Power consumption	kWh / day	≤ guaranteed performance value
7.	Plant operational availability	%	100
8.	Effluent discharge volume & parameters	m^3/day	≤ CPCB and SPCB norms

11.3 Price Discount on PGTR failure

In the event that the CBG plant fails to achieve the guaranteed performance output, the tests shall be repeated with mutual consent between the owner and the contractor. The Contractor shall conduct necessary tests with their own costs to identify the specific equipment or process causing the overall performance failure to meet the guaranteed levels. The contractor is permitted to repeat and complete the PGTR within a maximum of 2 months from the date of completion of the first PGTR. If, after the repeated tests, the contractor still fails to rectify the issue and meet the guaranteed performance, sole attribute to the reason of the contractor, the price discount shall be applicable in case of second failure of PGTR test as **per clause 12.1.9** under the special conditions of contract. Any reasonable expenses incurred by the Owner due to the repetition of these tests shall be deducted from the Contract Price.

11.4 Test Results and Report

The test report must include all relevant information to demonstrate that the Plant has met the specified requirements and Guaranteed Performance Levels as outlined in the PGTR procedure. All manipulations or adjustments must be independently verifiable. The report should contain the following elements:

- **Description of Measuring Points:** Detailed information on the locations and conditions of all measurement points.
- **Description of Measuring Methods:** Comprehensive explanation of the methods used for measurements.

- **Certificates of Measuring Equipment and Auxiliaries:** Valid calibration certificates for all measuring equipment and auxiliary devices used.
- **Description of Plant Operation During Acceptance Test:** Detailed account of the Plant's operation throughout the Acceptance Test.
- **Description of Additional Preparations/Installations:** Information on any additional preparations or installations made for the test.
- **Listings/Chart Records of Measured Raw Data:** Raw data listings and chart records with time and date stamps.
- **Conversion and Correction Methods:** Explanation of the methods used for data conversion and correction.
- **Comparison with Requirements/Guarantees:** Comparison of the Plant's data against the requirements and guarantees stated.
- **Final Conclusions:** Clear statement on whether the tests have been passed or failed, based on the results.
- **Raw Data from Continuous Monitoring:** Continuous monitoring data presented as charts in the report and provided as Windows-compatible files on disk with a file description.
- **Report Submission:** Within 2 weeks of test completion, the Contractor must supply the Owner with two copies of the test report, including a complete evaluation of the results.

11.5 Availability Test

The Availability Test shall be conducted in accordance with the following requirements:

- The Feedstock throughput shall be used as the main measurement to indicate the Availability of the Plant.
- The machine/equipment availability shall be 100% throughout the test period.
- In the event of Machine/ equipment unavailability, the test will be suspended and the testing period will be extended according to the following;
  - The extension will be equal to the duration of the event that has led to the suspension of the test.
  - In case the test is suspended more than 3 times or the total production interruption is more than 30% then the full test is cancelled and shall be repeated.
- The Availability Test will be suspended if the Plant is stopped due to:
  - A shortfall of Feedstock.
  - A disruption to the external electrical connection leading to loss of operation.
  - Periods affected by events of force majeure.
  - Periods of major plant breakdowns due to extreme weather conditions, such as heavy rainfall or earthquakes etc.
- Throughout the test period, the Plant will undergo regular maintenance. Any unscheduled stoppages that occur will be considered as periods of unavailability for the equipment/machine.
- During the test period the plant shall be operated and maintained by the Contractor in line with Good Industry Practice. However, no claims from the Contractor will be accepted on the grounds of improper operation or maintenance, except where such issues are the responsibility of the

Owner. Additionally, no claims will be considered if the Contractor's site representative was aware of inadequate operating and maintenance practices and failed to notify the Owner.

- Requirement for successful completion of the Availability Test,

Sl. No.	Parameter	Data
1.	**Plant Availability**	**100%**
a)	Pre-treatment system Availability	100%
b)	Hydrolysis and Digester Availability	100%
c)	Purification and upgradation unit availability	100%
d)	Compression and Bottling system availability	100%
2.	**System Monitoring Availability**	**100%**

12 GUARANTEE AND PRICE DISCOUNT

12.1 Performance during PGTR

12.1.1 The quality as well as quantity of Biogas and quality and quantity of CBG produced shall be in strict conformity to the Owner's requirements as mentioned in the technical bid package and no deviation shall be allowed.

Source Segregated Organic fraction of the MSW shall be fed to the digester after removal of rejects / impurities like plastic, paper, rubber, sand / grit, metals, non-digestible, etc. Vendor shall design and operate the entire plant in such a way so that guaranteed quantity of raw biogas at inlet of gas purification system with minimum 50% CH4 content is produced per MT of volatile solids fed to the Hydrolysis/Digestors (Bio-methanation) system of the plant. Vendor shall ensure that CH4 loss from raw biogas at inlet of gas purification system to purified biogas at the outlet shall not be more than 3% by weight.

Note:
CH4 loss %= [(Biogas flow at inlet of purification unit * CH4%) - (Biogas flow at outlet of purification unit * CH4%)] * 100 / (Biogas flow at inlet of purification unit * CH4%)

12.1.2 To calculate the above, samples of the slurry feeding to digesters will be drawn every 4 hours daily during feeding period. The composite sample of all the samples drawn daily shall be tested for volatile solids jointly at a mutually agreed accredited / Own plant lab. The total quantity of volatile solids in a particular day shall be calculated based on flow of total slurry fed to the digester and percentage of volatile solids checked on that day. Accordingly, Biogas production quantity (volume as well as its weight) from the digester shall be reconciled for each three days of PGTR. Price discount shall be levied for shortfall of as defined in the contract.

12.1.3 CBG shall not be delivered if CH_4 content in CBG is less than 97%. Contractor shall take all necessary steps like reprocessing in purification section etc. to ensure CH_4 content more than 97% so that it can be delivered to gas network.

12.1.4 The vendor shall ensure that CH_4 loss from raw Biogas at inlet of gas purification system to purified CBG delivered to gas network shall not be more than 1% by weight. CH_4 production quantity (Volume as well as weight) shall be calculated based on flowmeters and gas chromatograph at three locations i.e. inlet and outlet of gas purification system and final CBG delivery point to gas network. After that CH_4 loss shall be calculated for PGTR period and if the CH_4 loss exceeds 1% (by weight) the PGTR will not be considered successful.

12.1.5 The contractor shall ensure that all the instruments are calibrated from a NABL accredited laboratory.

12.1.6 Half yearly Calibration of Biogas Flowmeter, CBG Flowmeter and Gas chromatograph analysers shall be carried out in presence of Owner/PMC.

12.1.7 Owner has the authority to inspect the quality checking facility and verify the accuracy of lab instruments at any point of time. If the accuracy is found beyond the acceptable range, the instrument shall be recalibrated by the contractor at his own expenses.

12.1.8 Price discount: In case of second failure of PGTR test the Contractor shall pay up to maximum limit of 50% of EPC cost to Owner corresponding to shortfall @ 2% of EPC cost for every 1% of short fall of Biogas or part thereof over and above the permitted shortfall of 2%. A sample calculation sheet is given below:

Table 6: Sample Calculation for Price Discount

S. No.	Particulars	UoM	Value	
			Case-1	**Case-2**
1	EPC Cost Assumed	Rs in Lakh	8500	9500
2	Allowed Short fall	%	2.00%	2.00%
3	Guaranteed Production of Biogas	Nm^3/MT of VS	425	450
4	Actual Production during PGTR	Nm^3/MT of VS	415	440
5	Short fall in Biogas Production	Nm^3/MT of VS	10.00	10.00
6	Actual Percentage short fall	%	2.35%	2.22%
7	Percentage allowed as per tender	%	2%	2%
8	Percentage short fall for discount purposes	%	0.35%	0.22%
9	Percentage Price Discount 2% of EPC for every 1% shortfall	%	0.70%	0.44%

10	***Price Discount Amount**	**Rs in Lakh**	**60.00**	**42.22**

*Decimal up to a minimum of 6 digits shall be used for the calculation of the Price Discount Amount.

12.2 Performance during O&M Period

12.2.1 The quality as well as quantity of Raw Biogas and CBG produced shall be in strict conformity to the Owner's requirements as mentioned in the technical specification and no deviation shall be allowed.

12.2.2 During the O&M period, the bidder shall maintain plant availability of ≥96% for each operational quarter. If the plant Availability Warranty is not met, the bidder shall compensate the owner with Availability Liquidated Damages at a rate of 1.5% for every 1% reduction in plant availability, up to a maximum of 20% of the applicable O&M fees for the relevant operational quarter.

Note:
However, in case if there is any process upset during startup/operation/shutdown not attributable to the vendor, relaxation for the said time period on cumulative basis shall be given. Accordingly, the price discount shall be reconciled on Monthly O&M payment.

12.2.3 The raw biogas shall be purified by removing the impurities such as Moisture, Nitrogen (N_2), Hydrogen Sulphide (H_2S), Carbon dioxide (CO_2) etc. with suitable purification system such that CH4 content in at the outlet CBG shall be minimum 97% failing which it will not be accepted for delivery.

12.2.4 Vendor shall ensure that CH4 loss by weight from production of raw biogas measured at the inlet of gas purification system to purified CBG delivered at the outlet of the purification system shall not be more than 3%. If the shortfall of CBG biogas quantity (Volume as well its weight) finally delivered at the outlet of the purification system to Gas network piping header on quarterly basis (excluding the period of non-availability of the plant for which the penalty as per clause no.12.2.2 is applicable) over the quantity discovered during the final PGTR is more than 3%, a price discount @ 100% of prevailing CBG sale price for OIL (incl. of applicable taxes) shall be levied for shortfall of CBG biogas beyond 3% subject to a maximum of 50% of Monthly O&M bill.

12.2.5 The bidder shall ensure the delivery of the guaranteed CBG output with the specified purity throughout the entire O&M period.

Parameter	Formula

CBG production shortfall (CBG Performance Liquidated Damages)	$CBG_{shortfall}$ = ($CBG_{guaranteed}$ - CBG_{actual}) kg * CBG Market Price (INR/kg)

12.2.6 The O&M contractor will submit Monthly invoices along with the necessary documents to the owner. Each invoice will include breakdown of the calculation, and an explanation of the assumptions used. The Owner will calculate the Performance Liquidated Damages in accordance with the above clause. The amount of Performance Liquidated Damages, if any, shall be deducted from the Monthly O&M running bill. The aggregate amount of Performance Liquidated Damages in any operational quarter shall not exceed 50% of the O&M Price for the relevant operational quarter.

13 QUALITY OF FOM

13.1 General Requirements

13.1.1 The quality of FOM produced shall meet the following:

e) Moisture % by weight: Not more than 30%

f) Electrical Conductivity: Not Applicable for MSW based FOM.

g) Heavy Metals Content: Not Applicable for MSW based FOM.

h) All other parameters: Shall be as per Gazette Notification No. 1459 dated 27.03.2025 issued by Ministry of Agriculture and Farmers Welfare regarding inclusion of Fermented Organic manure (FOM) under fertilizer (Inorganic, organic or mixed) (control) act 1985.

13.1.2 FOM production quality which does not conform to the above requirements, shall be termed as off spec quality. Price discount @ prevailing selling price (incl. of applicable taxes) for FOM shall be levied for production of such off-spec quality and same shall be levied Monthly. No relaxation shall be given in this case. However, if FOM are produced off spec because of the quality of SSOF-MSW received, vendor shall highlight the same within a week and such source of waste shall be removed from the system, and no price discount shall be levied in this case.

13.1.3 However, there is no levy of price discount on the shortfall of quantity produced for FOM and LFOM.

14 ENERGY CONSUMPTION

14.1 General requirements

14.1.1 The bidder shall, at the tendering stage, declare the maximum energy consumption per day. The declarations shall be on the basis of valid energy calculations and assumptions, which

has to be submitted in the form BRS-7 during bidding stage. The bidder shall also specify the Contract Demand for Power connection.

14.1.2 Compensation /payment for increase in electricity tariff during O&M period and non-payment of bill

a) The contractor shall pay the monthly electricity bill on time failing which engineer in charge is entitled to deduct the amount from the Monthly O&M bill of contractor.
b) The contractor is entitled to get compensated / paid for increase in electricity tariff over the base tariff of Rs 7.94 per kWh up to the guaranteed electrical consumption only in the Monthly O&M payment due to contractor.
c) The Owner is entitled to get discount / paid for decrease in electricity tariff over the base tariff of Rs 7.94 per KWh up to the guaranteed electrical consumption only in the Monthly O&M payment due to contractor.

14.1.3 Loss in Power Factor (PF) incentive

a) Any deviation of PF from the specified range of 0.95 lag to unity attracts PF liquidated damages. This also causes an opportunity loss of incentive which could have been obtained, had the PF was in 0.95 lag to unity range.
b) The PF liquidated damages component from DISCOM Bill shall be deducted from Monthly O&M charges as a recovery.
c) The calculated opportunity loss of PF incentive shall be estimated considering a target PF of 0.98 and shall be deducted as a penal deduction from the O&M charges.

15 SPARES

15.1 Spare Parts & Tools

15.1.1 The Contractor shall provide spare parts needed for smooth operation of the equipment during start-up commissioning and mandatory spares as listed below.

15.1.2 Contractor shall submit the list of commissioning & 10 years operational spares as per prescribed format enclosed as BRS-13 recommended by OEM with quantity for each part for OIL/PMC for review. This list will be indicative and not exhaustive, any items which is required over and above those mentioned in the approved list to commission and operate the plant till successful PGTR is in contractor scope without any additional commercial consideration. The same shall be considered in the scope of the bid.

Note: The first year of O&M shall not include the spares, as the same shall be covered under defect liability period.

15.1.3 Contractor to submit the list of mandatory spares for all critical equipment as per prescribed format enclosed as BRS-14 and the same shall reviewed and approved by OIL/PMC during detail engineering. The quoted price for the equipment shall be inclusive of supply of mandatory spares.

15.1.4 Spares list for each equipment will be finalized during Detailed Engineering. All spare parts furnished by contractor shall be wrapped and packaged so that they will be preserved in original as-new condition under normal conditions of storage. For 10 years O&M, Contractor may use spares from above, however will have to replenish those spares to the original quantity by the contractor immediately after consumption. And after 10 years O&M period, all spares as per original list and quantity shall be handed over to OIL.

15.1.5 Contractor while ordering of all Equipment shall ensure that the guarantee of supply of spares for a period of 25 years or entire life of the equipment shall be obtained by the Contractor. The contractor shall submit the written compliance to the OWNER in this regard.

15.1.6 When special tools and fixtures are required to assemble, disassemble or maintain the unit they shall be included in the spares list and furnished as part of the initial supply of the machine with complete instructions for their use. For single/ multiple unit installation, minimum two sets of special tools and fixtures per plant / installation shall be supplied by vendor.

15.2 Mandatory Spares

A list of mandatory spare parts to be supplied by the Contractor is given in other parts of the tender. These spares should be dispatched that they are available at site before commencement of trial operation. The value of the mandatory spares shall not exceed **5.5%** of the CIF (**Cost, Insurance, and Freight)** value of the equipment price to be supplied under this contract. The contractor shall be responsible for safe storage of mandatory spares till completion of PGTR and handing over of the plant to the Owner.

15.3 O&M Spares

The contractor in his bid shall furnish the list of spares over and above the mandatory spare required for ten (10) years operation and maintenance of the plant and equipment supplied by the contractor, with price inclusive of all taxes and duties including inland transportation and insurance charges as per prescribed format enclosed as BRS-13.

Note: The first year of O&M shall not include the spares, as the same shall be covered under defect liability period.

16 OWNER'S REPRESENTATIVE AT SITE:

SE/ PMC shall be the Owner's representative at site and shall act as an In-charge for all the site works. The contractor's Resident Engineer shall report to him for all day to day works.

17 PAINTS, CONSUMABLES

It shall be the responsibility of the contractor to supply all the paints as required. It shall be the responsibility of The Contractor to supply all consumables like, grease, lubricating oils, all chemicals, ink & graphs for recorders etc., up to satisfactory completion of trial operation and three months thereafter. The Contractor shall also arrange any additional quantities required specifically for the Performance Guarantee Test Run. Contractor shall furnish specifications of all such consumables to enable the Owner to purchase his future requirements well in advance.

18 THIRD PARTY INSPECTION

Indigenous supplies: - The equipment to be supplied under this Contract shall be inspected during manufacturing as per the quality plan to be finalized. Material verification and stage inspection at all important stages as well as final testing and inspection fall within this scope. The inspection shall be carried out by a third-party inspection agency to be appointed by the Owner for indigenous supplies. The cost towards this inspection shall be borne by the Contractor.

In the case of imported supplies: - For imported materials or non- indigenous supplies, the inspection shall be carried out by a foreign agency of repute to be appointed by the contractor as approved by the Owner. The cost of such inspection shall be borne by the Contractor.

19 OPERATION AND MAINTENANCE MANUALS

For all equipment provided by the Contractor, ten sets of the Operation and Maintenance (O&M) manuals shall be submitted to the Owner. These manuals must include the operational features of the equipment, DOs and DON'Ts, troubleshooting guidelines, preventive maintenance schedules, detailed dimensional drawings, cross-sectional drawings, and assembly methods. This information is essential to familiarize the Owner's staff with the equipment and enable them to operate and maintain it correctly.

The manuals should also contain comprehensive information for ordering spare parts, including part names, part numbers, drawing and material specifications, and the supplier's contact details (address, phone number, and fax number). The Contractor must ensure that these O&M manuals are provided to the Owner well before the initial trials of the equipment commence.

19.1 Erection Manuals

In order to enable the engineers of the Owner to supervise the works properly, Contractor shall furnish five copies of erection manuals depicting therein the erection procedure, special precautions to be taken, various clearance to be maintained, erection checks and tests to be carried out before the equipment is put to initial trials.

19.2 Submission and Approval of Drawings

The Contractor shall submit drawings in a sequential order that aligns with the completion of milestone activities. This includes all General Arrangement (G.A.) drawings, mechanical, electrical, and civil drawings, data sheets, design calculations, and any relevant general write-ups for the Owner's approval. All system drawings must be properly coordinated.

During the review process, the Owner will indicate any necessary corrections, which the Contractor must either incorporate or justify. The Contractor will then submit the revised drawings for the Owner's approval. Upon approval, the Contractor shall provide six hard copies and a soft copy on an SSD of the approved drawings to the Owner, as per the specified distribution.

Any delays in the approval process caused by the submission of incorrect data, failure to submit data, or not updating drawings in line with indicated corrections will be the Contractor's responsibility. If any approved drawings need modifications during the contract period, these changes must be separately documented. Upon completion of all work, the Contractor shall incorporate all changes into the drawings and submit six sets of the "As Built" drawings for the Owner's records.

It is important to note that the Owner's approval of the drawings, based on the information provided by the Contractor, does not absolve the Contractor of responsibility for the correctness of the design and performance of the equipment.

19.3 Test Reports

Upon completion of equipment tests at the manufacturer's facility, the Contractor shall provide four copies of the test certificates to the Owner for approval and subsequent dispatch clearance. The test report must include identification data such as model number, serial number, method of application, duration of the test, and the test results. Dispatch clearance for the material will only be issued once the Owner or the Owner's representative has approved these test results.

19.4 Field Quality Plan

Erection shall be carried out in accordance with the contract, the manufacturer's manual, the approved quality plan, and industry best practices. After the erection of individual equipment is completed, the equipment shall be tested for startup. The list of inspections and tests to be conducted before startup shall be mutually agreed upon. Following these tests, the equipment shall be tested as a subsystem and then as a complete system. All inspections and tests during these stages shall be mutually decided and aligned with best practices. This schedule of inspections and tests shall be referred to as the field quality plan, which the Contractor shall adhere to during various stages of erection, testing, and operations.

20 HSE POLICY

The bidder shall be bound as per OIL's HSE Safety and Security Regulations provided in Annexure-4.

21 SUBMISSION OF INVOICE

Digitally signed invoice along with supporting documents (if any) against the Work order / Contract shall be submitted in OIL vendor portal (vim.oilindia.in). Only after receipt of undisputed invoice payment shall be processed.

22 PLACE OF ARBITRATION

The place of Arbitration will be at Delhi. The Contractor shall submit Hindrance Register as per Annexure-5.

23 ORDER OF PRECEDENCE

The clauses of SCC shall supplement and /or amend the GCC clauses. Whenever there is a conflict in the tender conditions the following order of precedence shall prevail:

a) Work Order / LOA
b) Instructions to Bidder (ITB)
c) Bid eligibility Criteria and Evaluation Criteria
d) Special Conditions of Contract (SCC)
e) Scope of Work (SOW)
f) Technical Specifications

g) General Conditions of Contract
h) Any other document

24 INFORMATION TO BE PROVIDED

24.1.1 Bidder shall provide Approach & Methodology used for segregation of MSW and to get maximum output of CBG in BRS-17.

24.1.2 Bidder shall provide performance chart of running plant for estimated output verses actual output or copy of PGTR test report can be enclosed.

24.1.3 Owner / Consultant may visit CBG/Biogas plants (considered in Eligibility criteria) during technical evaluation of the bids. Though all cost of travelling, Boarding etc. will be borne by owner yet arrangement for visit required to be made by bidder which interalia includes plant visit, access to plant performance. Bidder's authorised representative needs to be available at site during such visit.

END OF SECTION - V

Section-VI Schedule of Rates

Table of Contents

PREAMBLE AND NOTICE TO BIDDERS FOR PRICE BID 164

DECLARATION 165

INDEX OF PRICE SCHEDULES 166

1 Price Schedule – 1: Design & Engineering 167

2 Price Schedule – 2: Civil Works 168

3 Price Schedule – 3: Mechanical Works 170

4 Price Schedule – 4: Electrical & Instrumentation Works 173

5 Price Schedule – 5: Operation and Maintenance (O&M) of the Plant 175

6 Price Schedule – 6: Grand Summary (For Award of Works) 176

7 Guarantee & Declaration 177

FORM OF PRICE PROPOSAL, APPENDIX TO PRICE PROPOSAL AND SCHEDULE OF PRICES

PREAMBLE AND NOTICE TO BIDDERS FOR PRICE BID

This Volume comprises three Parts – Form of Price Proposal, Appendix to Price Proposal and Schedule of Prices. All the three Parts of this Volume should be carefully read through and thoroughly understood in the context of various General Conditions of Contract, Special Conditions of Contract and the OIL's Requirement before being filled in.

The items listed in the Schedule of Prices have been defined in Sections VII, VIII, IX, X, XI, XII. The rates to be filled in shall cover all Units described in Scope of Work.

Attention of the bidders is drawn to "Completeness of Offer which stipulates that the costs indicated in the Price Proposal should include the cost of all Works, Plant, Equipment and Material that are usually to be incorporated in such Facility in consonance with Sections VII, VIII, IX, X, XI, XII.

The Total Cost quoted by the bidder at Price Schedule – 6 of Price Bid shall be filled in as Offer of Bidder for final level treatment.

This is clarified here that the Total Cost quoted by the bidder at Price Schedule – 6 of this Price Bid shall be considered as 'Lump Sum Cost' quoted by the bidder for complete the Work subject to following.

1) The bidder will have to revise the Design Items of Work within the 'Lump Sum Offer' quoted as per Price Schedule – 6 for variations desired by the OIL with reference to the Design Norms, Design Criteria and Scope of Work mentioned in the Tender. No claim or extra payment will be tenable on this behalf.
2) The costs mentioned in Price Schedules – 1, 2,3 and 4 are for completing the item in full respect as per the changes / deviations suggested and approved by the OIL on the basis of the design requirement and included in the Scope of Work of the Tender.
3) The costs mentioned in Schedule – 5 is Annual Operation and Maintenance Cost for Water Charges, Manpower, Spares, Repairs and Maintenance, Chemical & Consumables and other Miscellaneous as specified in Schedule – 5. The same shall be considered for Contract Value Determination.
4) Price Schedule – 6 is for Grand Summary for Contract Value Determination.

DECLARATION

I/We have read all the contents in Price Bid and Preambles and Notice to Bidders for Price Bid thoroughly and I/We have filled in all the detailed costs wherever mentioned.

I/We also agree to abide the conditions referred herein above in addition to General Conditions of Contract (GCC), Special Conditions of Contract (SCC) and Scope of Work for evaluation and variation of Cost.

I/We agree to all the contents in the Price Bid as referred above.

Yours faithfully,

_____

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

INDEX OF PRICE SCHEDULES

S. No.	Schedule No.	Particulars
1.	Price Schedule – 1	Design, Engineering, Drawings and Documentation
2.	Price Schedule – 2	Civil Works
3.	Price Schedule – 3	Supply and Installation of Mechanical, Equipment's (both outside and within country) and other Services
4.	Price Schedule – 4	Supply and Installation of Electrical and Instrumentation Equipment's (both outside and within country) and other Services
5.	Price Schedule – 5	Operation and Maintenance (O&M) of the Plant and Facilities
6.	Price Schedule – 6	Grand Summary (For Award of Works)

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

1 Price Schedule – 1: Design & Engineering

Sl. No.	Description	Unit (L.S.)	Qty	Total Cost
1.1	Total Price Schedule for the following activities: a) Basic Engineering Package (BEP). b) General Arrangement Drawings of Civil Units). c) Structural Designs and Drawings of Civil Units. d) Architectural Drawings of Civil Units. e) General Arrangement Drawings / Datasheets for all Mechanical Equipment. f) Basic Engineering Package (Electrical & Instrumentation Works) g) Operation & Maintenance Manual h) Any other documents to comply with the OIL's Requirement as indicated in "Section – VII: Detailed Scope of Work.	To be filled by bidder		
1.2	For providing services for obtaining permissions/ clearances from various Agencies	To be filled by bidder		
1.3	Grand Total of Schedule – 1 (Carry over to Schedule – 6)			

NOTE: The Lumpsum price quoted in this schedule should be equal to or less than 3% of EPC Contract price i.e. excluding O & M Prices quoted in schedule -5.

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

2 Price Schedule – 2: Civil Works

Sl. No.	Description	Unit (L.S.)	Qty	Total Cost
2.1	**Site Development & Infrastructure Works**			
a)	Site Development including Cutting, Filling, Grading, Levelling etc. complete			
b)	Boundary Wall with Main Gate			
c)	Internal Roads with Pathways, Storm Water Drains and Service Corridors			
d)	2-Wheeler Parking, Car Parking, Truck Parking and Truck Washing Area			
e)	Internal Sewerage / Effluent Network			
f)	Plantation / Gardening / Landscaping			
g)	Any Other (Please add, if applicable)			
2.2	**Liquid Retaining Structures**			
a)	Digester			
b)	Digestate Sump			
c)	Centrate Sump (Decanter Centrifuge Feed Sump)			
d)	Effluent Treatment Plant (ETP)			
e)	Treated Effluent Storage Tank			
f)	Potable Water Storage Tank			
g)	Fire Water Tank			
h)	Any Other (Please add, if applicable)			
2.3	**Building/Shed for**			
a)	Wet MSW Receiving and Processing Facility including Central MCC-cum-Control House			
b)	Bio-Gas Purification System			
c)	CBG Compressors			
d)	Digestate Dewatering System			
e)	Solar-Enhanced Composting Facility			

Sl. No.	Description	Unit (L.S.)	Qty	Total Cost
f)	Compost Screening, Bagging & Storage Facility			
g)	Effluent Treatment Plant (ETP)			
h)	Security Terminal			
i)	Weighbridge Terminal			
j)	HT Sub-station			
k)	Workshop & Store			
l)	Laboratory			
m)	Pump House for Fire Fighting Pumps			
n)	Any Other (Please add, if applicable)			
2.4	**Grand Total of Price Schedule – 2 (Carry over to Price Schedule – 6)**			

NOTE: The Lumpsum price quoted in this schedule should be equal to or less than 40% of EPC Contract price i.e. excluding O & M Prices quoted in schedule - 5.

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

3 Price Schedule – 3: Mechanical Works

Supply, Installation and Commissioning of Mechanical Equipment (both outside and within country) and other Services.

S. No.	Description	Unit	Qty	Total Cost
3.1	**MSW Processing System**			
a)	Infeed Bunker for Wet MSW	Nos.		
b)	Organic Extraction System	Nos.		
c)	Grit Removal System	Nos.		
d)	Conveyors: Chain Belt, Roller Belt and Screw	Nos.		
e)	Digester Feed Pump	Nos.		
3.2	**Digesters**			
a)	Mixer	Nos.		
b)	Pressure Door, Manhole, Nozzles, Heating Coil, Rupture Disc, Pressure & Vacuum Regulating Valve etc.	Lot.		
c)	Biogas Holder with Support Air Blowers	Nos.		
3.3	**Hot Water Recirculation System**			
a)	Dual Fuel Hot Water Generation System with Infeed Blowers	Nos.		
b)	Hydraulic Separator, Distribution Manifold & Expansion Tank	Lot.		
c)	Hot Water Recirculation Pumps: Main + Individual	Lot.		
d)	Biogas Accessories including Flame Arresters, Condensate Separators etc. complete			
e)	Biogas Flaring System with Infeed Blowers	Nos.		
3.4	**Bio-Gas Purification System**			
a)	Bio-Gas Desulphurization System including Infeed Blowers	Lot.		
b)	Bio-Gas Purification System including Infeed Compressors	Lot.		
c)	CBG Compressor	Nos.		
d)	Cascade System	Lot		
e)	CBG metering system	Lot		
3.5	**Digestate Dewatering System**			
a)	Digestate Transfer Pump	Nos.		
b)	Digestate Sump: Air Blower/Mixer	Nos.		
c)	Press Screw Separator Feed Pump	Nos.		
d)	Press Screw Separator	Nos.		
e)	Air Blower/Mixer for Centrate Sump	Nos.		
f)	Digestate Dewatering Equipment Feed Pump	Nos.		

S. No.	Description	Unit	Qty	Total Cost
g)	Digestate Dewatering Equipment	Nos.		
h)	Dewatering Polyelectrolyte Dosing System with Agitators & Pumps	Nos.		
i)	Solar-Enhanced Composting Facility: Sludge Tilling, Turning & Conveying (STTC) System	Nos.		
j)	Compost Screening Plant	Nos.		
k)	Compost Bagging Unit	Nos.		
l)	Effluent Treatment Plant (ETP) comprising Ammonia Stripping System + Ultra-Filtration (UF) System + Sequential Batch Reactor (SBR)	Lot.		
m)	Conveyors: Chain Belt, Roller Belt and Screw	Lot.		
n)	Electronic Weighbridge	Nos.		
3.6	**Pumps**			
a)	Potable Water Transfer Pump	Nos.		
b)	Fire Hydrant Pump: Electric Motor Driven	Nos.		
c)	Fire Hydrant Pump: Diesel Engine Driven	Nos.		
d)	Jockey Pump	Nos.		
e)	Odour Control System including Centrifugal Fans, Air Ducts, Modular Bio-filters etc. complete			
f)	Air Compressor for Instrument Air	Nos.		
g)	Laboratory Equipment + Glassware + Chemicals			
h)	Plant Cleaning Equipment	Lot.		
3.7	**Vehicles**			
a)	Skid Steer Loader	Nos.		
b)	Tractor	Nos.		
c)	2-Wheeled Hydraulic Trolley	Nos.		
d)	Truck mounted Sewer Suction Machine	Nos.		
e)	Emergency Response Vehicle	Nos.		
f)	Piping, Appurtenances & Valves for the entire Plant	Lot.		
3.8	**Fire Fighting System** including Pipes, Strainers, Air Cushion Tank, Reflex Valves, Sluice Valves, Hydrant Valves, Air Release Valves, Hose Boxes, Hose Reels with Drums, Fire Brigade Connection, Hose Pipes, Nozzles, Sprinklers, Smoke Detectors, Manual Call Points, Fire Extinguishers, Hooters etc. complete.	Lot.		
a)	Any Other (Please add, if applicable)	Lot.		
3.9	**Grand Total of Price Schedule – 3 (Carry over to Price Schedule – 6)**			

The Unit Rate / Total Price of each Item to be quoted by the Bidder above shall be inclusive of Custom Duties (if applicable), Packing and Forwarding, Loading and Unloading, Transportation up to Project, Site, Transit Insurance, Octroi (if applicable), Storage at Project Site, Installation, Commissioning, Guaranteed Performance Run, Works Contract Tax, Trade Tax, Income Tax, Surcharge (if any) and all other Central Govt. and State Govt. Taxes and Duties etc. as applicable and any other Cost required to complete the project as per RFP.

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

4 Price Schedule – 4: Electrical & Instrumentation Works

Supply, Installation and Commissioning of Electrical and Instrumentation Equipment (both outside and within country) and other Services

Sl. No.	Description	Unit	Qty	Total Cost
4.1	HT Works including 2/4-Pole Structure, Ring Main Unit, HT Panels, Transformers, HT Cables, Accessories, Hardware etc. complete.	Lot.		
4.2	LT Works including LT Panels, LT Cables, Cable Termination Kits, Cable Trays, Accessories and Hardware etc. complete.	Lot.		
4.3	Earthing Works including Earthing Pits, Earthing Strips, Earthing Cables, Accessories and Hardware etc. complete.	Lot.		
4.4	Lighting Works Street Light Poles, Lighting Fixtures, Hangers, Lighting Cables, Junction Boxes, Accessories and Hardware etc. complete.	Lot.		
4.5	Miscellaneous Works including Air Conditioning System, Distribution Boards & MCBs, Modular Switches, Point Wiring, Lightening Arrestor, Accessories and Hardware etc. complete.	Lot.		
4.6	Safety Equipment including Accessories and Hardware etc. complete.	Lot.		
4.7	Emergency Diesel Generating Set with Alternator including Accessories and Hardware etc. complete.	Lot.		
4.8	Field Instruments, Instruments & Control Cables, Cable Termination Kits, Accessories and Hardware etc. complete.	Lot.		
4.9	PLC & SCADA based Automation System including PLC Panel, HMI, SCADA, Accessories and Hardware etc. complete.	Lot.		
4.10	IT Works including CCTV System, IP-PBX System, Server, Personal Computers & Peripherals, Large Display Screens, HD Projectors, Bio-metric Attendance System, Wi-Fi System, Optical Fibre Cable Network, UPS, Walkie Talkies, Accessories, Hardware and ERP System etc. complete.	Lot.		
4.11	Any Other (Please add, if applicable)	Lot.		
4.12	Grand Total of Price Schedule – 4 (Carry over to Price Schedule – 6)			

The Unit Rate / Total Price of each Item to be quoted by the Bidder above shall be inclusive of Custom Duties (if applicable), Packing and Forwarding, Loading and Unloading, Transportation up to Project, Site, Transit Insurance, Octroi (if applicable), Storage at Project Site, Installation, Commissioning,

Guaranteed Performance Run, Works Contract Tax, Trade Tax, Income Tax, Surcharge (if any) and all other Central Govt. and State Govt. Taxes and Duties etc. as applicable and any other Cost required to complete the project as per RFP.

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

5 Price Schedule – 5: Operation and Maintenance (O&M) of the Plant

Sl. No.	Year	Unit
5.1	Year-1	
5.2	Year-2	
5.3	Year-3	
5.4	Year-4	
5.5	Year-5	
5.6	Year-6	
5.7	Year-7	
5.8	Year-8	
5.9	Year-9	
5.10	Year-10	
5.11	Grand Total of Price Schedule – 5 (Carry over to Price Schedule – 6)	

Note:

- The O&M Cost to be quoted by the Bidder above shall be exclusive of the cost of electricity but inclusive of Water, Chemicals & Consumables, Fuel & Lubricants, Spare & Wear Parts, Repair & Maintenance, Laboratory Analysis, Manpower, Statutory Compliance, Insurance, Administrative Expenses etc. complete.
- The price quoted for the first year of O&M shall not include the price of the spares, as the same shall be covered under defect liability period.
- The cost of grid electricity consumption will be calculated based on guaranteed energy consumption per day as quoted in BRS-7 @ Rs 7.94 per kWh.
- Grand Total of O&M Cost quoted by the bidder in Schedule – 4 above and cost of grid electricity charges for 10 years shall be considered for bid evaluation.
- For evaluation of Price Bids, the Present Value (PV) method shall be applied on the Annual O&M Cost and annual grid energy cost for 10 years.

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

6 Price Schedule – 6: Grand Summary (For Award of Works)

S. No.	Description	Price (INR)
6.1	Design, Drawings and Documentation (Price Schedule – 1)	
6.2	Civil Works (Price Schedule – 2)	
6.3	Supply, Installation and Commissioning of Mechanical Equipment (both outside and within country) and other Services (Price Schedule – 3	
6.4	Supply, Installation and Commissioning of Electrical and Instrumentation Equipment (both outside and within country) and other Services (Price Schedule – 4)	
6.5	**Sub total**	
6.6	**GST on 6.5 Subtotal @13.8%**	
A	**Total cost of EPC inclusive of GST (A)**	
6.7	Operation and Maintenance Cost of the Plant and Facilities for 10 years (Price Schedule – 5)	
6.8	**GST on 6.7 Subtotal @18%**	
B	**Total O&M cost inclusive of GST**	
C = A+B	**Grand Total inclusive of GST**	

Note:

- "Grand Total" specified above shall be considered as the "Award Value of Work" including prevailing GST and shall be final and binding on the bidder.
- GST on EPC is considered as composite **@ 8.9%** and during O & M as 18%.
- However, GST shall be payable as per the prevailing rates during billing stage

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

7 Guarantee & Declaration

The bidder should provide guaranteed parameters for the following in respective BRS and confirm the same.

a) Guaranteed Biogas production per MT of Volatile Solid in BRS -6

b) Electrical Consumption per day in BRS -7

c) The prices quoted in Price schedule -1 is less than 5% of the EPC cost

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

Section-VII Detailed Scope of Work

Table of Contents

1 GENERAL PLANT DESCRIPTION 182
1.1 Introduction 182
1.2 Project Information 183
2 Intent of Specification 185
3 SCOPE OF WORK 188
3.1 Scope of Work: General 188
3.2 Scope of Work: Specific 188
3.3 Detailed Scope of Work 190
4 GENERAL PLANT DESIGN REQUIREMENTS 201
4.1 Intent 201
4.2 General Requirements 202
4.3 Redundancy Requirements 203
4.4 Standards and Codes of Practice 204
4.5 Plant Operational Requirements 206
4.6 Vibration 207
4.7 Noise Levels 207
4.8 Units of Measurement 208
4.9 Safety 208
4.10 Fire Protection and Precautions 209
4.11 Signs 210
4.12 Package, Storage and Store House 211
4.13 Painting, Insulation, Anti-dewing 212
5 OIL'S RESPONSIBILITY 213
6 CONTRACTOR'S RESPONSIBILITY 214
7 MISCELLANEOUS PLANT FACILITIES 215
7.1 Sheds (Conventional Steel Structure / Pre-Engineered Steel Structure / Self-Supported Roofing System) for: 215
7.2 Buildings 215
7.3 Other Infrastructure Works 215
7.4 Other Miscellaneous Equipment 217
7.5 Vehicles 217
7.6 Control and Automation Philosophy for Operation of Plant 218
8 PROJECT MONITORING 220
8.1 Progress Monitoring 220
8.2 Progress Report 220
8.3 Overall Time Schedule 221
8.4 Extension of Time 221
9 QUALITY ASSURANCE, SHOP INSPECTION AND TESTING 222
9.1 General 222
9.2 Scope 222

9.3 Inspection Program and Test Notifications 224
9.4 Test Certificate Documentation 224
9.5 Codes and Standards 225
9.6 Services prior to and During Inspection and Testing 226
9.7 Testing During Manufacturing 226

10 EQUIPMENT ERECTION 227
10.1 Introduction 227
10.2 Erection 227
10.3 Supervision during Erection 228
10.4 Sequence of Erection Work 229
10.5 Safety Regulations 229
10.6 Proper Treatment of Injured 231
10.7 Inspection 231
10.8 Cleaning 232

11 TESTING 233
11.1 Erection Test 233
11.2 Pre-Commissioning Testing 234

12 COMMISSIONING 237
12.1 Introduction 237
12.2 Commissioning Tests 237
12.3 Trail Operation 238
12.4 Reliability Run 239

13 OPERATION AND MAINTENANCE 240
13.1 General Requirements 240
13.2 Operation & Maintenance Services (O&M) 244
13.3 Responsibility of Owner 244
13.4 Responsibility of O&M by EPCOM 244
13.5 Contractor's Right and Obligations during the O&M Period 246
13.6 Plant Availability and Liquidated Damages 247
13.7 Scope of Supply for O&M 248
13.8 Scope of Work - Civil 249
13.9 Scope of Work - Mechanical 249
13.10 Scope of Work - Electrical 251
13.11 Scope of Work - Instrumentation 253
13.12 Consumables 254
13.13 Tools, Tackles & Equipment 255
13.14 Organogram 256

14 APPROVED SUB-VENDORS/ MAKES 258

15 INSURANCE 259
15.1 During Execution of Project 259
15.2 During O&M Period (Insurance by Owner) 259
15.3 During O&M Period (Insurance by Contractor) 260

16 DOCUMENTATION 261

16.1 Format of Documentation 261
16.2 Numbering and Identification of Documents 261
16.3 Provision for Documents 262
16.4 Owner's Responsibilities 262

17 PLANT AND EQUIPMENT IDENTIFICATION, LABELLING 263
17.1 Plant and Equipment Identification 263
17.2 Labelling 263

18 DRAWINGS, DOCUMENTS FOR APPROVAL, LIAISON MEETINGS 264
18.1 General 264
18.2 Liaison Meetings 265

19 TRANSPORTATION & CUSTOM CLEARANCE 266
19.1 Transportation 266
19.2 Custom Clearance 266

20 MANUALS 267
20.1 General 267
20.2 Certification Manual 267
20.3 Design Manual 267
20.4 Construction Manual 267
20.5 Commissioning Manual 267
20.6 Operating and Maintenance (O&M) Manuals 268
20.7 Operating Instructions 268
20.8 Maintenance Instructions 269
20.9 Owner's Responsibilities 270

21 ENVIRONMENTAL PROTECTION 271
21.1 Applicable Standards 271
21.2 Environmental quality standards 271
21.3 Fundamental Requirements of Environmental Protection for CBG Projects 271

22 ENVIRONMENT, HEALTH, SAFETY AND SOCIAL 274
22.1 General Requirements 274

23 LANGUAGE TO BE USED 282

24 DEVIATION POINT 283
24.1 Deviation sheet sample format 283

25 DOCUMENTS TO BE SUBMITTED ALONG WITH BID 284

1 GENERAL PLANT DESCRIPTION

1.1 Introduction

This Chapter specifies OIL's requirements for setting-up of state-of-the-art Compressed Biogas (CBG) Plant including Design, Basic & Detailed Engineering, Supply, Transport to Site, Unloading and Storage at Site, Handling at site, Construction, Installation, Erection, Testing, Commissioning, Performance Guarantee Testing, and Operation and Maintenance for a period of 10 (Ten) Years of Civil, Mechanical, Piping, Electrical, Instrumentation, Automation & Control Units along with all associated non-technological works from "Concept" to "Completion" to meet the specified performance criteria and all other requirements specified in this bid document .

The proposed CBG Plant shall be designed to process 200 TPD Source Segregated Organic Fraction of Municipal Solid Waste as described below:

a) Biogas shall be de-sulphurised to remove Hydrogen Sulphide (H_2S) and then further purified/upgraded to remove Carbon Dioxide (CO_2), Moisture and other impurities. The purified/upgraded biogas will be compressed for injection into the City Gas Distribution (CGD) pipelines. The operating pressure of CGD pipeline may vary upto 45 bar (g).
b) Digestate shall be treated in the Digestate Dewatering System, followed by a maturation process in the Composting Facility to produce Fermented Organic Manure (FOM).
c) Liquid Digestate from Digestate Dewatering shall be treated in the Effluent Treatment Plant (ETP).
d) The treated effluent will be reused within the facility for various purposes, and any excess treated effluent will be discharged according to the General Discharge Standards of Environmental Pollutants as per the Environment (Protection) Rules, 1986, and its subsequent amendments.
e) Any process rejects or inert materials will be landfilled in the Sanitary Landfill Facility (SLF). Loading of the rejects and / or inert materials into the vehicles provided by the Owner within plant battery limit, is in the scope of the Contractor

The proposed CBG Plant shall be in accordance with the RFP Document and meet the Solid Waste Management (SWM) Rules, 2016 prescribed by the Ministry of Environment, Forests & Climate Change (MOEF&CC), Government of India and its subsequent amendments.

The proposed CBG Plant shall be designed and constructed/installed as per National Building Code (NBC) of India, Bureau of Indian Standards (BIS), International Organization for Standardization (ISO), other applicable Industrial Standards and Good Engineering Practices (GEPs).

The proposed CBG Plant shall be monitored and operated from a Centralized Control Station through a Programmable Logic Controller (PLC) and Supervisory Control and Data Acquisition (SCADA) System.

1.2 Project Information

Sl. No.	Description	Details
A.	**Project Information**	
1.	Owner	OIL India Limited
2.	Project Output Capacity	Bidder to provide
B.	**Site Information**	
3.	Site location	Gulunda, Maneswar Taluk, Sambalpur, Odisha
4.	Site Coordinates (approx.)	20°29'32"N 85°55'56"E
5.	Country	India
6.	State	Odisha
7.	Administrative district	Sambalpur
8.	Road access	NH 55
9.	Nearest airport	Veer Surendra Sai Airport (Jharsuguda Airport)
10.	Nearest railway station	Maneswar Railway Station (MANE)
11.	Nearest National Highway	National Highway 55
12.	Approach road Distance to NH	3 km Approx.
13.	Nearest Harbour	Nil
C.	**Meteorological Information**	
14.	Ambient Temperature	Min 10° C - Max 45° C
15.	Design Ambient Temperature	≥ 50° C
16.	Relative humidity	Min 10% to Max 100%
17.	Wet Bulb Temperature	27° C
18.	Basic design wind speed	44 m/sec
19.	Seismic Intensity	MSK VII or more
20.	Seismic Zone	Zone III
21.	Hazardous Area Classification	Shall be as per BIS:5572, IEC:60079 & API RP 505
22.	Average Annual rainfall	1437 mm (average)
D.	**Finished Ground Level**	Bidder to refer the topography survey
E.	**Electrical Details**	
23.	Electrical voltage levels	415 V, 3-Phase, 50 Hz
F.	**Project Feedstock**	• Municipal Solid Waste - from Sambalpur Municipality
G.	**Project Utilities**	• Water - Ground Water • Electricity from the Grid • Diesel - For Emergency DG set (as backup power for emergency operations) • Biogas Fired Hot Water Generators or Heat Pumps to generate hot water
H.	**Project – Other inputs**	• Bidder to indicate
I.	**Project Outputs**	• Compressed Biogas (CBG)

Sl. No.	Description	Details
		• Fermented Organic Manure (FOM)
J.	**Product Sales mode**	• Compressed biogas to be injected into nearest City Gas Distribution network pipeline injection point • Organic Manure to be sold to the fertilizer dealers & distributors in Odisha and neighbouring states
K.	**Project Technology**	• Anaerobic Digestors – for converting the feedstocks into biogas • Biogas upgradation – Purification of biogas produced by the Digestor to natural gas grade (methane)
L.	**Energy Sources**	• Electricity from the Grid • Hot Water Generators or Heat Pumps to generate hot water

2 Intent of Specification

2.1.1 This specification covers the scope requirements of Design, Engineering, Supply, Construction, Erection, Testing and commissioning with all allied civil works for 200 TPD SSOF-MSW based CBG plant. Bidders shall ensure that engineering and supply of equipment shall be done for efficient and trouble-free operation of CBG plant. The Scope also includes Ten (10) year of Operation and Maintenance (O&M) of the plant.

2.1.2 The bidder's scope of work includes the completion of a CBG plant with a processing capacity of ≥200 TPD SSOF-MSW, achieving a purity of CBG (Methane content) of ≥97% and a Methane recovery rate of ≥97% in the biogas purification and upgrading unit. The produced CBG shall be at a pressure up to 45 bar (g) to be injected into the CGD pipeline.

2.1.3 The raw biogas net output (after deducting the raw biogas used for the hot water generator) shall not be less than 425 Nm^3/Ton of volatile solids (in the slurry fed to the Hydrolysis / Digestors (bio-methanation) system), and before it is sent to the upgradation systems.

2.1.4 This specifications document is not exhaustive, and the Bidder shall be responsible not only for the requirements specified herein but also for the site suitable choice of materials, for proper fabrication and for the conformity to codes, regulations, legal requirements and for supplying all the documentation of these materials. However, the equipment shall conform in all respects to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation as per agreed guarantee.

2.1.5 This document, while being detailed, is not intended to define each individual piece of equipment or material but to provide an overview to the contractor of the scope of work and the main components.

2.1.6 The general terms and conditions, instruction to Bidders and other attachments referred to elsewhere be hereby made part of the technical specification. Bidder's offer shall conform to all requirements stipulated in the specification.

2.1.7 Any item(s) not exclusively included or mentioned in the specification/schedule but required for completion of the work shall have to be carried out/supplied by Bidder without any extra cost to the Owner. Such works, not listed in the schedule of works but elaborately described to perform or to facilitate operation(s) required for completion of the project shall be deemed to have been included in the scope of this work and the Contractor shall supply, install the same without any extra cost to Owner.

2.1.8 Supplies and services shall be rendered in conformity with proven design principles, considering the current technology. The requirements of the Contract must be fulfilled in its entirety. The supplies and services shall be rendered inclusive of all appliances and interconnecting arrangements with other supplies, necessary for installation of all accessories, needed for proper and reliable continuous operation and for satisfactory maintenance and repair. It is not the intent to completely specify all the details of Design, Construction and Installation herein.

2.1.9 All technology selections must be based on proven designs. The equipment, processes, or strategies proposed by the Bidder must have been successfully operational for at least 2 (Two) Years in their previous projects. Additionally, all equipment must be suitable for the specific treatment of Source Segregated Organic Fraction of Municipal Solid Waste.

2.1.10 The work to be carried out shall be all in accordance with the requirements, conditions, appendices etc. given in Technical Specifications together with those stated in other Parts/ Sub-Parts/tender drawings of Bid Documents which shall be considered as a part of this volume as completely as if bound herewith.

2.1.11 Bidders are requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specifications. Such clarifications should be sought within a specific time period. Bidder's offer should not carry any parts like clarifications, interpretations and/or assumptions. However, if the Bidder feels that, in his opinion, certain features brought out in his offer are superior to what has been specified, these may be highlighted separately.

2.1.12 In case of any conflicts/contradiction among various clauses/Parts/Appendix/ Annexure/chapters/ tender drawings of bid documents, the most stringent requirement shall govern; decision of the Owner shall always be final & binding on the Bidder/Successful Bidder. No extra claims shall be allowed on this account.

2.1.13 The scope shall also include submission, in proper shape & format, of all types of manuals, handbooks & documents in requisite numbers to the Owner at different phases of the project as per the requirement of Owner.

2.1.14 Bidder shall be responsible for providing all materials, equipment and services, specified or otherwise which are required to fulfil the intent of ensuring operability, maintainability, and reliability of the total work covered under this specification within his quoted price. This work shall be consistent with modern practice and shall be in compliance with all applicable codes, standards, guides, statutory regulations and safety requirements in force on the date of award of this Contract.

2.1.15 The drawings enclosed with the specification are indicating the minimum requirement and all Bidders shall comply with it. Any further improvement required during detailed engineering and execution shall also be implemented by Bidder. Bidder shall confirm that the type, make, model of all bought out items supplied by the Bidder under the specification shall be subject to the approval of the Owner during detailed engineering stage.

2.1.16 The Owner shall have the right to and may modify/clarify the RFP document prior to the submission date of the bids by issuing amendments/addendum/errata/corrigenda, as appropriate and such documents shall be construed as forming part of the RFP document.

3 SCOPE OF WORK

3.1 Scope of Work: General

The detailed Scope of Work has been described in the following clauses. However, any item of work required to be carried out for proper satisfactory completion of the work with good standard of workmanship shall be deemed to be included in the Scope of Work with no additional cost for such items, whether or not specifically included/described below:

a) Commencement of work including Construction of temporary Site Office and Labor Camp at the Project Site.

b) Arrangement of Construction Power and Water etc. at the Project Site.

c) Topographical Survey and Soil Investigation at the Project Site.

d) To make Reference Pillars required for setting-out of the Structures/Buildings and safeguard them till the completion of the Construction Period.

e) To prepare Construction Program in the form of Gantt Chart/Bar Chart including details of Main Activities/Critical Activities/Monitoring of Work Progress etc.

f) To prepare Construction Methodology and Quality Plan etc.

g) To meet the Scheduled Milestones, Quality and Safety requirements.

h) To make arrangements for protection and safety of Material, Equipment, Machinery and Tools & Tackles at the Project Site.

i) To ensure timely submission of all Reports, Test Results and Samples etc.

3.2 Scope of Work: Specific

a) Preparation of Process, Hydraulic, Civil, Mechanical, Piping, Electrical and Instrumentation Design and Drawings including Construction and Architectural Drawings.

b) Procurement, Supply, Transport to Site, Unloading and Storage at site, handling at site, Installation, Erection, Testing, Trial Runs, Commissioning, , and Performance Guarantee Testing Run of all the Mechanical Equipment and Machinery.

c) Procurement, Supply, Transport to Site, Unloading and Storage at site, handling at site, Installation, Erection, Testing, Trial Runs, Commissioning of interconnecting Conveyors, Piping and Valves.

d) Procurement, Supply, Transport to Site, Unloading and Storage at site, handling at site, Installation, Erection, Testing, Trial Runs, Commissioning of all the Electrical Equipment including HT and LT Panels, Transformers, Cables, Cable Trays, Earthing, Lighting Fittings & Fixtures, Local Push Button Stations, Junction Boxes, etc.

e) Procurement, Supply, Transport to Site, Unloading and Storage at site, handling at site, Installation, Erection, Testing, Trial Runs, Commissioning of Water pumping system including adequate numbers of borewells for sourcing water as per Water requirement during construction, commissioning and O & M of the plant for entire plant.

f) Procurement, Supply, Transport to Site, Unloading and Storage at site, handling at site, Installation, Erection, Testing, Trial Runs, Commissioning of all the Instruments.

g) Procurement, Supply, Transport to Site, Unloading and Storage at site, handling at site, Installation, Erection, Testing, Trial Runs, Commissioning of PLC / SCADA based Automation System for the entire Plant.

h) Procurement, Supply, Transport to Site, Unloading and Storage at site, handling at site, Installation, Erection, Testing, Trial Runs, Commissioning of Fire Fighting System.

i) Procurement, Supply, Transport to Site, Unloading and Storage at site, handling at site, Installation, Erection, Testing, Trial Runs, Commissioning of Safety Equipment at required locations including Safety Showers, Sand Buckets, Fire Extinguishers etc.

j) Procurement and Supply of all Spare & Wear Parts, Tools & Tackles required during Erection, Commissioning and Performance Run of the Plant and O&M Period.

k) All Civil works including Liquid Retaining Structures, Sheds, Buildings, Roads, Pathways, Parking etc. **as per latest CPWD Works Manual and Standard Operating Procedures (SOPs)**.

l) Gardening / Landscaping.

m) Commissioning and Performance Run of the constructed & hydraulically tested Plant followed by Operation & Maintenance (O&M).

n) Preparation and submission of As-built Drawings and Operation & Maintenance Manuals of entire plant consisting of Mechanical, Electrical & Instrumentation Items. etc.

o) Any other item not mentioned specifically, but necessary as per good engineering practice, safety norms and successful operation and guaranteed performance for the entire Plant.

3.3 Detailed Scope of Work

3.3.1 The detailed scope of work covered by this bid document shall be complete from site clearing to project take over by the Owner including all supplies and services. The Contractor's scope of work shall include those listed under "Detailed Technical Specification" described in following sections, as well as those listed below and shall not be limited to the following clauses.

3.3.2 Design, Engineering, Manufacture, Procurement, Assembly, Testing at Manufacturer's facility, painting, packing / dispatch and transportation to site (including transit insurance). This includes storage, erection, testing, and commissioning within the specified supply limits and connection at the boundary limits, as detailed in the technical specifications for the EPCOM turnkey project. The scope also covers the provision of special tools and tackles, startup/commissioning spares, mandatory spares, and all necessary auxiliaries and accessories for the complete setup of the 200 TPD SSOF-MSW based CBG plant. Additionally, operate and maintain the plant for Ten years (10) following the successful completion of the performance test and handover to the Owner.

3.3.3 **Major Facilities:** This section outlines the indicative facilities to be included in the project. The list provided is not exhaustive, and the contractor is responsible for submitting a comprehensive list of facilities and equipment necessary for the safe and successful operation of the plant. This is to ensure the required output as defined in the project design basis in the subsections. The final list of equipment will be determined based on the technology selected by the contractor and must be submitted to Owner for approval before proceeding further.

S.No.	Major Facilities	Remarks
A. Mechanical Components		
1.	Weighbridge system	-
2.	MSW Processing & Pre-Treatment (Complete) system	-
3.	Anaerobic digestion (AD) system	-
4.	Biogas holder/storage system	-
5.	Biogas purification and upgradation system	-
6.	Biogas compression and filling system	-
7.	Solid liquid separator system	-
8.	Pumping systems	-
9.	Digestate Conveying system	-
10.	Composting plant	-
11.	FOM preparation / screening system and bagging unit	-
12.	Lab equipment	-

S.No.	Major Facilities	Remarks
13.	Hot water generator or Heat Pump system	-
14.	Flare system	-
15.	Air compressor system	-
16.	Blower system	-
17.	Briquetting system (if required)	-
18.	Service water system	-
19.	Potable water system	-
20.	ETP system	-
21.	Sewage treatment plant	-
22.	HVAC system	-
23.	Chemical dosing system	-
24.	Piping, valves and fittings	-
25.	Mandatory spares	-
26.	Start up and commissioning spares	-
27.	Operation and maintenance spares	-
28.	Special tools and tackles for erection & maintenance	-
29.	Fire Protection, Detection and Alarm System	-
30.	Cranes and hoists	-
31.	Workshop equipment	-
32.	Mobile equipment (including Ambulance)	-
33.	Any other Item / Equipment not indicated above but required for satisfactory completion and operation of the CBG Plant.	
B. Electrical Equipment / Components		
1.	Distribution transformer (Oil type)	-
2.	MV Switchgear (ICOG MV Panel)	-
3.	Emergency generator set	-
4.	Non-segregated phased busduct	-
5.	Low voltage switchgear	-
6.	Motors	-
7.	Electrical actuators	-
8.	Battery, battery charger & DC/DC	-
9.	Uninterrupted power supply system	-
10.	Illumination system	-
11.	Cables	-
12.	Cabling accessories	-
13.	Fire stop system	-
14.	Earthing & lightning protection system	-
15.	Mandatory spares	-

S.No.	Major Facilities	Remarks
16.	Start up and commissioning spares	-
17.	Operation and Maintenance spares	-
18.	Special tools and tackles for erection & maintenance	-
19.	Any other Item / Equipment not indicated above but required for satisfactory completion and operation of the CBG Plant.	
C. Civil Works / Items		
1.	Site development work o Site grading o Plant storm water drainage system for the entire plant o Security gate house	-
2.	Feedstock Trucks Arriving Area & Weighbridge Civil Works	-
3.	Feedstock Processing & Pre-Treatment Buildings	
4.	Hydrolysis, Digester, Digestate & Underground water Tanks	-
5.	ETP system civil works	-
6.	Networks of Roads, Strom water drains, sewers inside the Plant	-
7.	Composting Plant / FOM Area	-
8.	Admin building (Including Canteen, Laboratory, Parking etc)	-
9.	Control building	-
10.	MCC Panel / Electrical Rooms	-
11.	Hot Water Generator System Civil Works	-
12.	Air Compressor Shed & Civil Works	-
13.	Biogas Upgradation Systems Shed & Civil Works	-
14.	Dewatering Systems building/platforms	-
15.	Switchyard	-
16.	Central Workshop	-
17.	Vehicle Parking and Green area/Landscape Development along Boundary periphery	-
18.	Foundations and sheds for various equipment, Facilities and its auxiliaries	-
19.	Civil Works for Fire water system / Ground water system / Service water System / Potable water Systems - Storage Tanks, Pump Houses, Platforms etc.	-
20.	Construction / Site Enabling Works:	-
	Site office	-
	Site stores	
	Temporary workshop and garage	
	Fabrication yard	

S.No.	Major Facilities	Remarks
	Quality control laboratory	-
21.	Any other Works / Item not indicated above but required for satisfactory completion and operation of the CBG Plant.	
D. Control and Instrumentation Equipment / Items		
1.	Control & Instrumentation including Main PLC system for - MSW Processing & Pre-Treatment Plant - Bio-methanation Plant - Digestate Dewatering Plant - Effluent Treatment Plant - Composting Plant - All the Water Systems - Compressed air Systems - Any other as required	-
2.	Control & Instrumentation including PLC system for -Biogas Purification and Upgradation System -CBG odorising system -CBG injection system	-
3.	Control & Instrumentation including PLC system for Hot water generator / Heat Pump System	-
4.	pH sensors along with transmitters for digesters	-
5.	Digester level and temperature gauges/sensors and temperature transmitters	-
6.	Slurry line pressure transmitters, flow meters & transmitters	-
7.	Raw biogas flow meters (ultrasonic type)	-
8.	Online & Offline biogas analysers wherever required	-
9.	Biogas flow meters & transmitters (Coriolis type) wherever required	-
10.	Control & Instrumentation cables	-
11.	Master clock systems (for GPS time synchronisation)	-
12.	All other field instrumentation, erection hardware's (impulse lines, fittings, glands, etc.) and junction boxes	-
13.	Field mounted instruments and accessories, JBs, instruments cables	-
14.	Desktop Workstations, Control desk & other furniture's	-
15.	CCTV monitoring systems	-
16.	Gas leak detection system	-
17.	Mass Flow meter	-
18.	Mandatory spares	-

S.No.	Major Facilities	Remarks
19.	Start up and commissioning spares	-
20.	Operation and maintenance spares	-
21.	Special tools and tackles for erection and maintenance	-
22.	Any other Equipment / Item not indicated above but required for satisfactory completion and operation of the CBG Plant.	-

3.3.4 Intermediate site storage, transport to the erection area, receipt of materials at the site, including unloading from carriers, handling, storage, preservation, and intra-site transport. Electrical equipment such as switchgear and motors, as well as mechanical equipment like pumps, valves, and pipes, shall be stored in a covered shed. Electronic items, including PLC panels, DCS panels, and cards, must be stored in an air-conditioned storage shed. This clause applies to all electrical, mechanical, and electronic components for the CBG plant.

3.3.5 Contractor to provide adequate number of Borewells for the Water requirement during construction, commissioning and Operation & Maintenance of Plant.

3.3.6 Inspection, testing, cleaning, painting, marking, etc. at the Contractors and/or Sub-contractor workshops, delivery and transportation to the site, including transit insurance, unloading, etc.

3.3.7 Overall project management, project control, quality assurance, site management and coordination for all technical matters, interconnections, connection to off-site facilities, scheduling, contractual matters and obligations, etc. with suppliers, Sub-suppliers, Sub-contractors, vendors, the owner, authorities as required on an EPCOM basis for the implementation, construction and putting into commercial operation of the whole project under the overall and sole responsibility of the EPCOM Contractor.

3.3.8 Supply of all information, documents, calculations, drawings, reports, etc. which are required for Owner's approval and to obtain all necessary permits, clearances, from the Government authorities.

3.3.9 Apply for and obtain all necessary permits and approvals from local Government and statutory authorities for all required actions.

3.3.10 Supply of all consumable materials required for construction, erection, testing and commissioning, reliability run, performance guarantee test, taking over of the plant. Feedstock required for these trials / test of the plant will be Owner’s scope. Supply of emergency DG Set till ‘Take Over’ by the Owner will be in Contractor’s scope.

3.3.11 Provide all necessary labour, erection equipment, temporary site facilities, and temporary connections to power and water supplies. Ensure these provisions are in place for the erection and commissioning phases to fulfil the Contractor's duties and complete the entire project on time.

3.3.12 Provision of all accommodation, transport, canteen facility, social facilities, etc. for the Contractor's personnel employed at site. Labour's accommodation at the site shall not be allowed.

3.3.13 Cleaning and application of corrosion protection during erection as required by the Owner and apply final & touch up painting in accordance with the specification.

3.3.14 Conduct commissioning, testing, trial operations, reliability runs, and performance guarantee tests for the systems, equipment, and plant. This includes all specified civil, structural, and architectural works, ensuring compliance with the requirements of this specification and obtaining the Owner's approval before handing over the plant.

3.3.15 Provision of supply of all documents required and specified including As-built drawings.

3.3.16 Training services for the Owner's operation and maintenance Personnel.

3.3.17 Any other supplies and services in connection with or related to the works so far as the necessity for providing the same is specified in or reasonably to be inferred from the Contract and/or required for the completion of the CBG project.

3.3.18 The Contractor shall accept full responsibility for the completeness and flawless operation of the equipment and the plant as a whole. These tasks shall be executed based on proven design principles and state-of-the-art practices, ensuring that the plant fulfils its intended purpose in every respect, with maximum operational dependability and efficiency. The design shall incorporate standardization of equipment, materials, and buildings. Additionally, care must be taken to ensure safe operation and the simplicity of assembling and dismantling all parts of the plant.

3.3.19 Satisfactory conclusion of the Contract:

a) By accepting the Contract, the Contractor shall be deemed to accept the obligation of supplying everything necessary for the purpose mentioned above, regardless of any omission in the specification or on the drawings.

b) More detailed scope of supply and service is described under this section and the relevant chapter of the detailed technical specification.

3.3.20 Scope of Engineering Services:

a) The Engineering services of the Contract refer to the complete basic and detail engineering of all equipment and equipment systems, providing engineering drawings, data, instruction manuals, As-built drawings and other information for the Owner's review, approval and records.

b) The detailed engineering deliverables shall include comprehensive documentation, drawings, analysis and calculations essential for the project's execution. These encompass Process Flow Diagrams (PFD), Piping and Instrumentation Diagrams (P&ID), and detailed equipment lists specifying capacity, weight, and electric load. Additionally, mass, gas, and water balances, along with plant layout and General Arrangement (GA) drawings, are required. Building-wise assignment drawings, civil and structural calculations, and electrical single line diagrams are also part of the deliverables. The control philosophy, instrument lists with process parameters, and Equipment GA drawings with Bill of Quantities (BOQ), Material of Construction (MOC), and manufacturing standards must be included. Furthermore, civil foundation drawings, structural load data, structural GA drawings, and Electrical Terminal and Operational (TOP) drawings with battery limits are necessary.

c) The Contractor shall be responsible for liaisoning for all statutory applications/ approvals/ NOC.

3.3.21 Obtain all necessary approvals, coordination, and permissions from various agencies to ensure the smooth operation of the plant. The Bidder must secure all state-related approvals as well. These approvals include, but are not limited to, CTO, CTE, PCB, PESO, Factory License, Fire NOC, Building Approval, Plot Approval, and all approvals related to CBG Storage, Handling, and Transport, Ground Water Usage, and usage of electricity etc. All approvals related to land procurement will be the responsibility of the Owner. All approvals related to preconstruction, construction, and operation will be the responsibility of the Contractor. The selected bidder must have valid licenses and insurance for all staff and equipment required on-site. Additionally, obtaining all necessary safety-related licenses and approvals for the execution of the work will be the bidder's responsibility.

3.3.22 After award of Contract the Contractor shall provide a certification from IIT/NIT/SERC (Structural Engineering Research Centre of CSIR) about the stability of the civil structure and foundation designs with factors of safety given in relevant Standards and codes shall also be taken care of, for review and approval by PMC/Owner. Bidders to also confirm that structure will withstand corrosion for minimum 25 years of designed lifetime from the date of stabilization.

3.3.23 Transport Insurance

3.3.24 Safety, security of materials and gate management

3.3.25 Firefighting system during construction

3.3.26 Medical facility during construction

3.3.27 Emergency evacuation plan

3.3.28 Security requirement for this project shall be engaged by the Contractor

3.3.29 All services shall be performed by the Contractor to obtain the required permits to commence the works and operate the plant, including but not limited to:

a) Clarifications with authorities

b) Participation in all clarification meetings

c) All other services as required

3.3.30 Common Equipment and Services

a) Provide a plant Handbook that includes the design and performance data of various plant equipment and systems. This handbook should cover the complete supply package, including operation philosophy, control philosophy, process details, standard operating procedure, list of equipment with their specification, maintenance manual, vendor details for further O &M of critical equipment Do's and Don'ts Safety guidelines, troubleshooting guidelines, details of staff for operating the plant, Single Line Diagrams (SLD), Protection Single Line Diagrams (PSLD), Process Flow Diagrams (PFD), Piping and Instrumentation Diagrams (P&ID), Mass Balance (MB), Energy Balance (EB) and among others etc.,

b) All necessary co-ordination with other Contractors on site for erection, testing and commissioning of equipment and accessories.

c) Making available of all testing and commissioning equipment.

d) All necessary pipelines, warm up system, vents, drains, valves, actuators, required for commissioning, operation and preservation in standstill.

e) All temporary installations required for tie-in measures including complete post weld heat treatment, inner cleaning, etc.

f) All temporary pipes work as required during connection measures.

g) All support structures, hangers, supports etc.

h) All base frames, mounting plates, grouted in parts, rag bolts, covers, etc.

i) All required steel parts embedded in concrete.

j) All couplings and coupling guards for electric motors and other drives.

k) All lifting equipment (crane, hoist, lift etc.) required for maintenance.

l) Required safety equipment, pressure relief valves, etc.

m) All thermal (Hot and Cold) and noise insulation including cladding as well as any other noise attenuation measures

n) Stairways, ladders, platforms, galleries and walkways to all plant components, including escape routes as necessary, pipe cross overs and other necessary steel structures.

o) All required ventilation and/or air conditioning equipment as specified and as required for safe operation of mechanical control and electrical equipment, to be supplied

p) All necessary corrosion protection measures for plant components and equipment stored or mounted on site up to the time of" Handing Over".

q) Complete primer and top coatings conforming to colour code, to be agreed with the Owner/Owner's Engineer.

r) Noise abatements measure to comply with noise pollution control requirement.

s) Complete labelling of all plant components according to the Owner's system in English and also in local language for notices etc.

t) All fire protection measures.

u) Initial filling of Lubricants and further makeup, chemicals, consumables up to trial operation shall be covered under the scope of Contractor. Refilling/makeup of lubricants, chemicals shall be covered under the scope of Contractor up to 3 months after trail operation.

v) Flushing of all other pipelines including disposal of the effluents; protection with wood and/or plastic at all instrumentation and appendages to be installed during construction.

w) All standard accessories and auxiliary equipment which normally from part of the scope of supplies.

x) Removal of any unused material from site.

y) Any necessary surveying works.

z) Earthworks, drainage, excavation and refilling works.

aa) Roads and pavement.

bb) Concrete and reinforced concrete works, masonry and earthing.

- Water proofing works for pressing and non-pressing water.
- Roofing (non-asbestos).
- Plumbing.

- Facade works/glazing works; non asbestos.
- Non-load bearing walls/installation partitions/dry construction works.
- Metalwork and blacksmith work/raised flooring/doors and gates/sheet metalwork.
- Flooring work.
- Corrosion protection for underground/ over ground RCC and steel structures.
- Crane way works.
- Potable water, service water and wastewater, sewage water, storm water (permanent and during construction), etc.
- Housekeeping during construction (at least twice a week total).

cc) Transport of all dumping material to dump locations (at least twice a week).

3.3.31 Disposal of waste excavated material not reusable in levelling and construction shall be disposed by the Bidder in the disposal sites arranged by Municipal Corporation/ OIL.

3.3.32 Bidder must make his own arrangement to develop infrastructure for all their man and materials required during the construction period. Necessary residential and labour camps including other facilities like water supply, sanitation etc. is to be developed /arranged by the Bidder on his own including its maintenance during the construction period & O&M of the Project. All the camps, facility areas, main works area etc. are required to be fenced and protected by the Contractor on his own. The manpower engaged by the Contractor for the works of the project shall be mainly from local population to the extent available. However, in case of non-availability of highly skilled/semi-skilled manpower among local population, the same shall be arranged from outside.

3.3.33 Contractor shall provide Client's site office with a minimum 3 nos. of porta cabin to provide at least 20 working desks for its employees and its representatives, 2 nos. of Manager cabin, 1 no. of conference room, Pantry, separate toilet block for male & female (min 2 nos. each).

3.3.34 Contractor shall provide electricity, water, Internet, AC for sufficient cooling, A3 printer cum scanner for the owner and its representatives as required with no charges to Owner.

3.3.35 The required storage yard area shall be properly demarcated and fenced for the warehousing of materials. The Contractor shall be responsible for arranging lighting, security, weather protection, and storekeeping.

3.3.36 Appropriate housekeeping and security shall be provided by the Contractor to timely replenish the material breakage/ theft/repair including transport without cost to the Owners.

3.3.37 The Contractor shall provide adequate number of mobile toilets and rest sheds with drinking water facilities in multiple locations within the site.

4 GENERAL PLANT DESIGN REQUIREMENTS

4.1 Intent

4.1.1 This chapter defines the standard drawings and documents for various equipment. These, along with those specified in the Detailed Technical Specifications, must be delivered by the Contractor to the Owner according to the agreed schedule, and in the quantity and quality specified in the bidding document.

4.1.2 The Owner reserves the right to request the Contractor for additional drawings/documents as may be required for proper understanding and definition of constructional, operational, co-ordination or other matters.

4.1.3 All documents must be submitted according to the agreed schedule during detailed engineering. The Bidder must ensure that any comments or changes requested by the Owner are addressed before the equipment is manufactured in the workshop or installed at the Site.

4.1.4 If the Contractor fails to submit the required documents, any subsequent execution of changes requested by the Owner, along with the resulting additional costs and/or delays, shall be the Contractor's responsibility. The Contractor shall not be absolved of his responsibility and guarantee even after drawings and computations have been approved by the Owner.

4.1.5 On drawings, catalogue sheets or pamphlets of standard Works submitted to the Owner, the applicable types, paragraphs, data, etc. shall either be marked distinctively, or the non-applicable parts shall be crossed out. Documents not marked in such a manner will not be accepted and approved by the Owner.

4.1.6 If required for proper understanding of the documents, additional descriptions/ explanations shall be given on these documents or on separate sheets. All symbols, marks, abbreviations, etc., appearing on any document shall clearly be explained by a legend on the same document or on an attached sheet.

4.1.7 Each device appearing on any document (drawing, diagram, list, etc.) must be clearly designated. The abbreviation mark used for an individual device must be consistent throughout the entire documentation to avoid confusion. All documents must have a uniform title block, as agreed upon by the Engineer in Charge. Starting with the very first submittal to the Engineer in Charge, the Contractor's drawings must bear a serial number corresponding to a drawing classification plan agreed upon by both the Contractor and the Engineer in Charge.

4.2 General Requirements

The complete design of the multi feedstock-based CBG plant and its associated auxiliaries must generally conform to the following requirements.

4.2.1 All equipment and machinery installed in the plant must be new, recently manufactured, and unused. Additionally, they must be certified for operation in flammable environments suitable for a CBG production plant.

4.2.2 All equipment and components shall be designed to ensure safe, reliable and economical operation at the maximum throughput rates, thereby to achieving the guaranteed yield of CBG.

4.2.3 The plant shall be constructed considering prudent engineering practices and optimal utilization of resources. These shall be complete and include all the equipment and systems necessary to ensure high level of reliability, availability, efficiency, safety and maintainability over their lifetime. It is also necessary to consider various precautions to safeguard the operating and maintenance personnel.

4.2.4 The plant and electric lines must be suitable for the full range of ambient and environmental conditions prevailing at the site. The design of the plant should ensure that, under normal operation, it can adapt to variations in load, frequency, power factor, and ambient conditions within the allowable design range.

4.2.5 The auxiliary systems and plant facilities shall be designed for serving the whole plant with adequate redundancy. Secondary system component shall be designed generally for 100% redundancy in order to achieve high reliability and availability of the plant.

4.2.6 The life span to be considered for the design of equipment and component selection shall be at least 25 years. The civil structures shall be designed for a design life of 30 years.

4.2.7 The various parts or components or assemblies of equipment and systems shall be of proven materials with well-established physical and chemical properties appropriate to the service as intended. It is required that the equipment shall be of a rustproof, moisture proof and waterproof type to ensure continuous trouble-free operation.

4.2.8 All materials, components and equipment shall be tested at all stages of procurement, manufacturing, erection, commissioning as per comprehensive Quality Assurance Programme to be agreed mutually between the Owner and the equipment supplier.

4.2.9 In the design of the plant and selection of equipment, the specific requirements of this project and likely occurrences of abnormal operating conditions have to be taken into consideration to ensure that the plant can, under these circumstances, operate

continuously, safely and with high efficiency. The selection of materials shall be suited to local conditions.

4.2.10 Equipment installed outdoors shall be capable to operate in all and extreme weather conditions and withstand the work site environment. For equipment in operation or in standby that may be influenced by direct sunshine, shelter or cover shall be provided.

4.2.11 The equipment must operate without vibrations that could affect its own operation, the operation of other machinery, or the integrity of civil works under any condition.

4.2.12 Corresponding parts throughout shall be made to gauge and be interchangeable wherever possible. In case required, the supplier shall provide the necessary references for all kinds of equipment.

4.2.13 All stand-by auxiliaries shall be designed for auto start up, on failure of running auxiliaries with minimum time delay and without runback on unit load.

4.2.14 All heavy parts of the plant must be provided with some convenient arrangement for aligning and for handling during erection and overhaul. Any item of plant required to be stripped or lifted during period of maintenance and weighing one tonne or more shall be marked with its approximate weight.

4.3 Redundancy Requirements

The following redundancy shall be considered while designing the various systems in the proposed plant:

4.3.1 All the rotating equipment (Pumps, Blowers etc.,) shall be of 2 x 100% or 3 x 50% capacity.

4.3.2 All the Heat Exchangers / Coolers shall be of 2 x 100% or 3 x 50% capacity.

4.3.3 All the mixers and agitators (except for Digestors with Single Top Mounted Vertical Agitator) shall be of n+1 configuration (n=design number). In other words, the mixers / agitators capacity or rating shall be selected such that, even if one mixer or agitator is out of operation, the unit / system shall be able to give the designed outcomes.

4.3.4 All the tanks / sumps shall be of 2 x 60%.

4.3.5 Bidder shall clearly indicate the redundancy considered by him in the offer and the same shall be subject to the approval of the Owner.

4.4 Standards and Codes of Practice

4.4.1 All equipment, systems, and works specified herein must comply with the latest applicable statutes, regulations, codes and standards. This includes all relevant local standards, statutes, regulations, and safety codes where the equipment will be installed. Contractors should familiarize themselves with these requirements before preparing bids. The complete design, including pressure parts, piping, valves, and fittings, must meet or exceed the latest versions of the Indian/International Standards, and ASME codes.

4.4.2 The design, construction and testing of all equipment, facilities, components and systems shall be in accordance with latest version of relevant standards and codes issued by Bureau of Indian Standards (BIS) and/or reputed International Standards and codes. A non-exhaustive list of reputed international standards is given below:

- American National Standards Institute (ANSI)
- American Petroleum Institute (API)
- American Society of Mechanical Engineers (ASME)
- American Society of Testing and Materials (ASTM)
- American Welding Society (AWS)
- British Standards (BS)
- Central Electricity Authority (Construction of Electrical Plants & Electric Lines)
- Cooling Technology Institute (CTI)
- Deutsches Institute for Normung (DIN), Germany
- Heat Exchange Institute (HEI), USA
- Hydraulic Institute Standards (HIS), USA
- International Electro-technical Commission (IEC)
- Institute of Electrical and Electronics Engineers (IEEE)
- International Organisation for Standardisation (ISO)
- National Electric Code (NEC), USA
- National Electrical Manufacturers Association (NEMA), USA
- National Fire Protection Association (NFPA), USA
- Occupational Safety & Health Administration (OSHA)
- Petroleum and Explosives Safety Organization (PESO)

- Tubular Exchanger Manufacturers Association (TEMA), USA
- VDE association for Electrical, Electronic and Information Technologies (VDE), Germany

4.4.3 Other International Standards, equivalent or superior to the aforementioned standards, may also be adopted. However, in the event of any conflict between the requirements of international standards or codes and those of BIS standards or codes, the BIS standards or codes shall prevail.

4.4.4 The plants and Electric Lines shall also be designed to comply with the requirements stipulated in,

- Central Electricity Authority (Installation and Operation of Meters) Regulations.
- Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations
- Central Electricity Authority (Measures relating to Safety and Electricity Supply), Regulations as and when these are notified by the Authority.
- Central Electricity Authority (Safety Requirements for Construction, Operation and Maintenance of Electrical Plants and Electric Lines) Regulations as and when these are notified by the Authority.
- Central Electricity Authority (Grid Standards) Regulations as and when these are notified by the Authority.
- Indian Electricity Grid Code issued by Central Electricity Regulatory Commission (CERC)
- Applicable State Grid Code issued by appropriate Regulatory Commission

4.4.5 All materials and equipment supplied, and all work carried out, including calculation sheets, drawings, quality and class of equipment, methods of inspection, constructional peculiarities of equipment and parts, and acceptance of partial plants, shall comply in every respect with the technical codes of the aforementioned standards, beyond the special requirements of the specifications.

4.4.6 It shall be the responsibility of the Contractor to take all approvals required.

4.4.7 In cases where no standards or regulations exist, or where existing standards are insufficient to meet the design and supply requirements for items related to the CBG plant, the Contractor shall undertake the design, manufacture, supply, and installation based on good engineering practices, subject to the Owner's approval.

4.4.8 During the Contract execution period, if any standards change, the Contractor must notify the Owner and provide justification that the change will not lower the quality, performance,

or service life of the CBG plant. Upon mutual agreement, the amended standard can then be followed.

4.4.9 Further requirements about applicable standards and codes are specified in the detailed technical specifications.

4.5 Plant Operational Requirements

4.5.1 The CBG plant shall be designed to process the Source Segregated Organic Fraction of Municipal Solid Waste quantity and achieve the minimum CBG output as specified below:

	Feedstock	Ton/day	Ton/Year
A.	Source Segregated Organic Fraction of MSW	200	73000
Total Feedstock			73000 TPA

4.5.2 The incoming feedstock shall be processed through a SSOF-MSW processing system, followed by a bio-methanation system to produce biogas. The front end of the process (MSW processing system) shall operate for a minimum of 365 days per year, allowing for a maximum of 15 days per year for major maintenance shutdowns.

4.5.3 The biogas shall be desulfurized to remove hydrogen sulphide (H_2S) and other impurities / inert gases, and then further upgraded to achieve a methane purity of ≥ 97%. The purified/upgraded CBG shall be compressed to the pressure requirements of the pipeline injection points of the city gas distribution (CGD/ PNG) network (up to **45 Bar(g)**).

4.5.4 The digestate shall be processed through a dewatering system and then a composting facility to produce Fermented Organic Manure (FOM).

4.5.5 Although the plant will operate 24 hours a day, 365 days a year, the following operation times are assumed for different plant processes for design purposes.

S. No.	Equipment/Section Name	Owner's Design requirement
1.	SSOF-MSW Processing & Pre-Treatment system	16 hours/day
2.	Grits and Inert Storage	7 days
3.	Recyclables Storage	7 days
4.	Rejects Storage	7 days
5.	Hydrolysis	24 hour/day
6.	Anaerobic Digestion	24 hour/day
7.	Raw Biogas storage	4 hour/day
8.	Biogas purification & upgradation system	24 hour/day

S. No.	Equipment/Section Name	Owner's Design requirement
9.	Purified biogas storage (in a buffer tank)	As per the system operational requirement but minimum 30 minutes / day
10.	Compression systems	24 hour/day
11.	Solid Liquid Separation	16 hour/day
12.	Effluent Treatment Plant	24 hour / day
13.	Compost Storage	7 days
14.	Compost Rejects Storage	7 days
15.	Compost packing Section	8 hours

4.6 Vibration

4.6.1 Vibration shall be reduced to the minimum as far as possible to well within the limit of the standard where it cannot be completely eliminated. Amplitude and frequency limitation in the design and supporting structure shall be considered.

4.6.2 Special care shall be taken to avoid operating equipment making resonance with foundations, packing, duct, platform, piping or other components.

4.6.3 Unless otherwise stated or agreed by the Owner each rotating machine has to comply with the requirements for designation as 'good' stipulated by ISO/ASME std for the respective group of machinery. If the vibration is higher than stipulated as 'satisfactory' the Owner has the right to reject the corresponding equipment, subject to the conditions specified elsewhere.

4.7 Noise Levels

4.7.1 The plant shall be designed and constructed to reduce the operating noise level as much as possible and when the plant is operating at all loads, the noise pressure levels as per statutory and environmental requirements shall not be exceeded.

a) Noise level at the Station boundary shall not exceed the Ambient Air Quality Standard in respect of noise as notified by MoEFCC and any other stipulation of the state PCB and central PCB in this regard.

- Noise level for the continuously operating equipment shall not be more than 85 dBA at a distance of 1 metre and at a height of 1.5 metre from any equipment. For short term exposure, noise levels shall not exceed the limits as stipulated in the Occupational Safety & Health Administration (OSHA) Standard.
- The noise level in the offices and the control room shall not more than 50 dBA.

- Equipment/machines shall be provided with acoustic enclosures, wherever required so as not to exceed the permissible noise limits.

4.8 Units of Measurement

4.8.1 All technical tables, diagrams, calculation results, drawings, test data, and scales used in the design and provided for the CBG plant shall uniformly employ the Standard International (SI) unit system, in accordance with the International Organization for Standardization (ISO) standards.

4.8.2 SI system shall be employed for all the first-class plant layout and arrangement drawings of equipment made especially for the project. In spite of the employment of British Standard in the layout or drawings and single item standard drawings made with other measuring units, the principal dimensions and demarcation points on these drawings shall also be converted into SI system to be directly marked onto them.

4.9 Safety

4.9.1 Special importance shall be assigned to all aspects related with the safety of personnel operating, assembling and maintaining the equipment, including other persons who are likely to come in contact with same.

4.9.2 The possibilities of human failure must be foreseen. Provisions shall be taken to avoid damage caused by human error, or to ensure that such damage both to persons as well as to the equipment is the least possible.

4.9.3 Rotating or any other moving part of the machinery, hot parts or any part that may cause accident to the staff must be adequately protected, in accordance with the safest method known.

4.9.4 Areas where a potential flammable atmosphere may exist shall be classified in accordance with the provisions of latest version of relevant IS. Certified equipment shall be used in the designated hazardous areas. To the extent practicable, equipment requiring operator's attention and/or electrical equipment shall not be installed in hazardous areas.

4.9.5 Insulation along with aluminium cladding shall be provided for all the equipment/surfaces having skin temperature more than 60 °C considering wind velocity of 0 m/s.

4.9.6 Bright paints used will be agreed upon with the Owner to protect personnel, so that anything representing a potential danger will stand out: such as elements in movement, suspended hot, with electric tension, etc.

4.9.7 It should be possible to carry out frequent maintenance operations required by the equipment without interrupting its operation and without danger to the personnel.

4.9.8 Access stairs to the equipment must be safe, with anti-skid rungs and handrail. Normal circulation areas of the equipment shall be protected to keep personnel from falling or shall be surrounded by strong guardrails, platforms should have kicking plates to keep loose objects placed on the floor from dropping off, entrances and large openings in the equipment shall be provided with lids or doors affixed in such a way as to open them also from the inside.

4.9.9 Every equipment or parts of equipment that must operate under certain conditions of maximum pressure, temperature, speed, position etc., and it should have devices to keep such limits from being exceeded and, if necessary, to stop the operation of the machine (Safety valves, limit switches, thermal switches, etc.).

4.9.10 For protection against the possible failure of the above devices, additional safety elements shall be provided such as stroke limiting stops, diaphragms, bolts, etc. and/or links or other dimensioned rupture elements so that in case of failure, when exceeding extreme operating conditions, additional safety is provided to the equipment.

4.9.11 Inside air and gas ducts, ladders have to be installed for inspection of dampers, venturies, etc.

4.9.12 In designing an area where combustible gases are likely to accumulate, due consideration shall be given to provide safety measures to allow the gas to continuously diffuse or leak off to prevent explosion. The electric equipment in those areas shall be of the fireproof and explosion proof type. Suitable grounding shall be provided on the casing of electrical apparatus which might be energized.

4.9.13 Draining of water shall be performed with respect to the safe mode of discharge and is not allowed to be carried out at or near the places where people exit and at the exit of the plant.

4.9.14 Safety measures / equipment shall be provided as per the applicable statutory codes and standards.

4.10 Fire Protection and Precautions

4.10.1 The Contractor shall adopt necessary methods to minimize fire hazards.

4.10.2 The fire protection system shall in general follow the recommendation of Tariff Advisory Committee of India and the system and equipment shall meet with their approval.

4.10.3 The design of CBG plant shall include a complete set of composite fire monitoring, protection, and fighting system to identify, isolate, and distinguish fires as well as minimizing potential fire hazards.

4.10.4 A warning alarm for the CBG plant and alarm for evacuation shall be provided. The alarm is to be audible in the normal working areas of personnel. The selection of the alarming device shall be such that it is audible about the normal background noise of the plant. Visual alarm shall be provided in addition to audio alarms in high noise areas.

4.10.5 During the construction phase of CBG plant, the Contractor adopts advanced and safe working practices and a set of guidelines to keep the site in a clean condition to reduce the possibility of fire. The basic guiding ideology is to adopt two methods: fire prevention and fire control shall adopt to improve conditions in designing the layout, to reduce potential fire danger, ensure the safety of personnel, ensure the safety of the important and main equipment of the CBG plant.

4.10.6 Use fireproof or fire-resistant materials, ensuring that, isolating combustible material is not used or stored in possible fire source area of the CBG plant.

4.10.7 The end connection type of hydrant shall fit in with local fire brigade requirements to ensure the manual device in CBG plant to be compatible with the fire control device of local fire brigade.

4.10.8 Fire Protection and Precautions shall be provided as per the applicable statutory codes and standards.

4.11 Signs

4.11.1 Safety colours, safety symbols and safety signs must comply in construction, geometrical form, colour and meaning with the ISO Recommendation 507 of the ISO committee TC 8O 'Safety Colours'. All signs should give the identification number. All signs shall be in the English language.

4.11.2 The signs should be of a material which is weather-resistant and of sufficient durability for the conditions prevailing on site. Indian regulations and codes are to be considered.

4.11.3 The positions for the signs must be chosen so that they are within the field of vision of the intended persons. The signs should be permanently attached. Temporarily dangerous areas (e.g., construction sites, assembly areas) may also be marked with movable signs. The safety signs must be mounted or installed in a manner that eliminates any possibility of misunderstanding.

4.11.4 All necessary traffic signs, informational signs, emergency signs, mandatory signs, warning signs, and prohibition signs (e.g., No Smoking, No Entry, Do Not Start) shall be installed at appropriate locations throughout the entire CBG project area.

4.12 Package, Storage and Store House

4.12.1 The Contractor should provide all the specifications and instructions for the self-purchased and fabricated equipment during the planning period of the Contract. These specifications should include the cleanliness and maintenance requirements of materials during fabrication and the protection measures for the equipment from damage during transportation. Loss of materials during storage should be avoided before installation. The instruction should be worked out especially to suit the particular work site program.

4.12.2 All materials and equipment should be packaged according to the typical environmental conditions during storage. In case of severe conditions, these materials and equipment should be packaged carefully by taking a full and appropriate preventive measure to protect from any damage or wear.

4.12.3 The Contractor and his appointed Sub-contractor for installation should guarantee jointly that a good supplementary storage will be carried out within the equipment site controlled by them.

4.12.4 Three classes for storehouse are described as follows:

- Storehouse class A items: Special measures are taken to protect the stored goods and the temperature, humidity, are controlled within a specified range.
- Storehouse class B items: Goods are stored with temperature uncontrolled.
- Storehouse class C items: It is an outdoor storage with a drainage system on the ground.

4.12.5 For storehouses of class A and B they should be fireproof, heat resisting, waterproof and well ventilated. They should not be wet and should be provided with good drainage system and preferably with a brick laying or concrete ground. For storehouses of class C, they should not be wet and should be well drained, preferably with a brick laying or crushed stone ground, should be protected from rainfall, salt corrosion, ash and other adverse conditions with a temporary cover or tent if possible

4.12.6 Component surfaces should not be contacted directly with the ground or ground laying material. There should be a layer of oilcloth or wax or other similar materials between the machine surface and ground surface.

4.12.7 All components shall be inspected for their painting, storing, sealing etc. and any damage or wear should be repaired during acceptance and storage periodically. The inspection interval is determined by the component function, applied protection measure and storehouse class.

4.12.8 Many components are provided with a drying agent or sealed in a coverage (polyethylene or insulating cover) containing drying agent. The drying condition shall be inspected during storage in an interval of every 4 weeks.

4.13 Painting, Insulation, Anti-dewing

4.13.1 Anti corrosive coatings and painting shall be carried out as a pre-treatment to all equipment and parts. The paint system used should coordinate with the painted objects and surrounding conditions of project.

4.13.2 Anti-corrosive coatings and painting shall comply with ISO 12944 classification, with a minimum rating of C3 for all equipment and structural steel, both inside and outside the plant boundary.

4.13.3 In multi-layer painting system, different painting layers should be selected to make the painting coordinate. If multi-layer painting system is used, various painting layers should have distinct colours so that the later layer can be distinguished from the former one.

4.13.4 After the equipment or apparatus finished preliminary or full painting, it can be supplied to field. After the installation is finished, ground coat must be painted.

4.13.5 Entire painting procedure should be supplied in order to repair the injures of painting coat after the equipment is delivered to field.

4.13.6 Colour strip indication system should be used for pipes. These strips should be painted on the joint of pipes, entrance, valves of pipe. This pipe without outside protection layer should be marked by some colour in whole length.

4.13.7 The principal colour of field equipment should be determined by the Owner and Contractor during execution stage.

4.13.8 The specified requirements shall be applied to the whole equipment and facilities of the CBG project Contract.

5 OIL'S RESPONSIBILITY

Following are the provisions/supplies by the Owner:

5.1.1 Approach Road up to the Project Site.

5.1.2 Project Site free of all encumbrances / encroachments, on which the complete Plant shall be constructed.

5.1.3 Incoming HT Power Supply from nearby "Source" up to the Site boundary.

5.1.4 Internet Broadband Line from nearby "Source" up to the Site.

5.1.5 Input Feedstock shall be supplied at the plant storage yard.

5.1.6 CBG Transmission Pipeline up to the terminal point near the boundary

5.1.7 Sale of all Products (Elemental Sulphur, Compressed Biogas, Compost etc.) to be generated in the Plant.

5.1.8 Disposal of all Process Rejects (Metals, RDF, Inert, Excess Treated Effluent etc.) from Plant to the required Disposal Points.

5.1.9 Drawings and Documents as tabulated below

- Site Plan
- Preliminary Topographical Survey Drawing / Contour Drawing of the Site. However, the bidder needs to satisfy with the submitted report and may conduct more investigation at his own cost, if required.
- Preliminary Geo-Technical Investigation Report of the Site.

6 CONTRACTOR'S RESPONSIBILITY

Statutory Approvals/Permits as tabulated below.

6.1.1 Authorization under the Solid Waste Management Rules, 2016. (Authorities responsibility, contactor to support)

6.1.2 Consent to Establish under Water Act, 1974 and Air Act, 1981 and Authorization under Rule 6 of the Hazardous and Other Wastes (Management, Handling and Transboundary Movement) Rules, 2016.

6.1.3 NOC from Airport Authority of India (AAI), if required.

6.1.4 NOC from the concerned Municipal Corporation.

6.1.5 Approval of Plans/Drawings from the concerned Department/Authority.

6.1.6 Consent to Operate under Water Act, 1974 and Air Act, 1981 and Authorization under Rule 6 of the Hazardous and Other Wastes (Management, Handling and Transboundary Movement) Rules, 2016.

6.1.7 NOC under Fire Force Act, 1986.

6.1.8 Factory License under the Factories Act, 1948.

6.1.9 Petroleum and Explosives Safety Organization (PESO) License.

6.1.10 Provide assistance for Hazard Analysis (HAZAN) / Hazard Identification Study (HAZID) / Hazard and Operability (HAZOP) Study, if required.

6.1.11 Any EIA Study, Environment Clearance (EC), and all other Statutory Approvals required from any local/state/central/any other authority for Construction as well as Operation & Maintenance of the Facility. (Authorities responsibility, contactor to support)

7 MISCELLANEOUS PLANT FACILITIES

The Scope of Work under Miscellaneous Plants and Facilities shall consist of the Units as mentioned below:

7.1 Sheds (Conventional Steel Structure / Pre-Engineered Steel Structure / Self-Supported Roofing System) for:

Sheds of suitable size shall be provided to accommodate all the Units, Equipment and Accessories as required. Sheds shall be either of the following types:

- Self-Supported Roofing Structure.
- Conventional Steel Structure i.e. Traditional metal structures constructed by rolled steel sections which are designed individually and fabricated at site using welding and cutting.
- Pre-Engineered Steel Structure i.e. Steel built-up sections which are designed and fabricated in the factory and assembled at the site of construction using bolted connections.
- Tipping Floor + Wet Waste Processing Facility + Centralized MCC-cum Control Centre.
- Bio-Gas Purification/Upgradation System. • Digestate Dewatering System.
- Effluent Treatment Plant (ETP).
- Solar-enhanced Composting Facility.
- Compost Screening Plant + Compost Bagging & Storage Facility.
- HT Sub-Station.
- Laboratory.
- Workshop & Store.
- Security Terminal.
- Weighbridge Terminal.

7.2 Buildings

Buildings shall be considered in M25 grade RCC frame structures with brick masonry and designed as per relevant IS Codes, Building Byelaws and recommendations of Equipment Manufacturers.

7.3 Other Infrastructure Works

- Main Gate
- 2-Wheeler Parking + Car Parking + Truck Parking.
- Potable Water Network including Potable Water Storage Tank with Pumps and interconnecting Piping & Valves etc. complete.
- Service Water Network including Service Water Storage Tank with Pumps and interconnecting Piping & Vales etc. complete.

- Fire Fighting System including Fire Water Tank, Pumps, interconnecting Piping, Valves and Hydrants etc. complete.
- Internal Roads & Pathways + Storm Water Drainage System.
- Internal Sewerage/Effluent Network.
- Gardening/Landscaping with Drip Irrigation System.

7.3.1 Main Gate

Main Gate shall be provided at the Entry/Exit of the Plant with proper Signboards as approved by the Engineer-in-charge.

7.3.2 Parking

A Parking Facility, sufficient to park 2-Wheelers, Cars and other Vehicles (as listed above) shall be provided. Heavy-duty, interlocking, coloured paver blocks shall be provided in the Parking Area.

7.3.3 Internal Roads & Pathways

Suitable Internal bituminous/concrete Roads & paved Pathways for easy movement of transport vehicles, operation & maintenance, loading and unloading of materials and as required for approach to all Units / Equipment shall be provided.

7.3.4 Storm Water Drains

Storm Water Drains shall be provided on one or both sides of the Roads with sufficient numbers of Cross Drainage Works, all along the Road. Based on contour levels, adequate number of disposal points shall be provided at the ultimate boundaries of the Plot for discharge of rains/storm water during monsoon.

7.3.5 Portable Water Network

OIL shall provide a Potable Water Line up to the battery limit of the Plant. This incoming potable water line shall be terminated in an underground Water Storage Tank, from where it shall be pumped to all Buildings for various human consumption e.g. drinking, handwash, shower etc.

Usage of water from the incoming Potable Water Line provided by OIL shall be on a chargeable basis as per prevailing rates.

7.3.6 Service Water Network

The Bidder shall provide a Treated Water Line up to the battery limit of the Plant for all other water requirements (other than human consumption as stated above) e.g. In Organic Extraction System, Preparation of Chemical Solution, Washing (Floor, Equipment, Vehicles etc.), Horticulture/Gardening and Fire Fighting System etc. shall be met by the Treated Water. The treated water shall be stored in a Service Water Storage Tank from where it shall be pumped to the Service Water Network. Service

Water Line shall be painted with proper colour coding and proper signage "Not Suitable for Drinking" at adequate locations.

7.3.7 Fire Fighting System + Fire Water Network

An adequate Firefighting System shall be designed, installed and maintained in accordance with the guidelines specified in Fire Protection Manual by Tariff Advisory Committee (TAC) and complying with PASSO requirements.

A Fire Water Tank shall be provided for storing Fire Water. This Tank shall have provisions for receiving water from borewell/potable/service water. The Fire Water Tank shall always be kept in a fully filled condition. Necessary Fire Hydrant Pumps and Jockey Pumps shall be provided to pump water into the Fire Fighting Network with suitable hydrant connections as per specifications.

Fire Water Pipelines of adequate size shall be provided covering the entire useable Plant area, with proper water tapping and Fire Water Hydrants/Hoses to ensure complete working area is properly accessed with Fire Water in case on any emergency. Design, Drawings and Specifications for the Fire Fighting System shall be reviewed and approved by OIL prior to implementation of the same.

Any other item, which is required to make the system complete shall be deemed to be included by the tenderer irrespective of the fact whether it has been specifically mentioned/specified above and the tenderer shall supply/construct/provide the same, if called upon to do during any stage of execution.

7.3.8 Gardening / Landscaping

Gardening / Landscaping within the Plant shall be provided as directed by OIL.

7.4 Other Miscellaneous Equipment

- Air Compressor for Service / Instrument Air.
- Plant Cleaning Equipment.
- Laboratory Instruments, Accessories, Glassware & Chemicals.

7.5 Vehicles

- Skid Stir Loader.
- Truck.
- Tractor + 2-Wheeled Hydraulic Trolley.
- Truck Mounted Sewer Suction Machine.
- Emergency Response Vehicle (Ambulance).

7.6 Control and Automation Philosophy for Operation of Plant

1. The complete Plant shall be designed for automatic operation through Programmable Logic Control (PLC) and Supervisory Control and Data Acquisition (SCADA). All the Equipment shall be necessarily connected to PLC for monitoring and control. This shall be achieved by PLC of individual equipment's, Digital Controllers with Human Machine Interface (HMI). These individual PLCs or Digital Controllers shall be integrated with main PLC and SCADA for centralized control and monitoring. The main PLC shall be located in central Control Room.
2. **The Plant shall have provision for operations in following modes:**
    a. Automatic: Auto operation through PLC/Digital Controller.
    b. Manual: Operator intervention through SCADA/HMI.
    c. Local: Local operation through local Control Panel located near Equipment.
    d. It is essential that all PLCs and Digital Controllers shall communicate to central PLC and SCADA. For communication, a cable can be used, depending upon its signal carrying distance. However, if cabling distance between two systems is more than its signal carrying capacity or 80 meters (whichever is less), fiber optic cables shall be used.
    e. All pre-set time shall be editable in HMI/SCADA
3. **CCTV System**: At Key Locations e.g. Main Gate, Weighbridge, Tipping Floor, MSRC Shed, Manual Sorting Station, Compost Shed, Digesters, Bio-Gas Genset Building, ETP, Store etc. shall be provided with high resolution CCTV Cameras with adequate storage of Historical Data in the central Control Room.
4. **Remote Monitoring System**: The SCADA shall be equipped with provision of remote monitoring to enable the Plant monitoring from any remote location.
5. **ERP System**: An Enterprise Resource Planning (ERP) System shall be used for daily Plant operation activities, collection of data from various functions and integration into a single system and facilitate the flow of real-time information to ensure visibility, analytics and efficiency across every aspect of operation of the Plant. The ERP Shall have various modules as described below:
    a. **Operations**: Preventive as well as breakdown maintenance of Plant and Equipment shall be carried out through this module. Preventive maintenance activities of each Equipment shall be assigned to the maintenance team as per pre-set schedule (e.g. daily, weekly, monthly, half yearly, yearly etc.) and the current status of the same can be tracked. Similarly, breakdowns shall be reported, scheduled and carried out.
    b. **Inventory**: Inventory Management shall be done through this module. Various types of inventories (e.g. Spare Parts, Chemicals, Fuel & Lubricants, Hardware, Personal Protection Gears, Tools etc.) shall be stocked, requested and issued as per operation requirement.

c. **Material Requisition System**: This module shall be used to create requisitions for inventory whenever required, make purchase orders, track status and receive the same in Store for further use.

d. **Employee**: This module shall maintain details of personnel employed at the Plant and update their biometric attendance.

e. **Laboratory Reports**: All the required process parameters shall be analyzed in the in-house Laboratory and Analysis Reports shall be maintained in this module. This module shall help to control and monitor performance of the Plant.

f. **MIS Reports**: This module shall automatically collect data from various areas within the Plant and generate reports (e.g. Incoming-Outgoing Waste, Alarm-Uptime- Downtime-MTTR-MTBF-Availability and critical operation parameters of Plant and Equipments, Inventory Reports, Laboratory Analysis Reports etc.) to help evaluate daily activities and problems that arise, analyze and make decisions and track progress.

g. **Alerts**: This module shall generate various types of Alerts (e.g. Open/Pending Maintenance Activities, Low Inventory, Late Inventory, Delayed Orders etc.) as per pre-defined policy and trigger E-mails/SMS.

8 PROJECT MONITORING

8.1 Progress Monitoring

1. It is proposed to have an effective system of progress monitoring to ensure timely completion of all project activities. The guidelines laid down herein shall ensure progress monitoring by OIL.
2. The intention is to dwell upon the progress of the activities related to Engineering Procurement, Manufacturing, Dispatch, Site activity, PG Test.
3. In the interest of the timely completion of the project, the area of monitoring can be altered in consultation by OIL with the Contractor. The Contractor shall furnish adequate information in the monthly progress reports on the formats to be mutually agreed upon.
4. The OIL will invite Contractor for monthly/fortnightly meetings to review the progress of each activity and depute OIL authorized representatives for ascertaining/expediting progress of Contractor's works and suggest remedial actions to bridge-up time gap if any between progress and observed progress.

8.2 Progress Report

Project Progress Reports shall be submitted by the Contractor as follows:

1. A monthly progress report with exception report showing current status of various activities including status of ordered/yet to be ordered items shall be submitted to the OIL by the Contractor, referring to the schedule of order, reasons for not achieving it and remedial measures / Catch-up plans proposed.
2. The Contractor shall submit Programme of execution both in the form of activities in 'PERT network' as well as quantitative Programme in terms of month wise physical targets for various disciplines of work.
3. The Contractor shall submit computerized updated time analysis reports every month along with a progress report. The updated PERT network drawing (both Level I and Level II) is to be submitted in requisite no. of copies at least once every month. The format of the submission is to be mutually discussed and agreed.
4. The monthly progress report shall indicate progress of activities against targeted dates and targeted quantities in Proforma as per the requirement of the Contract for maintaining consistency of reporting and for maintaining database by the Contractor. Reasons for the shortfalls, if any, shall be clearly brought out and proposed remedial measures to arrest the delays shall be indicated by the Contractor in the progress report, wherever applicable.
5. Quantitative programme which is termed as "Work Plan" shall be updated regularly at a mutually agreed interval of time and Principal Contractor shall submit the same for OIL approval keeping in view the balance time available to execute the balance of activities. Once if approved, subsequent report shall indicate the revised targets.

6. The Contractor shall furnish information on site activities viz. daily progress report, weekly receipt of equipment, monthly erection plan, etc. The Contractor has also to indicate resource deployment at site, highlights of critical areas and constraints in the daily progress report once in a week.
7. Other information related to site activities as may be required by the OIL, shall also be submitted by the Contractor.
8. The Contractor shall submit progress photographs in a Pen Drive / E-mail every month relating to the progress in sequence of work of all major site activities. The OIL will arrange the necessary permission for the same.
9. The progress report will also highlight inspection status. The Contractor shall submit one copy of the inspection certificate duly signed by representatives/authorized agencies after inspection

8.3 Overall Time Schedule

The Time Schedule (L-1 PERT network) furnished by the Contractor will form part of the Contract.

8.4 Extension of Time

1. The Contractor shall not be allowed for any extension of time for completion except in the following cases:
    a. Force Majeure As per details stated in the Contract.
    b. Major changes or substantial addition to work ordered by the OIL adversely affecting the completion time.
    c. Any other circumstance of any kind whatsoever which may occur making the Contractor entitled to an extension of time which, however, shall be in the absolute discretion of the OIL.
2. The Contractor, upon the happening of any such event as stated above shall immediately inform OIL but nevertheless use constantly his best endeavours to prevent or make good the delay and shall do all that may be reasonably required to the satisfaction of the OIL to proceed with the work.
3. Request for extension of time shall be submitted by the Contractor in writing to OIL, based on the merit, shall consider the request and convey his decision to the Contractor in writing within a reasonable time.
4. The Contractor shall not be eligible for any extension of time on account of any delay in procurement of materials.
5. Joint Monitoring Group: Joint Monitoring Group comprising representatives of OIL as well as the Contractors as Members for this Contract shall be constituted to deliberate all issues affecting execution of the Contract periodically and a Record Note of Discussion shall be signed by the parties.

9 QUALITY ASSURANCE, SHOP INSPECTION AND TESTING

9.1 General

9.1.1 This section contains general requirements for inspection of material, parts, equipment and workmanship of the plant during manufacture, assembling to demonstrate compliance with specification, codes and standards to ensure overall reliability of plant operation and performance.

9.1.2 The Owner and/or Authorized Representatives shall, at any time, be allowed free and ready access to the Contractor's premises and those of his suppliers as well as to the site installation and the Contractor must make the plant items available for the purpose of inspecting the specified equipment components and obtaining information as to the progress of the work. Failure on the part of the Owner, at this or any other time, to discover or reject materials or work which do not meet specified requirements shall not be deemed an acceptance thereof nor a waiver of defects therein.

9.1.3 The approval of the Owner shall not prejudice the right to reject equipment if it does not give complete satisfaction in service.

9.1.4 The cost of travel expenses, boarding and lodging expenses of the inspection have to be borne by the Contractor. This includes inspection in India and foreign countries.

9.2 Scope

9.2.1 All materials, components and equipment's covered under this specification shall be tested at all stages of procurement, manufacturing, erection, commissioning as per a comprehensive quality assurance programme. The requirements of minimum quality plans to be followed by the Contractor in respect of various equipment are specified in detailed technical specification. The Contractor shall draw his own quality plans in line with these requirements and his standard practices and implement such programme after approval by the Owner.

9.2.2 Manufacturing quality plan shall detail out, for all the components and equipment's, various tests/inspection to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's quality control organization, the relevant reference document and standards, acceptance norms and inspection documents raised etc. during all stages of material procurement, manufacture, assembly and final testing/performance testing.

9.2.3 The Contractor has primary responsibility for ensuring the quality of items of equipment supplied under the Contract and remains accountable when manufacture or erection is Sub-contracted. It is therefore a requirement of the specification that work is only Sub-

contracted to companies with effective quality control organizations and that the Contractor monitors the performance of these by the attendance at tests of experienced inspectors employed by the Contractor. The Contractor shall, at the appropriate time, prove that his material and / or equipment comply with all the requirements of this Section, such proof being the successful completion of tests and inspections. Routine test and type test certificates shall be submitted for each item of equipment, wherever applicable.

9.2.4 All materials, components and equipment supplied under the Contract shall be subject to inspection by the Owner, his representative or his Authorized agency or any other Inspector of the Government, should they so require during manufacture, erection and after completion. The necessary inspection charges of the authorized agency shall be borne by the Contractor. The inspection and tests shall include but shall not be limited to the requirements of this section of the specification. Further requirements to be applied are specified in the detailed specification.

9.2.5 The Contractor along with quality plan, shall also furnish copies of the reference documents/plant standards/acceptance norms/test and inspection procedure etc. referred by him in quality plans. These quality plans and reference documents/standards etc. will be subject to Owner's approval and will form a part of the Contract. In these approved quality plans, Owner shall identify customer hold points (CHP), indicating tests/checks which shall be carried out in presence of the Owner's engineer or authorized representative and beyond which work will not proceed without consent of Owner's engineer/authorized representative in writing.

9.2.6 No materials/equipment shall be dispatched from the manufacturer's works before the same is either accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by the Owner's Engineer /authorized representatives, or such pre-dispatch final inspection is waived by the Owner and dispatch is authorized after review of test reports.

9.2.7 All materials used or supplied must be accompanied by valid and approved material certificates, as well as test and inspection reports, duly approved by the Owner. These certificates and reports must indicate the acceptable identification number of the material they certify. The certified material must also have the identification details stamped on it.

9.2.8 All material used for equipment construction including castings and forgings etc. shall be of tested quality as per relevant codes/standards. Details of results of the test conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedures recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.

9.2.9 All welding shall be carried out as per welding procedure drawn and qualified in accordance with requirements of ASME Section IX. Welding procedures shall be submitted to the Owner for approval prior to carrying out qualification test in the presence of Owner's representative.

9.2.10 All welders/welding operators employed on any part of the Contract either in the Supplier's works or at site or elsewhere shall be qualified as per ASME Section-IX.

9.2.11 Test results of qualification tests and specimen testing shall be furnished to the Owner for approval. However, wherever required by the Owner, tests shall be conducted in presence of Owner's Engineer/ authorized representative.

9.2.12 All the Sub-vendors proposed by the Contractor for procurement of major bought out items including castings, forgings, pumps, heat exchangers, semi-finished and finished components/equipment- (list of which shall be drawn up by the Contractor along with his offer and finalized with the Owner) shall be subject to Owner's approval.

9.2.13 The type and extent of inspection of items shall be in accordance with the relevant International/Indian Standards and other standards approved by the Owner, supplemented or amended by the requirements of this section of the specification or as specified elsewhere in the Specification.

9.3 Inspection Program and Test Notifications

9.3.1 Before manufacturing commences and not later than 45 days after award of Contract, the Contractor shall submit an outline of his proposed inspection program, which shall include all major stages during manufacturing. The inspection and test program shall include for the various items the designation number, name of equipment, part of equipment, the kind of test, test standard, company which carries out the test, place, date and witnesses by the Contractor, third party or Owner's Representative.

9.3.2 The Owner will return a copy of the Contractor's proposed inspection program indicating those inspection stages for which notification is required. Notification shall be by Fax or email in a format to be agreed and shall be sent prior to the intended test. If the Owner intends to be represented at the test, he will provide at least 24 hours' notice and if his representative does not attend on the notified date, the test may proceed unless an alternative date has been requested by the Owner.

9.4 Test Certificate Documentation

9.4.1 The results of all tests shall be certified by the Manufacturer, Contractor or Independent agency as appropriate.

9.4.2 Document files containing material certificates, welding procedures, test report etc. shall be compiled for each item of plant and shall be suitably identified (including equipment classification reference) and bound.

9.4.3 Three copies of each document file containing inspection reports and certificates of site erection testing activities of a particular item of plant or system shall be supplied to the Owner prior to commissioning.

9.4.4 Copies of the performance and acceptance test reports shall be prepared and distributed with Owner.

9.5 Codes and Standards

General

9.5.1 The type and extent of inspection shall generally be in accordance with that specified in the standard used for design and construction of the item of equipment supplemented or amended by the requirements of this section of the specification. The Contractor should provide the copy of relevant codes and standard to the Owner if requires.

Reference to Codes and Standards

9.5.2 Reference to special codes and standards, where designated either directly or as "relevant", is intended to provide a measure of performance, safety, in-shop and on-site testing, and methods of construction and/or installation which must be equalled or exceeded in order to be considered acceptable for use under this specification. If more than a single degree of quality or accuracy is permitted within the scope of particular code or standard, the highest quality shall be applicable and the degree of accuracy commensurate with the intended function shall be selected, but with the understanding that the final decision will be made by the Owner. In all instances, the finally accepted applicable code or standard shall be the version last published.

Alternative Standards

9.5.3 Where no appropriate standard is available, tests shall be conducted in accordance with the manufacturer's standard practice, subject to the approval of the Owner.

9.5.4 In such cases the Contractor shall submit to the Owner, complete data and a suggested procedure for the testing to be performed. Commencement of manufacture before receipt of the Owner's approval shall be at the Contractor's risk.

9.5.5 If the proposed procedures are accepted, the Contractor shall provide the Owner with four additional copies in English before any test is performed.

9.5.6 The Contractor's attention is drawn to the climatic conditions in the site area. Derating factors shall apply in accordance with the relevant and approved standards if not specified in the Contract documents.

9.6 Services prior to and During Inspection and Testing

9.6.1 In accordance with and in addition to specified standards the Contractor shall submit procedures for material testing, manufacture, quality control and performance testing right from the procurement phase of raw materials to the finished product. Manufacture commenced before receipt of the Owner's approval of material specifications and testing procedures shall be at the Contractor's risk.

9.6.2 No inspection shall be valid unless the Contractor and manufacturer are in possession of relevant approved drawings and procedures for the item to be tested. The Contractor on request shall supply the Owner's representative with a copy of drawings and procedures at the time of the test.

9.6.3 All instruments and apparatus required for the inspection or used for the performance of tests shall be subject to the approval of the Owner at his discretion and shall be calibrated to an agreed standard in approved laboratories. The cost of making such calibrations shall be borne by the Contractor in all cases.

9.6.4 If the Contractor wishes to apply for a concession in respect of a departure from an approved procedure or standard, this shall be made in writing with full information substantiating the technical acceptability of the proposed change. The Owner's decision shall be final. Concessions granted shall not absolve the Contractor from any of his responsibilities under the Contract.

9.7 Testing During Manufacturing

9.7.1 The minimum testing requirement for mechanical, electrical and C&I items to be conducted at manufacturer’s works are specified under respective sections.

10 EQUIPMENT ERECTION

10.1 Introduction

10.1.1 This section generally covers the standards, scope of works, documentation, scope of installation, testing and commissioning of various requirements to be adhered to during the execution of the mechanical, electrical, control & instrumentation works.

10.1.2 Works shall be performed in accordance with this technical specification and various other drawings and schedules submitted and approved by the Owner during the execution and the instructions from Engineer-in-charge or his authorized representatives during the progress of the work. All consumables required for the job shall be ensured by the Contractor. All necessary equipment's & instruments required to carry out the works, recalibration of the instruments required during loop checking and commissioning shall be done by the Contractor.

10.1.3 Field quality plans must be submitted and should comprehensively outline the quality practices and procedures for all equipment. These plans should be followed by the Contractor's site quality control team throughout various stages of site activities, including receipt of materials/equipment at the site, preservation and storage, pre-assembly, erection, pre-commissioning, and commissioning. The Contractor is responsible for providing all necessary resources to execute inspection and testing in accordance with the specified requirements.

10.2 Erection

10.2.1 Erection work shall be carried out in the manner and sequence as may be directed by Contractor's supervisory Engineers and the Owner.

10.2.2 All erection work shall be carried out in accordance with the instructions provided by the equipment's OEM.

10.2.3 All existing structures, piping, conduits, equipment and facilities, if any, shall be protected by the Contractor against damage during erection. Any damage caused by Contractor shall be rectified at his cost to the satisfaction of the Owner.

10.2.4 As erection proceeds, each assembled part shall be inspected and approved by the concerned supervisor before being finally boxed up for erection. If any defects are found during such inspection, the Contractor shall rectify them according to the directives from the Owner.

10.2.5 All materials used for the erection such as electrodes, gaskets, bolts, nuts etc., shall be of reputed make and conforming to relevant Indian Standards. Prior approval of Owner will

have to be obtained before commencement of work. Manufacturer's test certificate shall have to be provided when called for.

10.2.6 The equipment shall be placed on respective support, levelled and aligned with precision measuring instruments, checked for proper clearance between moving and stationary parts wherever applicable.

10.2.7 The installation of motors shall be carried out along with driven equipment in accordance with manufacturer's instructions and/or as directed by the Owner.

10.2.8 Wherever the scope includes control panels, all connections in control panels shall be completed, checked and adjusted to ensure safety and satisfactory operation of the equipment.

10.2.9 Particular attention shall be given towards removal of buckles and other forms of distortion.

10.2.10 Holes in plate work to assist in erection should be avoided.

10.2.11 Misalignment in vertical joints shall not exceed 10% of plate thickness or 1.0 mm, or whichever is larger.

10.2.12 Misalignment in horizontal joints shall not exceed 15% of upper plate thickness with a maximum of 2 mm for plate thickness above 8 mm and a maximum of 1.0 mm for plate thickness less than 8 mm.

10.2.13 Welding sequence shall be adopted in such a way so as to minimise distortion due to weld shrinkage and shall be got approved from the Owner prior to commencement of work.

10.2.14 Welding shall not be carried out on wet surfaces and shall be protected from high winds.

10.3 Supervision during Erection

10.3.1 The Contractor shall provide at proper time the necessary supervisory Engineers, Supervisors and other supervisory personnel duly qualified and in sufficient number for transportation, handling, unloading, storage, erection, pre-commissioning and post commissioning etc., startup, testing and trial operation of plants and equipment.

10.3.2 The Contractor shall keep a competent representative who will be resident Engineer-in-charge and shall remain as In-charge of Contractor's work site and also remain answerable to the Owner for all activities of the Contractor at site. Before his placement at site, the Contractor shall submit his biodata to the Owner for his approval.

10.3.3 The resident Engineer-in-charge shall supervise the work of all men of the Contractor working at site. He shall work in complete harmony and co-operation with Owner. All statutory rules and labour laws prevailing in the area must be observed by the Contractor. All safety measures against occurrence of accidents must be taken effectively. Resident Engineer-in-charge shall not be withdrawn without written permission of the Owner. If any of the Contractor's personnel was found unsuitable for the job, the Contractor shall remove him forthwith and a suitable replacement shall be posted to site within a reasonable time. No compensation for withdrawing of unsuitable or unqualified person(s) from site or for posting suitable person(s) to site at any stage of the project shall be allowed by the Owner.

10.4 Sequence of Erection Work

10.4.1 All packing cases and packages shall be opened in presence of the Owner or his authorized representative.

10.4.2 Each material after stripping from boxes or received loose, shall be carefully inspected, checked with shipping list and identified with erection drawing if necessary. Any short supply and/or damaged part shall be reported forthwith to the Owner in writing. The Contractor shall be completely responsible to make all necessary arrangements, application and follow procedure to process claim on underwriters, obtain replacement repair/rectify and modify as required on all such damaged/defective/lost equipment and material at no extra cost to the Owner in order to execute the work to satisfaction of the Owner within the stipulated Contract time. Once the materials are inspected, the same shall be preserved properly and adequately protected from theft and deterioration or damage by rain, storm, dust, water, tampering by casual visitors or workers. The Contractor shall prepare and maintain stores, ledgers and bin cards for all materials in his custody.

10.4.3 Carrying out all repairs to damages that might have suffered during transit and in subsequent storage and modifications and rectification work and replacement of all lost parts, are under the Contractor's scope.

10.4.4 Nails and packing strips should be pulled out with suitable appliances and kept separately in container and not thrown away at random. All timber of packing cases shall have to be sorted out and stored properly at a suitable place as directed by the Owner. From time to time packing materials, timber, nails and strips shall be delivered back to the Owner or otherwise disposed of as directed by the Owner. All timber and packing materials shall remain the property of the Owner.

10.5 Safety Regulations

10.5.1 Contractor should follow all the safety regulations/norms as imposed by the Law/Authority/factory inspectorate /owner. When going to or from place of work in the

plant only the prescribed walkways, paths or crossovers shall be used. Rail-road crossing warnings shall be needed.

10.5.2 The Contractor shall be fully responsible for ensuring that all employees, construction workers, engineers, and other staff are provided with appropriate personal protective equipment (PPE), necessary training, and a safe environment to ensure their utmost safety.

10.5.3 Crawling on, over or under movable equipment shall generally be prohibited.

10.5.4 For overhead work, ensure that proper signage is placed below the work area. Additionally, when conditions warrant, station a watchman to warn employees in the vicinity.

10.5.5 Work on or around crane runways shall not be undertaken without the Owner's permission. Whenever it is necessary to perform any work on or above the crane runways, the Contractor shall provide a flagman stationed on the floor.

10.5.6 Only scaffolds which meet the requirements of any Governing laws shall be used in the project.

10.5.7 Work in area of electric wires and cables shall generally be avoided.

10.5.8 All burning and welding equipment shall conform to and be used in accordance with the regulations governing such equipment. No burning or welding shall be performed at any location on the site until the area has been approved.

10.5.9 Adequate fire protection shall be available before proceeding the work.

10.5.10 All warning signs shall be observed.

10.5.11 Contractor shall require his employees to wear hard hats at all times when they are inside the plant area.

10.5.12 Goggles shall be worn whenever there is a possibility of flying particles or splashing of corrosive fluid.

10.5.13 When working around corrosive environment workmen shall wear gloves, goggles and protective shoes.

10.5.14 When ladders are the means of access to a platform, they shall be firmly secured top and bottom, and the ladder rails shall extend at least one meter above the top landing. When a ladder cannot be secured, a man shall be stationed at the base.

10.5.15 Safety belts shall be used by men working in high places when no handrails or other guards are in place.

10.5.16 All accidents resulting in injury shall be reported to the Owner promptly. Owner's safety rules, regulations and directives shall be followed and reports thereon shall be submitted as and when required.

10.6 Proper Treatment of Injured

10.6.1 Contractor shall ensure that proper treatment of injuries is immediately available either as such or in the form of constantly available transportation to a source of such treatment.

10.6.2 Contractor shall ensure that stretchers are available near all areas in which their men are working, and that the location of stretchers are well marked.

10.6.3 Contractor shall be solely responsible for the dissemination of all safety regulations including those written here, those promulgated by the Owner and those dictated by good practice and shall ensure that all his employees and those of his Sub-Contractors are conversant with same.

10.7 Inspection

10.7.1 After completion of erection and/or installations and before start-up the equipment and all its appurtenances shall be thoroughly cleaned and then, inspected in the presence of the Owner for correctness, soundness and completeness of installation and acceptability for start-up.

10.7.2 All works to be carried out by the Contractor shall be subject to inspection by the Owner as applicable. The work shall be carried out as per applicable specifications, codes of practice, drawings and instructions of Owner. The Contractor shall provide necessary facilities, instruments, personnel etc., for carrying out the inspection as above and shall comply with the instructions given.

10.7.3 A check list in triplicate will be furnished for the approval of Owner wherein all items to be checked and necessary instructions will be listed. Inspection and checking shall strictly follow this check list. On completion of the joint inspection and checking two (2) copies of the check list will have to be handed over to the Owner. The check lists after checking will have to be jointly signed by the Contractor's supervisor and the Owner to ensure that all inspection and checking have been properly carried out. However, such endorsement shall not relieve the Contractor from the responsibility in ensuring proper erection and cleaning.

10.7.4 During inspection all clearance, alignment and important measurements and adjustments as may be directed shall be noted by the Contractor for future reference and guidance. Two (2) copies of such notes shall be delivered to the Owner.

10.8 Cleaning

10.8.1 The Contractor shall observe strict cleanliness during execution of the work and shall be in possession of vacuum cleaner for cleaning the internals of machinery under installation. They shall check that all the finished surfaces are greased and covered.

10.8.2 Before boxing up, the Contractor shall examine carefully to ensure that no foreign material, such as welding rod ends, welding beads, metal chips, rope, working tools, etc., has been left inside any equipment.

10.8.3 In the case of motors, the following procedure shall be observed

- Checking and cleaning of bearings and charging / filling of lubricants, wherever necessary.
- Cleaning of core and winding, drying out and cornicing the winding and measurement of air gap for motor assembled at site.

10.8.4 Wherever the scope includes control panels, all withdrawable components shall be taken out and internals shall be cleaned with vacuum cleaner.

11 TESTING

11.1 Erection Test

11.1.1 Following the satisfactory completion of inspection, checking and cleaning of a unit, the plant will be placed in test run. During this period, all adjustments and repairs as required shall be made by the Contractor. Protocol shall be made, and signature has to be obtained from Owner/ Contractor. On completion of satisfactory test run, the plant will be placed under trial operation.

11.1.2 Prior to trial operation of any equipment the following shall be checked.

11.1.3 During erection all required erection tests as well as final erection checks of the mechanical completion of the systems and part thereof have to be performed.

11.1.4 After successful mechanical completion a "**Mechanical Completion Certificates"** will be issued.

11.1.5 The activities necessary for mechanical completion shall include but not be limited to following testing:

- Visual inspection after unloading at site
- Checking of completion of relevant systems
- Proper installation of the drive and equipment on the foundation
- Proper alignment of drive and the driven equipment
- Proper connection of supports, hangers, piping, valves, instruments and other fittings.
- Freeness of the rotors of drive and equipment
- Healthiness of lube oil system, changing and filling as necessary.
- Safety audit
- Testing of site welds (non-destructive examinations)
- Pressure/leak/tightness test
- Pipeline and equipment flushing and cleaning
- Chemical protection of piping systems
- Checking of coating
- Testing of cranes and hoists

- Safety signs and warning signs
- Completion of buildings and civil works
- Test of ventilating and air-conditioning units

11.2 Pre-Commissioning Testing

11.2.1 After alignment of all equipment, alignment tests shall be carried out by the Contractor to check levelling, clearance, eccentricity etc. Measurements will be witnessed, and acceptance will be certified by the Owner.

11.2.2 Hydro testing shall be conducted for the entire system/equipment after installation at required pressure. All necessary blanking arrangements for hydro testing shall be furnished by the Contractor. All necessary test pump/temporary piping etc., shall be supplied by the Contractor.

11.2.3 A leakage test shall be conducted for the entire system, including the Digester, Mixing Tank, Buffer Tanks and all other piping to identify any leaks. If any leaks are found, they shall be rectified, and a detailed report explaining the cause of the leaks shall be submitted to the Owner.

11.2.4 Preconditions for commissioning include the issuance of the Mechanical Completion Certificate, the availability of the accepted commissioning program, and the Contractor's commissioning procedures. The pre-commissioning checks cover the functional tests of individual items and their alarm and tripping systems. The following tests shall be included:

11.2.5 Mechanical equipment

- Individual pre-commissioning runs of all rotating equipment such as pumps, compressors, agitators, conveyors, shredders, hammers/extruders, solid liquid separator system, biogas holder, dosing equipment etc.
- Functional tests of all mechanical equipment
- Testing and adjustment of safety devices.

11.2.6 Water flushing of Piping Systems is intended to clean the following piping system,

- Feed Tank Piping
- Buffer Tank Piping
- AD piping
- HWG piping

- ETP Piping
- Other miscellaneous piping

11.2.7 However, the Contractor shall submit along with the offer his usual procedures and practices for water cleaning of the piping specified. The Contractor shall submit all schematics, write up detailed procedures he intends to follow.

11.2.8 Electrical equipment

The following checks and test measurements shall be made during erection and pre-commissioning (as appropriate) in accordance with agreed standards:

- Screwed connections for correct assembly
- Terminals and terminal connections for correct assembly.
- Checking of earthing connections and testing of earthing resistances
- Measurement of insulation values
- Fireproof partitioning
- Marking, inscription, provision of designation plates
- Voltage checks
- Polarity checks in the case of D.C. voltages
- Fuses, over current trips, short-circuit trips, time settings, relay settings
- Safety signs and warning signs
- Setting indicators, revertive (check-back) signals to the central control room etc.
- Checks on wiring and cabling for conformity with the constructional circuit-drawings and plans
- High-voltage tests
- Trip tests
- Functional test on equipment.
- Tests on the transformers
- During installation: checking of complete delivery, checking of core earthing and insulation of active part from tank, H.V. sample tests of transformer oil in accordance with IEC, or equivalent Standards.
- Checking for perfect electrical and mechanical correctness and for the air-tightness of individual main connections system.

- Tests on the earthing and lightning protection system
- Acceptance tests and measurements of the earthing installations in accordance with IEC or IS standards.
- Tests on the lighting system
- Proof of the minimum new value of lighting densities, checking of correct operation both electrically and mechanically.

11.2.9 Control and instrumentation equipment

Site related test for Control & Instrumentation equipment and Calibration tests of instrumentation loop checking, functional testing of control equipment, interlocks, protection inputs, etc. are covered under Section 11 - Detailed Technical Specification for Control & Instrumentation.

12 COMMISSIONING

12.1 Introduction

12.1.1 Commissioning of the Facilities or any part thereof shall be completed by the Contractor as per procedures specified in Detail Technical Specifications. All raw materials, tools, spares, utilities, lubricants, chemicals, catalysts, facilities, services and other matters required for Commissioning shall be provided by the Contractor, unless otherwise specified in the Contract.

12.1.2 The Guarantee Test, including any necessary repeats, shall be conducted by the Contractor after the commissioning of the Facilities or the relevant part thereof to determine whether they meet the KPI's specified in the Contract documents. The owner shall promptly provide the Contractor with any information reasonably required for the conduct and results of the Guarantee Test and any repeats thereof.

12.1.3 A precondition of the commissioning is the successful completion of the pre-commissioning checks of all items of the whole system. Commissioning basically consists of the following steps:

- Commissioning Tests
- Trial Operation for a minimum period of 15 days which also includes in 3 days of Reliability Run
- Biogas generation is established from MSW feedstock at rated full load or part load, as per the feedstock made available by the Owner for a minimum period of 7 days.

12.2 Commissioning Tests

12.2.1 Commissioning tests shall be performed in accordance with the procedure contained in the commissioning program approved by the Owner for individual equipment/system and as a plant. Commissioning test shall also include Redundancy and automatic fall back by simulation of fault conditions.

12.2.2 On completion of each commissioning activity to the satisfaction of the Owner/ Owner's Engineer, the commissioning schedule shall be signed and dated by the Contractor and countersigned by the Owner and Owner's Engineer.

12.2.3 Commissioning test shall prove that the plant is prepared and adjusted to ensure the correct functioning of the individual components and of the complete plant.

12.2.4 After successful completion of the commissioning tests "Authorization to Trial Operation" shall be signed.

12.2.5 The Commissioning test shall cover at least following tests:

- Equipment Protection tests
- Fire protection
- Method of alarm/trip condition reset for subsequent starting
- Isolation procedures method of isolation of plant equipment for safe shut-down and maintenance procedures including as a minimum
- Protection systems/settings, in accordance with agreed design and the requirements of the transmission system
- Start-up tests
- Operation of all auxiliaries
- Verification of vibration and noise emission guarantees
- Environmental monitoring equipment, water quality monitoring equipment, functioning tests and verification of guarantees
- Verification of completeness of scope of supply
- Verification of 24 hours uninterrupted plant and all its subcomponents in operation
- Verification of the design operating time of all equipment in the process

12.3 Trail Operation

12.3.1 After successful completion of commissioning test and after relevant test protocols have been accepted by the Owner, the Contractor shall be allowed to prepare the plant Units for trial operation. The plant will be started up and loaded. During this loading operation all the controls and protections shall be finally set.

12.3.2 After the plant is brought to its maximum operational capacity and the Contractor is fully satisfied with its performance, they shall offer the unit for Trial Operation by communicating the same to the Owner in writing. Upon receipt of such communication, the plant will enter trial operation. The trial operation will last for a minimum period of fifteen (15) days continuously at rated full load or part load, as per the feedstock made available by the Owner, to demonstrate the following:

- Sustained capability of the plant

- Reliability of the equipment and auxiliaries
- Adequacy of the various auxiliaries, ancillaries & systems and controls.
- Capability of each equipment of the plant to correctly perform the functions for which it is specified.
- Safety requirements
- Standby system availability

12.3.3 This trial operation shall be undertaken jointly with the Owner. As a part of the trial operation reliability run of the plant shall be conducted.

12.4 Reliability Run

12.4.1 Reliability run shall be undertaken jointly with the Owner as a part of the trial operation and within the trial operation period. Reliability run shall be conducted for three (3) days uninterrupted at rated full load or part load, as per the feedstock made available by the Owner, at prevailing ambient conditions.

12.4.2 In the event of interruptions to the reliability test run, for which the Contractor is responsible, the length of the reliability test run can be extended by a period equal to the total duration of the interruptions. If such an interruption lasts more than 24 hours, the reliability test run shall be restarted, after repairing the defect. The reliability test run may be interrupted on a maximum of three occasions only.

12.4.3 During the Reliability run, the plant shall be in continuous operation at full capacity or part capacity as per the feedstock made available by the Owner to be provided by the Owner for a continuous period of seventy-two (72) hrs and no interruption is allowed during this period.

12.4.4 Upon the successful and satisfactory completion of the Trial Run and Reliability Run, as approved by the Owner, the plant will be ready for the Performance Guarantee Test Run (PGTR).

13 OPERATION AND MAINTENANCE

13.1 General Requirements

13.1.1 The Comprehensive Operation & Maintenance period shall start from the date of successful completion of PGTR test and O & M charges will be payable accordingly.

13.1.2 The Bidder is responsible for the comprehensive operation and maintenance (O&M) of the entire CBG plant, up to the connection to the CGD network, for a period of Ten (10) years from the date of successful completion of the Performance Guarantee Test Run (PGTR).

Note: The first year of O&M shall not include the spares, as the same shall be covered under defect liability period.

13.1.3 A distinct O&M Contract will be awarded to the successful Bidder, who will then be responsible for achieving the guaranteed KPIs established following the successful completion of the PGTR.

13.1.4 Contractor shall be responsible for O&M contract including overall coordination of all staff & labourers (contractors) and interaction with owner on regular basis. Contractor shall be responsible for timely submission of comprehensive reports, availability and discipline of staff and labour, quality of work executed, safety of units in CBG & staff and accounting activities, keeping staff aware of safety and quality requirements, etc.

13.1.5 Contractor shall ensure the arrangement of the additional deployment of manpower for cleaning of the tanks/vessel/sumps so that ongoing activity of the plant cannot be affected.

13.1.6 Contractor shall ensure Support to OIL management's initiatives for any productivity drives, TPM/ISO related activities, energy optimisation, etc.

13.1.7 Contractor shall ensure insurance and health/medical check-up requirement of the staff.

13.1.8 Contractor shall ensure operating and maintaining Multidiscipline workshop with all tools and tackles at site to ensure minimum plant downtime.

13.1.9 Contractor shall ensure provision of all any tools and tackles required. Contractor shall ensure Housekeeping of the plant as well as internal roads and pathways.

13.1.10 Final deputation of contract manpower at the site will be subject to review by EIC/ Plant In charge/Maintenance in charge.

13.1.11 Contractor shall ensure to work as per standard safety norms & work permit systems and shall always adhere to the safety norms.

13.1.12 Supply of PPEs (Personal Protective Equipment) for contractor's manpower.

13.1.13 Contractor shall ensure to provide round the clock shift coverage in control room & field in all three shifts for carrying out the Operation & Maintenance of CBG.

13.1.14 Contractor shall ensure that good housekeeping in the plant and in control room. Contractor shall ensure that plant is always in healthy conditions. Equipment affecting unit quality and throughput to be attended on high priority (24 hrs. basis). Contractor shall ensure to maintain his own store at the specified designated area and keep required spares in his custody. Contractor to maintain records of supply and consumption of spares as required by the owner, Contractor to mobilize for hot Jobs / welding / fabrication group, whenever required complying adequate safety precautions under the supervision of contractor's safety officer.

13.1.15 If EPCOM does not repair / replace any faulty equipment within stipulated time, OIL is free to get it replaced / repaired, and Cost of such repair / replacement of equipment will be charged to the contractor and will be recovered from contractor bill.

13.1.16 Contractor shall ensure to maintain required facility at site for the repairs, maintenance and calibration of instruments.

13.1.17 Contractor shall ensure availability of adequate number of skilled and unskilled labour round the clock as per requirement. All staff & labour shall have to submit proper identification in advance for obtaining permission to work in CBG plant area.

13.1.18 Contractor shall ensure /produce yearly occupational health check-up certificate for all skilled and unskilled contract workers to be deployed at site.

13.1.19 Contractor shall ensure for at least 4nos. of First Aid trained person certificates who can provide the first aid if required. Contractor shall be responsible to complete the entire work as per schedule of prices, technical description, drawings etc in all respects and any other job necessary to complete the work though specifically may not be covered in the scope of work.

13.1.20 Contractor must set up a laboratory at site to carry out testing indicating various quality parameters as identified by owner or their representatives as per the requirement to meet the guarantee w.r.t. quality and quantity.

13.1.21 All laboratory chemicals, glass ware & equipment required for analysis shall be arranged/ maintained by contractor required for analysis.

13.1.22 Contractor shall ensure reporting (including generation of reports) of plant operation on daily basis, weekly MIS report, real time data update, monthly reconciliation, quarterly

reconciliation and half-yearly report to owner in format agreed by owner or their representatives. Reports shall include, but not limited to:
Online measurements.

- Laboratory Analysis Results
- Statistical analysis deducing performance of CBG
- Details of malfunctioning, start-up & shutdown, repairs, replacements etc.
- Chemical consumption & inventory
- Utility & power consumption
- Preventive & corrective maintenance record and schedules
- Utilization of spares & inventory.

13.1.23 Boarding and lodging of all the staff (Contractors#) shall be the responsibility of the O&M Contractor.

13.1.24 On completion of the Contractual O&M period the Contractor shall replenish and handover all Mandatory spares, fire-safety items and any other items provided to it during the start of the O&M period in proper condition.

13.1.25 The Contractor shall ensure Safe and efficient running of the plant for 100% period during the contractual O&M period, However Breakdown / shutdown in term of more than 10% production loss shall attract a price discount of 2 times the per day O&M cost calculated on Pro- rata Basis of overall O&M cost of the contract.

13.1.26 The CONTRACTOR shall deploy an adequate number of security personnel for security and safety of the plant.

13.1.27 Contractor will maintain daily record, will give weekly MIS to owner and real time data update to owner. Reconciliation will be done on a monthly basis and any deduction if applicable for shortfall in production shall be settled quarterly as per the clause given in SCC.

13.1.28 The contractor must provide the O&M manuals, schedules, and plans in five (5) hard-bound copies, along with a soft copy on a permanent storage media. These documents shall contain the following information in sufficient details to enable the Owner to maintain, dismantle, reassemble, adjust, and operate the Works, including all items and installations.

- Table of Contents
- List of Illustrations
- Introduction

The Introduction shall contain:

i. A brief general description of the Works items
ii. A brief description of the use of the Works items
iii. Definitions of technical terms used in subsequent graphs of the instruction book
iv. A complete list of all items used in accordance with the Works Components Identification System.

a) Detailed description shall contain a complete and accurate description of the Works, all components and ancillaries, their assembling and dismantling.

b) A summary of the technical operating principles of the Works, including diagrams, circuit diagrams, sequence diagrams, etc.

c) The Operating Instructions shall be accurate and easy to understand and shall contain the sequence of individual manipulations required for operation. The information shall be presented in such a manner that the contents of this paragraph can be used for instructing personnel in the operation of the Works.

d) Tables, lists and graphic presentations should be used whenever possible for making the description readily understandable. An appropriate trouble-shooting list shall be included in this chapter.

e) The entire testing and adjustment procedure required for the Works after overhauls and during operation shall be described.

f) Maintenance instruction indicating the inspections required at regular intervals, the inspection procedure, and the routine cleaning operations, the regular safety checks and similar steps. The maintenance instructions shall include a tabular (or in other approved form) summary of the required activities sorted according to

i. Weekly
ii. Monthly
iii. Quarterly
iv. Yearly
v. (Or other) cycles as applicable

g) This document shall provide the maintenance engineer with brief and yet fully comprehensive information including all references to the applicable, detailed service and maintenance instructions.

i. Repair and adjustment, describing the inspections, fitting and dismantling of parts, fault tracing as well as repair and adjustment procedures.
ii. Spare part lists, containing all the necessary data for ordering spare parts. These lists shall include all spare parts, those to be supplied and those not to be supplied under the present Contract. The prices for spare parts shall be indicated in the list. The above list should include minimum and maximum quantities of spares to be maintained by the project.
iii. Tool lists, containing all necessary data for identification of tools to be delivered under the present Contract.
iv. List of suppliers and alternative suppliers and addresses
v. As-built drawings

13.2 Operation & Maintenance Services (O&M)

O&M services provided by the contractor shall be comprehensive in nature which includes supply of all kinds of spares and consumable required to operate the plant without any exclusion. Only SSOF-MSW is supplied free of cost as raw material. Comprehensive O&M with all consumables and spares will be for a Period of total ten years from the date of completion of successful PGTR of the plant.

Note: The first year of O&M shall not include the spares, as the same shall be covered under defect liability period.

13.3 Responsibility of Owner

During the comprehensive O&M period, OWNERS scope shall be:

a) Supply of MSW at the CBG plant
b) Transport of CBG Ex CBG plant
c) Transport of Manure / Liquid Manure / Sulphur / Excess Treated Effluent Ex CBG plant
d) Transport of RDF and Inert Ex CBG plant

13.4 Responsibility of O&M by EPCOM

13.4.1 This shall include deployment of supervisory and skilled manpower (for three hundred & sixty-five days in a year with three shifts operation per day) for operation & maintenance, which includes supply of consumables, spares, satisfactory house-keeping of the plant, maintaining & reporting production log / reports, management of inventory of raw material, consumables, spares required etc. in close coordination with the Engineer -in-Charge.

13.4.2 Contractor O&M team shall perform all services as detailed out herewith and as per the directions of Engineer-in-Charge at site. O&M services shall start from getting the Raw Material Unloaded, weighed in the premises and getting all stages of operations carried out till it is converted into bio-CNG and fertilizer and injection of CNG in Gas pipeline header

at the boundary of the plant. For disposal of bio manure, the contractor is responsible for filling fertilizers in bags/ truck and loading and transporting them up to dispatch point within the plant boundary. Contractor shall also undertake housekeeping including sweeping of plant area, roads etc. to maintain cleanliness, sanitation, removing spill over materials etc. during operation on regular basis during O&M services.

13.4.3 Contractor shall prepare and maintain records / logbook of all operations of CBG plant, receipt of raw material, production availability and quality of Bio CNG, status on injection of CNG into pipeline on daily basis and report to Owner.

13.4.4 Salient features of operation are mentioned below:

13.4.5 Operation shall be in-line with Operation and control philosophy, Material handling philosophy, Process description and other approved technical documents. Operation scope shall be comprehensive in nature and shall include all scope for safe and efficient running of the plant. All efforts shall be made to optimize consumption and conserve the utilities. The contractor is responsible for the treatment and disposal of effluent.

13.4.6 Operation services shall start from receipt of the Raw Material, checking quality parameters of incoming feed on arrival and in Quality control lab, feed weighing in the weight measurement unit and keeping the record at each step as mentioned above. Challan and recording keeping in OIL SAP system/ any other system as specified by Owner to be done / Complied by Contractor.

13.4.7 Some of the Operations are described here with, but this are minimum indicative and any activities over and above these which is necessary for successful operation would be deemed included for O&M.

- Unloading of Raw Material (SSOF-MSW) from Tractor /truck/trolley in specified shed/ unloading area / Infeed Bunkers.
- Operation for Proper Segregation of MSW and transportation of segregated waste to Organic Extraction System.
- Operation service feed transfer to digester tanks.
- Operation service for Transfer of Digestate to Solid-liquid separator.
- Operation service for collection of wet cakes from bottom of Solid liquid separator and transportation and spreading the same in the Solar Enhanced Composting Shed through Sludge Tilling Turning & Conveying (STTC) machine.
- Operation of Solar-Enhanced Composting Facility.
- Operation service for transfer of Stabilized Wet cake (Bio-manure) to bagging Machine.
- Bagging of Bio manure and transfer Bio manure bags to Bio manure Storage area and unloading from storage yard into trucks/trolleys.

- Operation service for Transfer of Sulphur from Biogas purification area to Sulphur storage yard and unloading of same from storage yard into trucks/trolleys as and when required.
- Receipt and storage of all chemicals additives nutrients etc. required for safe and efficient running of the plant.
- Operation of Biogas Cleaning, Scrubbing and Purification Unit
- Operation of Bio CNG Compressors if installed
- Operation service for injection of Bio-CNG into pipeline header at the terminal point within boundary of the plant along with operation of Odorizing system for mixing Odorant for Compressed Biogas (75-80 % TBM (Tert-Butyl Mercaptan) + 20-25 % MES (Methyl Ethyl Sulphide)) in injected CBG.
- Operation of all the equipment in the whole process to ensure generation of required specification bio-CNG.
- Chemical solution preparation and it's dosing as per treatment process requirement.
- Collection of samples at all sampling locations identified by owner or their representatives and as per schedule given by owner or their representatives, as per the site requirement.
- Further any other operation related activities specifically not mentioned above and required to for smooth trouble-free operation of complete CBG plant shall also to be done by the contractor without imposing any additional cost.

13.4.8 Other Responsibilities:

- Provide supervisor and skilled personnel who can give proper training to technicians / operators to run the CBG plant smoothly.
- Provide PPE's for all the staff/supervisors employed for the Contract.
- Ensure adherence to OIL's procedures and work permit system.
- Ensure deployment of committed manpower (as listed in the bid package)
- Contractor shall check for all leakages within the plant.
- Contractor shall ensure management of all Safety systems including Fire water tanks, Fire water pumps, Deluge valves, Detectors etc. their regular trials and record keeping of the same.
- Laboratory analysis of feed and outputs, supply of laboratory consumables & apparatus, maintenance of lab Instruments.
- Keeping the overall CBG plant area clean and safe.
- Maintenance (Preventive and Break Down) of All Equipment and Machinery
- All challan and bills generations, recordkeeping of incoming feed and outgoing products and materials in and out of the plant in OIL SAP/ any other system as per instructions of Engineer in-charge.

13.5 Contractor's Right and Obligations during the O&M Period

13.5.1 The Contractor Shall operate and maintain the plant in a manner that:

i. results in the plant achieving the KPIs set forth during the PGTR.

ii. is compliant with the O&M Standards, Applicable Law, the Performance Standards and the terms of Applicable Permits.
iii. ensures that the plant can handle and process the MSW up to their Design Capacity daily, including handling, processing, segregating, storing, and disposing the inert.
iv. is safe and reliable, subject to normal wear and tear of the Plant.
v. ensures safe and reliable transportation of the Residual Inert Matter and/or any Residual Waste to the Delivery Point.
vi. ensures that any effluent discharge from the operations of the plant do not mix with and pollute any surface water, ground water, stream, pond, or other water body/source.
vii. ensures that there is no leakage from the operations of the Plant that could endanger the environment, people, or property at or around the Site.
viii. ensures that the Project Facilities comply with all emission control and effluent discharge norms specified under Applicable Law. If not, the Concessionaire shall be liable to pay any penalties and/or fines imposed by any Government Authority under Applicable Law.
ix. is in complies with the terms of the Offtake Agreements and Applicable Laws regarding the production and delivery of the CBG Output at the delivery point agreed upon with the Off-taker.
x. maintains the safety and security of personnel, materials, and property at the Site, in accordance with the approved EMP, OHS Plan, Applicable Laws, Performance Standards, and Applicable Permits.
xi. ensures that all waste materials and hazardous substances are stored and/or disposed of in accordance with the EMP, OHS Plan, Applicable Laws, Performance Standards, and Applicable Permits.

13.5.2 During the O&M Period, the Contractor shall:

i. ensure that it reasonably considers and acts upon the comments and suggestions made by the Owner/Owner's Engineer during any meetings between the Contractor.
ii. provide the Owner/Owner's Engineer with reasonable access to the Site during office hours to monitor and inspect the Plant.
iii. develop and implement a safety and surveillance programme for the Plant and adopt appropriate measures and safeguards for the security of the environment, life, and property at the Site.

13.6 Plant Availability and Liquidated Damages

13.6.1 The O&M Contractor shall maintain annual plant availability of ≥96% for each operations year during O&M period. In case of shortfall in meeting the plant Availability Warranty in any year, the Bidder shall compensate the owner, as per the penalty clause.

13.6.2 The Bidder shall guarantee that the average guaranteed CBG output shall not be less than the corresponding value of the KPIs based on the PGTR for the relevant operations year. In the event, the Bidder fails to achieve the Guaranteed CBG in an Operations Year then, the Owner shall be entitled to invoke the Performance Liquidated Damages related provisions and seek remedies for failure to meet Guaranteed CBG values Year wise for such site under this Agreement.

13.7 Scope of Supply for O&M

13.7.1 Preventive, Regular, Corrective and Break down maintenance of Complete Facilities that includes all mechanical/ electrical/ instruments related equipment, tanks, vessels, pumps, compressor, blowers, agitators, piping & valves and other items as required time to time to ensure smooth running of CBG plant on round the clock basis and to keep the plant at maximum productivity level and in good operating conditions.

13.7.2 Deputation of adequate number of skilled and unskilled labourers, for round the-clock O&M activities.

13.7.3 Contractor to ensure deployment of any additional manpower required during the rainy season to meet the overall objectives of the contract. Contractor shall maintain his own tools & tackles for carrying out all maintenance jobs.

13.7.4 Contractor shall periodically check equipment, lubrication, adjustments etc. to ensure proper performance. Contractor shall carry out all trouble shooting, if required, to keep the plant in perfect health as per O&M manuals. Contractor shall generate a failure analysis report in case of failure of any rotary or static equipment and submit the same to Engineer-in-charge.

13.7.5 Contractor shall carry out breakdown maintenance job as and when problems/ defects are noticed.

13.7.6 The housekeeping and keeping the CBG in good condition shall be the responsibility of the Contractor.

13.7.7 Rectification of all faults like leakages, passing valves etc. to ensure minimum losses in the plant.

13.7.8 If any support is required from O&M of any equipment (rotary/static, membranes, filters etc.) in the plant then the same shall be arranged by the contractor.

13.7.9 Further any other maintenance related activities specifically not mentioned above and require for smooth operation of plant shall also to be done by the contractor without imposing any additional cost.

13.7.10 Drawings, documents and O&M manuals of plant are OIL's property. Contractor shall always maintain all the documents in OIL premises and in good condition.

13.7.11 Discipline wise maintenance work is as mentioned below:

13.8 Scope of Work - Civil

13.8.1 Housekeeping of chemical area, all tanks area of CBG, pump area, compressor area etc. of CBG.

13.8.2 Cleaning tanks, vessels, sumps whenever opportunity is available.

13.8.3 Corrective maintenance of painting and protective coating (internal & external) of all items if damaged caused by O&M work.

13.8.4 Repair of any Civil related structure

13.9 Scope of Work - Mechanical

13.9.1 Consumables: Lubricants, grease, filter/strainer & spare parts etc.

13.9.2 Alignment, lubrication, maintenance of all drives and rotating parts as required from time to time as per the details in the instruction manuals.

13.9.3 Dismantling and assembling of equipment items, components and subassemblies like pumps, motors, agitators, compressors, tanks etc. as required.

13.9.4 Cleaning and flushing of pipelines, tanks and vessels as required.

13.9.5 Periodic inspection of all installations for checking any deterioration in surface Finish / Painting / Epoxy coatings etc.

13.9.6 Supply and Changing membranes / filters / strainers if due / damaged for replacement etc.

13.9.7 Patching and rectification of Biogas balloons for arresting leakages.

13.9.8 Cleaning of filters and strainers and replacement as and when required.

13.9.9 Submission of predictive /maintenance report on weekly basis of all rotating Equipment by using appropriate software

13.9.10 Contractor to carry out breakdown maintenance for all type of equipment at site itself including, supply and replacement of bearings, seals, seal testing & maintain the equipment history.

13.9.11 Maintenance spares for All Equipment, Machinery, tanks, pumps, compression system, treatment section etc. and Filter elements, bearing and gland packing of all pumps, blowers, fans, spares for pumps and compressors, NRV, strainers etc. as required time to time for smooth operation of CBG plan

13.9.12 Gaskets, gland packing, O rings, drive belts, oil cups, cleaning agent, cotton waste, adhesives, emery paper, gaskets, fasteners, fittings, pipes, valves, coupling etc.

13.9.13 Spare Parts, Wear and Tear Parts

Spares for the total plant of shall be divided into three categories namely:

- Start-up and Commissioning spares
- Mandatory spares
- Operation & Maintenance (O & M) spares

13.9.14 Start-up and Commissioning Spares

- Start-up and Commissioning spares are those which would be required during plant or equipment testing, start-up and commissioning. All spares used until the plant is finally handed over by the Contractor to the Owner come under this category. All start-up and commissioning spares as required shall be provided by the Contractor without any additional cost to the Owner. The list and details of start-up and commissioning spares shall be furnished by Contractor prior to award of Contract.

- Contractor shall be responsible for the ready and timely availability for all the start-up and commissioning spares as required during various stages of testing, cleaning and commissioning up to handing over of each system of the plant.

13.9.15 Mandatory Spares

The mandatory spares required for the plant shall be provided by the bidder. The bidder shall include the unit cost of the spares in the quoted price.

13.9.16 Operation and Maintenance Spares

a) The Contractor shall provide, based on his own experience of the performance of his equipment, in the form of a schedule given in bid documents, the complete list of operation and maintenance spares for Ten (10) years operation of the equipment covered under the proposal. In the list of operation and maintenance spares parts, the Contractor shall identify

the unit-wise population of each of items recommended and anticipated normal life of the spares.

Note: The first year of O&M shall not include the spares, as the same shall be covered under defect liability period**.**

b) The spare parts must be able to replace the original part completely and have the same technical specifications in quality, material, inspection and mechanical aspects.

c) Contractors shall supply all measurement testing data of any spare part supplied, if applicable.

d) All spare parts supplied shall be packed and stored for a five (05) year reservation based on the local climatic conditions. Small spare parts shall be packed and sealed by transparent plastic bags and drying agents will be used if necessary. Every spare part shall have operation instructions and design marks of the factory when it is supplied.

e) When multiple spare parts are packed in one packing box or container, the general indication to the spare parts outside the packing boxes or containers shall include a detailed list. All packing boxes, containers, and other such tanks shall be marked properly and numbered clearly. All electrical equipment including switches, fuse connection easy melting and other similar apparatus shall be protected and insulated.

f) The spares list for each piece of equipment will be finalized during the Detailed Engineering phase. All spare parts provided by the contractor must be wrapped and packaged to ensure they remain in their original, as-new condition under normal storage conditions. During the 10-year O&M period, the contractor may use these spares but must replenish them to the original quantity immediately after use. At the end of the 10-year O&M period, all spares, as per the original list and quantities, must be handed over to the Owner.

g) The identification of all spare parts shall be in the English language.

h) Spare parts shall be supplied 6 months before start of acceptance test of the respective unit.

i) Contractor's operation and maintenance spares required spare part list shall be confirmed during detailed Engineering phase.

j) The Contractor shall identify and inform the Owner of any items on the spare parts list that have a delivery time of more than two (02) months.

13.10 Scope of Work - Electrical

13.10.1 Motors

Clean the stator body, fan etc. Tighten the foundation and coupling bolts, Check IR value of windings, lubricate with grease the bearing at both ends, Tighten the termination at cable termination box as per preventive maintenance schedule & practices. Vendor shall take all precautions to avoid damage to winding of any motor.

13.10.2 Cable

Check and tighten the end termination. Check IR value and continuity. Replacement of damaged lugs as and when required. Lugs of appropriate size and type to be arranged by contractor. Location and rectification of all cable faults throughout the plant.

13.10.3 Meters

Check for the tightness of terminals. Check the zero error of the pointer and take corrective action, if required.

13.10.4 Switchgear Panels and VFD

Regular cleaning of interior and exterior of all the switch gear, Soft-starters, UPS, Battery banks VFD panels etc. with vacuum cleaner, blower and cleaning cloth and check tightness of power and control cables at terminals. Troubleshooting and rectification of faults in MCC, PCC, VSD panels, field equipment and lighting circuits.

13.10.5 Lighting:

Regular cleaning of light fixtures of all plant, control room and rack room lighting fixtures and replacement of defective lamps and accessories as and when required. Supply of Fittings, lamps and accessories is in EPCOM scope to ensure minimum Lux level as per technical Document with the bid package.

Further any other maintenance related activities specifically not mentioned above and require to for smooth operation of plant shall also to be done by the contractor without imposing any additional cost.

Contractor shall deliver the O&M spares parts required for smooth maintenance of plant as free of cost. Contractor shall maintain following adequate stock of all consumables as mentioned below:

a) Spares for Indicating lamps, fuses, push buttons, insulation tapes, lugs, local Ammeters, cleaning agent, cotton waste, adhesives.
b) Bearing of all motors, Cable jointing kits as when required, numeric relays, contactors, bimetal relays, light fittings, lamps and accessories.
c) Any electrical spares identified by Engineer in charge or required for safe and reliable operation of the plant.

13.11 Scope of Work - Instrumentation

13.11.1 Instrument Control Panel:

Clean the panel interior & exterior. Check for the tightness of terminals, cable end & earthing terminations. Check fuses, indicating lamps switches, PBS. Check the alarm and enunciator for its proper functioning.

13.11.2 Panel Instruments:

Check the terminals of connectors. Check the function of instruments for zero/span values. Replace the fused bulbs & Push buttons. Calibrate the instruments.

13.11.3 Field Instruments:

a) Check the tightness of terminals, cable and termination and earthling studs. Replace the defective components, if observed. Calibrate the instruments. Cleaning / Servicing of On-Off Valves & Accessories as per schedule of EIC.
b) Contractor to ensure that all Control Room and field instruments (including Complete Control and On-off valves) are maintained properly as per manufacturer's recommendation and requirement of the plant.
c) Contractor to ensure availability and accuracy of all the instruments throughout the contract period. Necessary preventive maintenance to achieve the same is to be carried out by Contractor.
d) Contractor to ensure the rectification of any instrument related problem immediately without hampering plant operation. Repair/ rectification jobs of instrumentation to be carried out at site only, necessary tools/ tackles and test equipment should be available with contractor at site. Including FF Communicator, Mustimeter etc.

13.11.4 Analysers:

a) Maintenance of all the analysers is also included in the scope of Contractor. Contractor must ensure that calibration of all analysers is carried out at intervals as per manufacturer's recommendation. Supply and preparation of required chemicals/ reagents/gases for normal operation and calibration of the analysers shall be in scope of contractor. Contractor to take all necessary steps and preventive maintenance jobs so that all the analysers are always in line and displaying / transmitting correct reading with accuracy as per analysers manufacturer's manuals.
b) The persons available at site for maintenance of instrumentation should be having detailed knowledge of the PLC System, all interlocks/ sequences and maintenance of all instruments being used in Effluent Treatment Plant. He should be well versed with all intricacies of Instrumentation pertaining to CBG. Contractor must ensure no tripping / shutdown and no damage to plant equipment due to instrumentation problem/ malfunction.

c) If any support is required from instrument/ control system manufacturer, contractor shall arrange for the same. The total responsibility of instrumentation maintenance and operation is in the scope of Contractor.
d) Further any other maintenance related activities specifically not mentioned above and require to for smooth operation of plant shall also to be done by the contractor without imposing any additional cost.
e) Timely Calibration of All Instrument with Proper Record Keeping Required Spares of PLC, Pressure, Flow, Temperature, Level Transmitters, interposing relays, RTD, Level Pressure Temperature switches, SDVs, Control Valves & Analysers. pH sensor, fuses, SS tubing/fittings, indicating lamps, lugs, Any Consumable Chemicals, Gases, Reagents for Analysers.
f) Any other items required for safe and efficient running of the plant.

13.12 Consumables

13.12.1 Lubricants and greases

a) All lubricants proposed for the plant operation shall be suitable for all operating and environmental conditions that will be met on site.

b) All oils and greases shall wherever possible be readily available in India.

c) The number of oils and greases shall be kept to a minimum. For each type and grade of lubricant recommended the Contractor shall list at least three equivalent lubricants manufactured by alternative companies.

d) For imported oils, lubricants, and other consumables, the Contractor must specify the local equivalents to allow the Owner to arrange future supplies. Preference should be given to local oils and lubricants for the initial filling. Items with a short shelf life should be supplied in phases, considering their actual usage.

e) The Contractor shall supply the initial fill of lubricants for the plant. At the time of the Completion Certificate, the Contractor must also provide sufficient lubricants and greases to ensure the efficient operation and maintenance of the plant at capacity, 24 hours a day, for the period specified in the scope of supply. A proper record of stock shall be maintained, which should be submitted to Owner /PMC.

13.12.2 Chemical and other consumables

a) Contract includes the supply (by the Contractor) of all chemicals, reagents, resins, and other consumables required for testing, commissioning and setting to work of each section of the Works.

b) The Contractor shall provide all chemicals and other consumables required for the efficient operation and maintenance of the plant capacity 24 hours per day for a period as specified under scope of supply and services.

c) The Contractor shall prepare a list of these consumables with quantities necessary for each section of the works and the recommended suppliers.

13.13 Tools, Tackles & Equipment

13.13.1 Maintenance and repair tools including all special tools and tackles required unit for the operation, maintenance, inspection and repair of the individual main equipment and auxiliary equipment shall be supplied by the Contractors in sufficient quantity to equip the shift personnel, maintenance personnel and workshop craftsman for commissioning, testing, calibration, modification and maintenance of the unit. List of such special tools, tackles and equipment shall be submitted by the Bidder along with the bid.

13.13.2 The special tools and equipment for maintenance and repair shall be delivered by the Contractor in lockable steel boxes and they shall be marked in an approved manner for identification purposes and a corresponding tool chart shall be supplied with the steel boxes.

13.13.3 The following tools and appliances shall be supplied under this Contract for use by the Owner:

- One sets of special tools and gauges required for the maintenance of the plant
- One set of special lifting and handling tackles / appliances required for the maintenance of the plant.

13.13.4 The tools, tackles and appliances supplied in general, shall not be used for erection purposes by the Contractor and shall be handed over in brand new condition. Damaged tools, tackles, and appliances shall be replaced before handing over.

13.13.5 The exception to this is the special lifting gear which may be used provided that when it is handed over to the Owner it has not been subjected to more than normal wear and is still fully suitable for its intended use.

13.13.6 Each set of tools, gauges and appliances under category (a) above shall be suitably arranged in fitted boxes of mild steel construction, the number of boxes being determined in relation to the layout of the plant and equipment in question.

13.13.7 If the weight of any box and its contents should be such that it cannot conveniently be carried, it shall be supported on steerable rubber-tyred wheels.

13.13.8 Each cabinet and box shall be painted, fitted with a lock and clearly marked in white letters with the name of the item of equipment for which the tools and appliances contained are intended.

13.13.9 Suitable storage racks shall be provided for all portable lifting tackle supplied under this Contract.

13.13.10 Suitable lifting lugs, ears or ring bolts, or tapped holes for lifting rings shall be provided on all equipment items where the weight exceeds 15 kg.

13.13.11 All lifting tackle shall be stamped with a unique identification number and safe working load. A test certificate from an approved Authority shall be supplied for each item of lifting tackle.

13.13.12 The Contractor shall provide a schedule of all lifting tackle and tools and appliances being supplied, for the approval of the Owner's Engineer.

13.13.13 The Contractor shall provide all runway beams, trolleys, mobile ladders, collapsible maintenance platforms, lifting blocks, special slings etc. necessary for the safe and efficient handling and maintenance of the works. Particular attention shall be paid to handling of equipment located at higher elevations.

13.13.14 The tools and appliances with the appropriate storage racks, cabinets and boxes shall be handed over to the Owner at the time of Taking Over of the complete plant.

13.14 Organogram

The contractor will submit an Organogram detailing the shift wise manpower such as Engineer, Supervisors, Skilled and Unskilled labour to the Engineer In charge for approval.

13.14.1 Contractor's Organization

The Contractor shall supply to the Owner a chart showing the proposed organization to be established by the Contractor for carrying out work on the Facilities. The chart shall include the identities of the key personnel together with the curricula vitae of such key personnel to be employed within twenty-one (21) days from the date of notification of award. The Contractor shall promptly inform the Employer in writing of any revision or alteration of such an organization chart.

13.14.2 Program of Performance

Within twenty-eight (28) days after the date of notification of award, the Contractor shall prepare and submit to the Employer a detailed program of performance of the Contract, made in the form of the critical path method (CPM), the PERT network, MS-Project or other internationally used programme

and showing the sequence in which it proposes to design, manufacture, transport, assemble, install and pre-commission the Facilities, as well as the date by which the Contractor reasonably requires that the Owner shall have fulfilled its obligations under the Contract so as to enable the Contractor to execute the Contract in accordance with the program and to achieve Completion, Commissioning and Acceptance of the Facilities in accordance with the Contract. The program so submitted by the Contractor shall accord with the Time Schedule included in the Contract Agreement and any other dates and periods specified in the Contract. The Contractor shall update and revise the program as and when appropriate or when required by the Employer, but without modification in the Times for Completion given and any extension granted and shall submit all such revisions to the Employer.

13.14.3 Progress Report

The Contractor shall monitor progress of all the activities and supply a progress report to the Owner every month. The progress report shall be in a form acceptable to the Owner and shall indicate:

a) Percentage completion achieved compared with the planned percentage completion for each activity

b) Where any activity is behind the program, giving comments and likely consequences and stating the corrective action being taken

14 APPROVED SUB-VENDORS/ MAKES

The makes / vendors for various equipment and items shall be as per the list of approved vendors /makes in Appendix-3 of this document.

15 INSURANCE

15.1 During Execution of Project

The Insurance during execution period till stabilization of the Plant should be arranged by the Contractor.

15.2 During O&M Period (Insurance by Owner)

15.2.1 Insurance during Operation and Maintenance period shall be arranged by the Owner.

15.2.2 The Owner will regularly take out an insurance policy for fire and allied perils, including earthquake, flood, storms, cyclone, tempest, and any other risks deemed necessary during the O&M contract period. In the event of any loss or claim covered under the policy, the O&M contractor must immediately inform the Owner and assist in filing the claim with the insurance company. The contractor must then submit all required documents to the Owner for onward submission to the insurance company and take all necessary measures to protect the Owner 's interests for the settlement of such claims.

15.2.3 The Contractor shall replace any damaged equipment resulting from events covered under the insurance policies without waiting for the settlement of the insurance claim. This replacement will be based on an estimation duly approved by the Owner. The Owner will issue a Letter of Authorization (LOA) or Purchase Order (PO), where applicable, to proceed with the repairs or replacement. Upon settlement of such claims by the insurance company, the Owner will bear any additional costs of replacement or repair that exceed the insurance claim amount. If the insurance company rejects the claim, the Contractor will bear the entire cost of replacement or repair, and any amount provided by the Owner for these purposes must be refunded by the Contractor.

15.2.4 The Owner will also take out an insurance policy for theft and burglary. In the event of a claim, the Contractor must replace any damaged equipment resulting from events covered under such insurance policies without waiting for the settlement of the insurance claim. This replacement will be based on an estimation duly approved by the Owner. The Owner will issue a Letter of Authorization (LOA) or Purchase Order (PO), where applicable, to proceed with the repairs or replacement. Upon settlement of such claims by the insurance company, the Contractor will bear any additional costs of replacement or repair that exceed the insurance claim amount.

15.2.5 In the event of a claim for fire (not attributable to Force Majeure), theft, or burglary, the Owner will reimburse the contractor up to the amount received from the insurance company. Any additional costs for replacement or repair beyond the settled insurance claim will be borne by the Contractor. If the insurance company rejects the claim, the Contractor will bear the entire cost of replacement or repair.

15.3 During O&M Period (Insurance by Contractor)

Operator shall provide or obtain and maintain in force throughout the period of O&M the following insurance coverage:

15.3.1 The Contractor must provide insurance to cover third-party liability, along with an undertaking indemnifying the Owner from any such claims.

15.3.2 The Contractor must also have a workmen's compensation and/or group personal accident insurance policy covering all its employees and workers, including sub-operators.

15.3.3 The Contractor is responsible for ensuring minimum machine downtime. Regardless of whether the Contractor takes out a Machine Breakdown (MBD) insurance policy, it is the Operator's responsibility to operate and maintain the wind farm and all associated equipment at their own cost for the quoted O&M period. The Owner will pay only the agreed O&M charges. Any replacement, repair, or modification of any item or equipment must be carried out by the Operator at their own cost for the quoted O&M period. The Owner will not be responsible for any breakdown or failure of any equipment for any reason, except for Force Majeure, Fire & Allied Perils Events, or extraneous reasons.

15.3.4 The scope, type, and form of insurance cover mentioned elsewhere in this bid for the scope of the project for the quoted O&M period will be superseded by this clause.

16 DOCUMENTATION

16.1 Format of Documentation

16.1.1 All engineering documents and drawings shall be of international "A" series sizes, that is A0, A1, A2, A3 and A4.

16.1.2 One set of Solid-State Drive (SSD) containing all the drawings in Auto CAD shall also be supplied in addition to the hard copies. Soft copy of all documents shall be supplied in PDF format with original file.

16.1.3 Grouped documents should be provided in A4 size. Larger drawings must be folded to fit within A4 dimensions.

16.2 Numbering and Identification of Documents

16.2.1 All the drawings shall be identified through a common way of numbering in accordance with the requirement of Contract. The numbering system of drawings and documents proposed by the Contractor shall be in compliance with the plant identification system and to be agreed with the Owner. Apart from this, some drawings may also be numbered in the way which the Contractor or Sub-contractors are used to do. But there shall be a common title block on all published drawings which include the following contents:

- Owner
- Owner's Engineer
- Project
- Contractor
- System
- Drawing Number
- Sheet Number
- Revision Number

16.2.2 The measuring units and dimensions marked on the project engineering drawings shall be of SI system conforming to ISO 1000.

16.2.3 English words shall be used as descriptions on drawings.

16.2.4 If the dimensions indicated on the drawing do not align with the scale used, and any dimension on the drawing differs from those measured using the scale, the dimensions explicitly marked on the drawing shall be considered accurate and take precedence.

16.2.5 When revising drawings, the changes must be clearly and distinctly indicated on the drawing. For grouped documents, a brief description of the revision should be provided, with a perpendicular line in the margin of the revised copy closely following it.

16.3 Provision for Documents

16.3.1 Generally, copies of drawings or documents containing trade secret and drawings with patented nature need not be provided.

16.3.2 However, to know whether the Contractor has performed its obligations, the Owner has the right to examine those drawings within the Contractor's working scope.

16.3.3 The Contractor shall meet the Owner's reasonable demands of files and do the following to satisfy the Owner:

- Contractor will work according to the requirements specified in the Contract.
- Contractor's working has been arranged properly and developed according to the plan.
- The quality control system is reliable.
- After receiving all documents necessary for CBG plant operation and maintenance, Contractor shall supply equipment and systems.
- Having received all necessary documents for Contractor to perform its legal obligations or other relevant responsibilities.

16.4 Owner's Responsibilities

16.4.1 The Owner agrees that the Contract will be concluded in accordance with the EPCOM method of building the CBG project. It is the Contractor's duty to ensure that design standards and conditions meet the requirements and that the CBG project shall operate safely and reliably and with high efficiency, having the same performance as stipulated and guaranteed.

16.4.2 The Owner will examine, check and approve the drawings and documents with the aim of ensuring all these drawings and documents meet the demands and duties written in the documents. The Contractor shall have an active and cooperation and working relationship with the Owner. If there is a disagreement over an issue, Owner and Contractor shall work together to reach some conclusion through mutual consultations.

16.4.3 If drawings and documents have been supplied to the Owner, the Contractor may not delay further design, waiting for the Owner's opinion. The Owner will arrange the time for submitting opinion and examination results for delivered documents. If the Owner finds that the Contractor cannot meet the Contract requirements, the Contractor has the duty to modify the design and drawings to meet the Contract demand.

17 PLANT AND EQUIPMENT IDENTIFICATION, LABELLING

17.1 Plant and Equipment Identification

The Contractor shall propose and apply a common identification system for the whole plant equipment, facilities and systems showing the name and number of each item and its respective drawing number etc. to fully identify the plant. The structure of the designations shall be developed in such a way that the symbols used can be handled by electronic data processing equipment. The identification system must be used by all Sub-contractors, vendors, etc., and shall be a proven system for CBG plant application. Each item of plant shall be separately designed with a reference number, which shall be used consistently on the drawings, in the documents and on the catalogues as well as on the equipment items themselves.

17.2 Labelling

17.2.1 Name plates which are to be firmly fixed on all the equipment, buildings and structures shall be provided. For equipment of small size, these are to be fixed on the piping or structure adjacent to the equipment. The contents of nameplate are to include the designation and principal parameters of the equipment.

17.2.2 The nameplate within the field shall be made of a high temperature - resistant metallic sheets, with designation permanently engraved on them. Indoor installed equipment's (e.g., panels, cabinets, switchgear, etc.) shall also be labelled by appropriate name plate.

17.2.3 The form, size, base colour and colour of contents of the name plates and prompting plates will be agreed between the Contractor and the Owner. It shall be possible for these to be readily seen by the operator. The designation of warning tags shall be different from that of other tags.

17.2.4 Labelling material shall be durable at least for 10 years.

18 DRAWINGS, DOCUMENTS FOR APPROVAL, LIAISON MEETINGS

18.1 General

18.1.1 The Owner reserves the right to ask the Contractor to submit copies of drawings and other documents for approval to his Head Office or to the Office of his Representatives. If the Owner or his Representatives are satisfied with the drawing, one copy will be returned to the Contractor marked with an 'Approved' stamp. If the Owner or his Representatives are not satisfied with the drawing, one copy stamped 'Reviewed and Returned with Comments' will be returned to the Contractor with comments marked thereon and the drawing shall be revised and re-submitted for approval. The drawing Review Scheme shall be shared with the Bidder post finalization of the Contract.

18.1.2 The purpose of having drawings reviewed and approved by the Owner is to aid the Contractor in accurately interpreting the Technical Specifications, thereby preventing errors in the equipment or materials delivered to the work site. This formal approval is intended to align with this objective and should not be interpreted as releasing the Contractor from any liability or responsibility for proper design, fabrication, or adherence to the Contract Documents.

18.1.3 Equipment drawings shall clearly indicate the general arrangement of the equipment to be furnished, give principal dimensions, and show sufficient details required for a complete CBG Plant.

18.1.4 When submitting drawings for approval, including those prepared by a Sub-Contractor, the Contractor must certify that they have thoroughly reviewed the drawings and confirm that they meet all Contract requirements.

18.1.5 If any item, equipment or work shown in the drawings does not completely comply with the requirements of the Specification or any other requirement of the Contract Document, the Contractor is obliged to clearly inform the Owner and his Representatives of the differences giving full explanations and reasons for such changes.

18.1.6 For the purpose of this Clause, the term "drawing" shall include design calculations, equipment specifications, diagrams, schedules, performance curves, procedures, simulation results etc.

18.1.7 Approval of a drawing by the Owner or his Representatives will imply that:

- Arrangement and layout drawings and key diagrams have been examined and appear to be in accordance with the basic design concept of the project and meet the requirements of the Specification.
- Other drawings of components and equipment have only been examined in relation to compatibility of the items and equipment with the Specification and in respect of interconnection with other items and equipment.
- Any approval given by the Owner, or his Representatives shall in no way relieve the Contractor of his responsibility under the Contract.

18.1.8 The Owner needs to receive copies of detailed manufacturing drawings and Contractor must make these drawings available.

18.1.9 The Contractor must ensure that drawings are submitted in a timely manner, allowing for any necessary amendments and re-submission for approval without causing delays to the scheduled deliveries or guaranteed completion dates as per the Contract. Work execution should only commence once the drawings have been approved by the Owner.

18.1.10 If, during the Contract period, the Contractor is required to modify the size of any buildings, foundations etc. from that shown on his Tender drawings to accommodate the finally approved arrangement of the Work (with due allowance for access, laydown, maintenance etc), then such modification shall be deemed to be included in the scope of the Contract.

18.1.11 Requirements about the format of drawings and documents, the provision for documents and the Owner's responsibilities with regard to documentation are specified in relevant section of this volume.

18.1.12 The Contractor shall be responsible for any discrepancies, errors, or omissions in the drawings and other details provided by them, regardless of whether these drawings and details have been approved by the Owner / Owner's Engineer.

18.2 Liaison Meetings

18.2.1 The liaison meetings shall be organised by the Contractor (once in 15 days during design period and once in 15 days during construction period) in accordance with stipulations specified elsewhere in the specification.

18.2.2 Contractor shall supply all documents required in the appropriated number as requested by the Owner.

19 TRANSPORTATION & CUSTOM CLEARANCE

19.1 Transportation

19.1.1 The Contractor shall at its own risk and expense transport all the plant equipment and the Contractor's Equipment to the Site by the mode of transport that the Contractor judges most suitable under all the circumstances

19.1.2 The Contractor shall be responsible for obtaining, if necessary, approvals from the authorities for transportation of the plant and Equipment and the Contractor's Equipment to the Site. The Owner shall use its best endeavours in a timely and expeditious manner to assist the Contractor in obtaining such approvals, if requested by the Contractor. The Contractor shall indemnify and hold harmless the Owner from and against any claim for damage to roads, bridges or any other traffic facilities that may be caused by the transport of the plant and Equipment and the Contractor's Equipment to the Site.

19.1.3 The Contractor has to comply with the provisions of carriage by Road Act 2007 Govt. of India and its rules and its further amendments (if any).

19.2 Custom Clearance

19.2.1 The Contractor shall, at its own expense, handle all imported plant equipment and Contractor's Equipment at the point(s) of import and shall handle any formalities for customs clearance including liability for port charges, if any, subject to the Owner's obligations, provided that if applicable laws or regulations require any application or act to be made by or in the name of the Owner, the Owner shall take all necessary steps to comply with such laws or regulations.

20 MANUALS

20.1 General

20.1.1 The Contractor shall provide the manuals in a timely manner to enable the Owner / Owner's Engineer to review and comments and request changes as necessary.

20.1.2 Payments will be withheld for non-compliance or for late delivery of the drawings, procedures and manuals. In particular the Contractor shall be held responsible for consequential damage to the plant where such damage is due to late delivery of the O&M manual resulting in non-familiarity of the operating technique.

20.1.3 The Contractor shall also note that while all documents, procedures and manuals shall be in the English language including that of the sub vender of the Contractor, it is particularly important that the O&M manuals be in clear concise English.

20.1.4 All manuals shall be divided by systems or sections and cross-indexed as necessary.

20.2 Certification Manual

This manual shall contain the approved works certification documentation for all plant equipment and services as specified in the relevant codes and standards and in this specification and the Contractors Quality Manual. This manual shall also include all material tests certificates. Certificates and test procedures shall be specific to the plant supplied.

20.3 Design Manual

This manual shall contain all the design calculations, and all equipment and system data sheets and design criteria required under the Contract.

20.4 Construction Manual

This shall include a comprehensive record of As-built site construction tests and records. Again, the manual(s) shall be compiled in separate parts to reflect the plant and services supplied.

20.5 Commissioning Manual

This manual shall include all the records, certificates and test results arising from the agreed pre-commissioning and commissioning procedures carried out on site. The performance tests and guarantee test results shall also be included. There is a particular requirement that all commissioned plant/equipment values be recorded in this manual and subsequently incorporated into the O&M manuals.

20.6 Operating and Maintenance (O&M) Manuals

20.6.1 The Contractor shall provide the O&M Manual properly bound, within the time specified, to enable the Owner's staff to become fully acquainted with the operation, adjustment and maintenance of the entire plant. The manuals shall contain full and explicit instructions in respect of the operation of the plant under all operating conditions and the maintenance routines and requirements to be established to maintain the plant in optimum performance. These instructions shall be in the English language and be as comprehensive as possible and the form in which they are to be set out shall be agreed with the Owner / Owner 's Engineer. The instructions may be divided as appropriate into in individual sections and Sub-sections as necessary. All section and Sub-sections shall be clearly indexed and cross-referenced as required for clarity.

20.6.2 The instructions shall be tailored to suit the specific requirements of the Operations and Maintenance functions and personnel, taking into account the staffing philosophy for the Compressed Biogas (CBG) project.

20.6.3 The instructions for the related parts shall be accurate and easy to understand and shall contain the necessary sequence of individual activities. The diagram and drawings associated with the instruction shall be clear and unambiguous.

20.6.4 All information and plant data in the manual must be project-specific, derived from the design, manufacturer/supplier details, and commissioning data of the As-built plant. If the Contractor includes standard brochures, the installed plant or equipment must be clearly identified. Each section should contain an introductory description of the item/system, including its function, operating criteria, and any special features. Based on the commissioning and operational experience of the plant, the instructions should be finalized within two months after commissioning. The Contractor must provide the required number of printed copies of all approved amendments for inclusion in the bound set of instructions.

20.6.5 The entire set of O&M manuals, including those from Sub-vendors, shall adopt a uniform format and paper size. The Contractor is responsible for preparing these manuals, integrating all equipment supplied by the Sub-vendors into a cohesive document.

20.7 Operating Instructions

The instructions shall include at least the following specific procedures/practices /items:

- starting-up
- shutting down
- operation / procedures during fault conditions
- surveillance and monitoring of plant check lists

- standard readings
- operational parameters (especially limiting values in critical areas)
- isolating procedures
- earthing /switching
- troubleshooting
- fault reporting
- normal operational reporting
- compliance with requirements for interfacing with grid
- safety/security/firefighting/ first aid
- general plant standards and guidelines.
- test procedures
- maintenance and operating management systems
- drawings, schematics, logics and wiring diagrams, function diagram, P&ID's.
- protection

20.8 Maintenance Instructions

The Maintenance instructions should provide for at least three maintenance functional groups – 1) Mechanical, 2) Electrical, and 3) Control and Instrumentation and shall include at least of the following:

- A complete and accurate description systems of the CBG plant specific to each function
- Detailed maintenance procedures and intervals for all plant items.
- Assembly and disassembly procedures.
- Spare parts
- Use of special tools and equipment
- Lifting procedures
- Handling procedures
- Drawings, detailing tolerances
- Schematics, logics and wiring diagrams, function diagrams P&ID's.
- Isolating procedures,

- Safety and codes of safe practice.
- Firefighting/first aid
- Set-up and calibrating procedures.
- Optimisation of Control Loops
- Diagnostics and trouble shooting
- Specialist maintenance/repair procedures including welding procedures.
- Materials test procedures

20.9 Owner's Responsibilities

20.9.1 The Owner agrees that the Contract will be concluded in accordance with the EPCOM method of building the project. It is the Contractor's duty to ensure that design standards and conditions meet the requirements and that the project shall operate safely, reliably and with high efficiency, having the same performance as stipulated and guaranteed.

20.9.2 The Owner/ Owner's Engineer may examine, check and approve the drawings and documents at his discretion with the aim of ascertaining that all these drawings and documents meet the requirements specified in the Contract documents. The Contractor shall have an active and cooperative working relationship with the Owner/ Owner's Engineer. If there is a disagreement over any issue, Owner/ Owner's Engineer and Contractor shall work together to reach some conclusion through mutual consultations.

20.9.3 The drawings and documents of the Contractor shall be returned with observations if any within fourteen working days by the Owner. The Contractor shall clarify the observations raised by the Owner and shall attempt to correct the drawing or document subsequently only.

21 ENVIRONMENTAL PROTECTION

21.1 Applicable Standards

The project must conform to the Bureau of Indian Standards (BIS). The following standards and /or regulations are to be applied:

- Solid Waste Management Rules, 2016.
- Environmental Impact Assessment (EIA).
- National Air Quality Standards as notified by Air (Prevention and Control of Pollution) Act.
- Water (Prevention and Control of Pollution) Act.
- Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.
- Emission limits for new diesel engine up to 800 kW for generator set (Genset) application as notified by Environment (Protection) Rules.
- Noise limit for generator sets run with diesel as notified by Environment (Protection) Rules.

21.2 Environmental quality standards

21.2.1 The discharge of pollution in water and air as well as noise levels shall meet with the stipulations of Pollution Control Board, Odisha as well as other Acts of the Government under the Ministry of Environment and Forestry. If there should be a discrepancy between standards and this specification from the more stringent requirement will apply.

21.2.2 Contractor shall comply with the following Environmental clearance obtained for the project, as applicable for the EPCOM scope:

- Environmental Clearance (EC)
- Consent to Establish (CTE)
- Consent to Operate (CTO)

21.3 Fundamental Requirements of Environmental Protection for CBG Projects

General principles

21.3.1 To protect the environment, CBG projects should comply with state regulations, carry out composition and review system for environmental impact assessment (EIA) report and execute the "Three Simultaneousness" system, namely, simultaneous design, construction

and operation of both pollution prevention facilities and the main plant. The preparation of EIA is not a part of Contractor's scope.

21.3.2 Environmental protection design for the CBG project will be based on the requirements of environmental impact report and relevant stipulations, and state-of-the-art, proven technology will be adopted. This will guarantee that the plant will run in a safe, efficient manner and with high availability, and satisfy the demands of protecting the environment. The air emissions of the plant will meet the Local Pollution control board norms and guidelines. The plant effluent shall also meet the stipulations laid down by Pollution control board. The general pollution control board (PCB) requirements shall be imposed. Any add-on requirements during public hearing and EC shall be imposed as amendment.

Atmosphere Pollution Prevention and Control

21.3.3 Flaring shall be done by either ground/elevated flare. Flaring shall be according to the norms of Central and State Pollution Control Board. No Deviation/correction in this regard is acceptable.

21.3.4 The biogas flaring shall be done by elevated flares except where there is any effect on crop production in adjoining areas due to the flaring. In such cases, one may adopt ground flaring.

21.3.5 For Elevated flaring, the minimum stack height shall be as per prevailing norms issued by State Pollution Control Board / Central Pollution Control Board with respect to Emissions Discharge from time to time.

21.3.6 In case of ground flaring, the flare pit shall be made of RCC surrounded by a permanent wall (made of refractory brick) of minimum 5 m height, to reduce the effect of radiation and glaring in the adjoining areas.

21.3.7 A green belt shall be developed around the flare after the refractory wall in case of ground flaring. If green belt is not provided, enclosed ground flare system shall be adopted.

Water Pollution Prevention and Control

21.3.8 The plant should be designed to economize on water use and to set up a water management system featuring equilibrium between water feed and water discharge.

- Wastewater from the plant shall be treated in distributed mode and will reach the standards before it is discharged. plant water pollution shall meet the State and Central PCB Norms and requirements. No Deviation/correction in this regard is acceptable.

- Sewage disposal shall conform to the State and Central PCB Norms and requirements. No Deviation/correction in this regard is acceptable.

21.3.9 All the Liquid Effluents shall be treated as per the applicable statutory norms and shall be recirculated as much as possible to the plant. The surplus treated liquid effluent (if any) which will be discharged into the Municipal Sewerage Lines, shall be as per prevailing norms issued by State Pollution Control Board / Central Pollution Control Board / Local Municipal Body with respect to Effluents Discharge into the Municipal Sewerage Lines, from time to time.

Noise Pollution Prevention and Control

21.3.10 The Contractor shall take all necessary measures for noise attenuation in order to meet the specified noise levels. Noise pollution shall meet the State and Central PCB Norms and requirements. All equipment shall be specified for a design to run without undue vibration and with the least amount of noise.

General requirements of noise control

21.3.11 The noise level shall meet the MoEFCC and OSPCB environmental requirements specified for the CBG project.

Green Belt

21.3.12 Adequate plantation shall be provided along the periphery and in the CBG project to satisfy the norms and stipulation as laid down by the SPCB, the Govt. of Odisha and MoEFCC, Government of India.

Soil Contamination

21.3.13 Soil can become contaminated by oil and chemical spillage during Operation and Maintenance of the plant. The entire plant shall be designed, operated and maintained in such a way to prevent any soil contamination and adequate provisions shall be made in the design.

Rainwater Harvesting

21.3.14 Rainwater collected from the roofs of the admin and other buildings will be directed through downspouts into garland drains surrounding the buildings. These garland drains will connect to the plant's storm water drainage network. Additionally, several strategically placed recharge wells within the plant will be interconnected with the storm water drainage system to ensure effective groundwater table recharge.

22 ENVIRONMENT, HEALTH, SAFETY AND SOCIAL

22.1 General Requirements

22.1.1 The EHSS Requirements set out herein refer to mandatory requirements pertaining to environmental, social, health and safety, labour, and security. The EHSS Requirements shall be the minimum requirements for EHSS compliance for the EPCOM Services & Works. This is to be read along with the HSE Policy given as ANNEXURE -4 in Section XIII.

22.1.2 The EPCOM Contractor shall appoint appropriately trained and qualified personnel who shall always be on site during the EPCOM Services & Works to be responsible for compliance with the EHSS requirements, provide suitably experienced and competent health and safety supervision ("EHSS Manager") who understands the EHSS requirements. The EPCOM Contractor shall be ultimately responsible for EHSS Management and aspects in relation thereto.

22.1.3 The EHSS Requirements shall be implemented by the EPCOM Contractor and its subcontractors, and any other parties involved in the EPCOM Services & Works and any associated activities pertaining to EPCOM Services Contract. The EPCOM Contractor is responsible for informing its subcontractors and workers of the EHSS requirements (i.e. the EHSS Requirements shall be included in all contracts) and for ensuring compliance and reporting to the Employer on compliance with the EHSS requirements.

22.1.4 The EPCOM Contractor shall ensure that the EPCOM Services & Works meet the requirements set out in: -

- Project Environmental and Social Impact Assessment (ESIA) Report prepared by Environmental Resources Management (ERM) and the Environmental and Social Management Plan (ESMP)
- Good International Industry Practice
- Indian regulatory framework
- Agreements relating to the EPCOM Services & Works
- International Finance Corporation (IFC) Performance Standards (2012)[1]
- World Bank Group Environmental, Health, and Safety General Guidelines (2007); World Bank Group Environmental, Health, and Safety Guidelines for Wind Energy (2015); and

[1] https://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Sustainability-At-IFC/Policies-Standards/Performance-Standards

World Bank Group Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution (2007)[2]; and

- International Labor Organization ("ILO") Core Labour Standards, the ILO Basic Terms and Conditions of Work, and the UN Guiding Principles on Business and Human Rights.

22.1.5 The EPCOM Contractor shall ensure that all permits and approvals are obtained prior to starting the works. These include, but are not limited to, approvals for drilling any well for groundwater extraction at the Project Site. Copies of the permits shall be provided to the Employer before starting the works and shall be available for inspection on the works site.

22.1.6 The EPCOM Contractor shall adhere to the following general requirements: -

- Avoid and otherwise minimise and mitigate the impacts of EPCOM Services & Works on local communities and the environment (including land, water, marine environment and flora and fauna).
- Use natural resources sustainably.
- Manage contribution to climate change through efforts to minimize use of fossil fuels, control of emissions to atmosphere and through energy conservation.
- Protect the health, safety and welfare of all those working on the EPCOM Services & Works in line with good international practice as set out in the IFC Performance Standards, especially IFC Performance Standard 2 on Labour and Working Conditions
- Proactively ensure that the working environment at the site is safe, without risks to the safety or health or exposure to hazards of its personnel, the Employer, the Employer's personnel or any member of the public.
- Maximise opportunities for positive environmental and social benefits.
- Assign adequate staff and resources in order to effectively manage and implement all requirements.
- Adopt governance and management arrangements so that the EPCOM Services & Works can be managed in an appropriate, accountable and transparent manner.
- Monitor and report on EHSS performance to strive for continuous improvement.

22.1.7 The EPCOM Contractor shall adhere to the following specific requirements: -

- The EPCOM Contractor shall restore the compacted soil at stock yard to make it fit for vegetation.

[2] https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/EPC-guidelines

- The EPCOM shall provide Disaster Management Plan and execute the necessary actions at the time of disaster and emergency. Disaster Management Plan shall include Emergency Preparedness Plan, Emergency Response Team, Emergency Communication, Emergency Responsibilities, Emergency Facilities, and Emergency Actions. The Disaster Management Plan shall be duly approved by the owner.
- The EPCOM Contractor shall undertake precautionary measures, plans for emergency response, preventive and emergency preparedness to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of its workers and locals.
- The EPCOM Contractor shall provide adequate number of fire-extinguishers/ fire-fighting equipment at the Project Site, especially in high-risk areas, such as storeroom, waste store, security office, etc.
- The EPCOM Contractor shall not store or use any prohibited hazardous materials at the Project Site.
- The EPCOM Contractor shall store chemicals such as admixtures, sealants, etc. safely so that they do not cause pollution or cause hazards to health.
- The EPCOM Contractor shall provide adequate secondary containment for oil and hazardous materials brought into the Project Site.
- The EPCOM Contractor shall store packaging, cement bags and empty oil drums so as not to cause pollution.
- The EPCOM Contractor shall be responsible for the control, minimisation and removal of waste generated from the activities under its scope of works in order to minimize any adverse impact to the environment, air and water at the Project Site
- The EPCOM Contractor shall ensure that hazardous waste is properly labelled and stored and disposed within 90 days from its generation.
- The EPCOM Contractor shall ensure that the security personnel deployed at the Project Site have received adequate training in how to respond to various situations, including emergency preparedness and in accordance with the IFC Performance Standards on security personnel.
- Excavated areas to be marked with temporary fencing/ safety signage.
- The EPCOM Contractor shall ensure that its vehicles which are being used within the Project Site have pollution under control certificate.
- The EPCOM Contractor shall implement and enforce a speed limit of 10 mph for all its vehicles within the Project Site.
- The EPCOM Contractor shall use of plastic insular caps on live electrical components.

- The EPCOM Contractor shall install bird diverters at spacing indicated in Figure 7.7 of the ESIA to ensure higher visibility of overhead line to the bird species (refer to the ESIA).
- The EPCOM Contractor shall raise transmission poles with suspended insulators and perch rejectors in order to reduce the electrocution of bird species (refer to the ESIA.
- The EPCOM Contractor shall provide bird-safe strain poles which have insulating chains at least 60 cm in length (refer to the ESIA).
- EPCOM Contractor shall display emergency contact details, safety signage at the Project Site, wherever required.
- The EPCOM Contractor shall provide workers at the Project Site with: clean and safe drinking water which meets Indian drinking water standards (and testing records provided); water and soap for washing hands; sanitation facilities (i.e. adequate number of toilets) with septic tank; and rest area with shade (including for security guards).
- Only use competent, qualified and approved contractors and subcontractors and ensure that all workers/site personnel under their supervision have been properly inducted in accordance with the EHSS Requirements and the approved EHSS Plan.
- Provide adequate secondary containment (bunds) for any oils and fuels to be used on site as per Good International Industry Practice and as set out in the World Bank Group Environmental, Health, and Safety General Guidelines (2007).
- Provide mobile spill kits which are transferred to the location of the EPCOM Services & Works, including a spill kit to be used in the marine environment and train workers on the use of the spill kits as part of the site induction.
- Ensure all workers stay in the project boundary for the EPCOM Services & Works (i.e. within 15 m of the transmission line safety corridor and WTG locations
- Ensure workers do not liaise directly with the community and landowners/land users – all interaction shall be undertaken by the Employer and its appointed owners' engineer.
- Prohibit fishing, hunting, poaching and disturbance/collection/removal of any flora and fauna by workers.
- Prohibit the use, possession, transportation, promotion or sale of illegal drugs, controlled substances, drug paraphernalia and the consumption of alcohol by workers.
- Be responsible for the provision of any equipment (including PPE e.g. safety boots, high-viz vest, life vest, ear plugs, dust mask, etc.) necessary for execution of any activity in a safe manner and ensure that those persons (and contractors) under their control who are required to use this equipment are given adequate training in its use.

- Maintain at the site and available for inspection (by the Employer or its agents) records of training, records of audit and inspection and copies of licenses and/or work permits.
- Conduct risk assessments for all at risk work activities and conduct daily toolbox meetings to ensure site personnel are properly informed of the risks, mitigation measures and PPE associated with their daily work activities.
- Implement method statements for hazardous operations.
- Implement and maintain compliance with 'Permit to Work' systems.
- Provide adequate first aid kits, facilities and personnel on site, as per statutory regulations and Good International Industry Practice.
- Provide adequate fire protection for their construction facilities, as per statutory regulations and Good International Industry Practice and
- Bird diverters to be installed on conductors as specified in ESIA.
- Spikes to be installed on insulators of internal poles.
- All heavy vehicles like JCP, cranes, dumpers etc. to be provided with reversing siren
- Any other requirement as per the Environment and social impact assessment (ESIA) studies and the resulting Environment and social management plan (ESMP)

22.1.8 The EPCOM Contractor shall adhere to the following requirements on labour and social protection: -

- The EPCOM Contractor shall employ local labour for skilled and unskilled works, where possible.
- Provide daily transport to and from the works site
- The EPCOM Contractor shall ensure that workers do not stay overnight on the site (when not working) and no labour camp shall be constructed at Project Site.
- Only allow workers aged 18 or above to be engaged for EPCOM Services & Works and proof of age shall be checked and retained.
- Only allow authorised personnel on the site.

- Comply with labour laws, including applicable Workers' Rights Laws[3] and Workers' Rights Requirements[4].
- Comply with the core labour standards, which are the elimination of all forms of forced or compulsory labour; the abolition of child labour; elimination of discrimination in respect of employment and occupation; and freedom of association and the effective recognition of the right to collective bargaining, as per the relevant conventions of the International Labor Organization
- Carry out its activities consistent with the intent of ensuring legally permissible equal opportunity, fair treatment and non-discrimination in relation to recruitment and hiring, compensation, working conditions and terms of employment for its workers (including prohibiting any form of discrimination against women during hiring and providing equal work for equal pay for men and women engaged, including those engaged by sub-contractors and their contractors)
- Not restrict its workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment; and
- Engage subcontractors and other providers of goods and services: who do not employ child labour or forced labour; who have appropriate mechanisms that will allow them to operate in a manner which is consistent with the intent of (1) ensuring legally permissible equal opportunity and fair treatment and non-discrimination for their workers, and (2) not restricting their workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment; and whose subcontracts contain provisions which are consistent with a) to d) of this clause.
- Put in place mechanisms to ensure and demonstrate compliance with these provisions on social protection.

22.1.9 The EPCOM Contractor shall provide monthly reports to the Employer within 10 days of the end of each month (i.e. by 10th January, 10th February, 10th March etc.). The information to be included in the report is as presented in the "Reporting Format" present as Appendix 2 to this schedule.

[3] Workers' Rights Laws means: all applicable law relating to employment and employment practices, including any such Applicable Laws regarding payment of wages or other dues, a minimum age for employment of children, acceptable conditions of work, minimum wages, hours of work, occupational health and safety, provident fund, gratuity, bonus, employees state insurance, overtime payments, employment discrimination, workers' compensation, employee social security contributions, employee income tax withholding and family and medical leave, and other worker rights and social benefits.

[4] Workers' Rights Laws means: (a) the obligation to refrain from (i) taking any action to prevent employees from, or to penalize employees for, lawfully exercising their right of free association or their right to organize and bargain collectively, (ii) using forced, child labour or bonded labour, or (iii) coercing or penalizing employees on the basis of trade union activities or membership, (b) international best practices concerning worker rights and social benefits (including taking into consideration standards promulgated by international organizations (including, by way of example, the International Finance Corporation's Performance Standard 2 (Labor and Working Conditions) and the guidance note entitled "Workers' Accommodation: processes and standards" published by the International Finance Corporation and the European Bank for Reconstruction and Development).

22.1.10 Notwithstanding the information required in the monthly reports, the Contractor shall submit the following reports on any accidents and incidents to the Employer in line with the following: -

- **Incident / Accident 1st Notification Report:** As soon as reasonably practicable and in any event within three (3) days after becoming aware of the occurrence, the Contractor shall notify the Employer of any reportable social, labour, health and safety, security or environmental incident or accident relating to the EPCOM Services & Works.
- **Incident / Accident Detailed Report:** As soon as reasonably practicable thereafter, but ultimately within twenty (20) days of the first notification report to the Employer, the Contractor shall provide a detailed report describing the nature of the incident / accident, the results of the investigation into the incident, and the corrective measures required to be adopted to prevent any future similar event.
- **Incident / Accident Progress Report:** The Contractor will keep the Employer informed on a monthly basis of the on-going implementation of the measures as defined in the Incident / Accident Detailed Report.

22.1.11 The EPCOM Contractor shall allow OIL's Representative/ Engineer to conduct periodic inspection and monitoring and shall provide the information as and when requested.

22.1.12 Prior to mobilising to site, the EPCOM Contractor shall develop and provide the following EHSS Plan for the Employer's approval:

- Confirmation of compliance to the EHSS requirements herein.
- Register of Legal and other requirements relating to the E&S requirements.
- Organization chart for the Early Works (including details of subcontractors and other parties).
- Name(s) of the personnel responsible for compliance with the E&S requirements and their qualifications and experience ("E&S Manager").
- Risk assessment for each work activity supported by documentation in the form of job hazard assessment (JHA) or equivalent.
- List of activities and roles which require qualified personnel (e.g. working at height, driving, operating machinery, electrical works, etc.) and names of personnel and copies of the certificates for these roles.
- Emergency response plan, to include the arrangement for first aid.
- EHSS induction plan for workers, to include PPE arrangement.

- List of any hazardous substances to be stored on site and storage/handling requirements (to include Material Safety Data Sheets (MSDS).
- Labor management policy and procedures.
- Alcohol and Other Drugs Policy, which shall be applicable for all workers (including those of subcontractors).
- Waste management plan.
- Chance finds procedure.
- Arrangement for worker accommodation (including for subcontractors).
- Program for audits and inspections during the Early Works.

22.1.13 The Employer's written approval on the EPCOM Plan is required before the Early Works can commence.

22.1.14 The E&S Plan shall be updated if there is any revision/change to the works and a revised version shall be submitted to the Employer.

22.1.15 The EPCOM Contractor shall ensure that all workers on the Project Site receive an EHSS induction before starting work at the site.

22.1.16 The EPCOM Contractor shall ensure that toolbox talks are undertaken ahead of commencing each activity.

23 LANGUAGE TO BE USED

- English shall be used as the primary language for the Contract. Translations into English must be provided for any codes and standards that are not originally in English.
- Name plates of equipment and instrument scale, etc. shall be marked in English as required for start-up, testing and training etc.
- Documents for training shall be provided in English.

24 DEVIATION POINT

The Bidder shall provide a list of deviations from the technical specifications in their Bid. If no deviation list is submitted, it will be understood that the Bidder fully complies with the Technical Specifications provided herein.

24.1 Deviation sheet sample format

The Bidder must submit deviations in an Excel file using the specified format below. Each deviation should be clearly addressed with precise language.

S. No.	Specification Reference				Deviation Taken	Reasons for deviation taken
	Section No.	Clause No.	Page No.	Description as Specified		
1.						
2.						
.						
.						
n.						

We confirm that above are the only deviations from the bid document.

Notes:

1. Additional sheets of similar size and format may be used as per Bidder's requirement and shall be annexed to this schedule.
2. Deviations to bid documents, if any, shall be indicated only in this schedule.
3. Deviations listed elsewhere will be summarily rejected and shall be ignored.

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____

COMPANY SEAL

DATE _____

25 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

Below are the Drawings & Documents to be submitted along with the proposal,

S. No.	Documents
25.1.1	**General (Applicable for all discipline)**
1.	Completely filled in technical schedules & other schedules for all equipment's as enclosed with the Tender specification.
2.	Duly filled equipment datasheet and PGTR KPI's provided in the bid.
3.	Plot plan and General arrangement drawing showing the major buildings / equipment viz MSW Pre-Treatment / Processing, Digester, Hydrolysis tank, Feed mixing tank, Electrical Rooms, Control Room, SLS / Decanters, ETP, Solar Composting, Biogas Purification shed, Laboratory, Admin Building, Parking, Unloading, Storage, Maintenance Areas etc.
4.	Quality Assurance and plan.
5.	Technical concepts note of the plant.
6.	Performance Guarantee Test Run Procedure.
7.	Electrical Load List of all equipment.
8.	List of make/vendors.
9.	HSSE Plan.
10.	List of spares.
11.	List of special tools and tackles.
25.1.2	**Mechanical**
1.	Plant Process Description.
2.	Process Flow Diagram (PFD).
3.	Mass Balance
4.	Water Balance
5.	Energy Balance
6.	Correction Curve - Raw Biogas Generated Vs Volatile Solids to Bio-methanation System
7.	Correction Curve - CBG Generated Vs Volatile Solids to Biomethanation System
25.1.3	**Electrical**

S. No.	Documents
1.	Technical description of electrical system.
2.	Typical Single line diagram (SLD).
25.1.4	**Control & Instrumentation**
1.	DCS / PLC architecture drawing (also indicating interconnection of different offsite C&I System)
2.	Plant Control and operational philosophy.
3.	Process description / functional write – up.
25.1.5	**Others**
Overall project implementation with key dates and milestones for major plants design, construction, erection, commissioning, trial operation and testing up to provisional takeover of the complete CBG project.	
Reference lists for delivery and installation of plants of similar type and size	

Section-VIII Detailed Technical Specifications - Process & Mechanical

Table of Contents

1 INTRODUCTION 290

2 Design Philosophy 292

2.1 Plant Operation Design Philosophy 292
2.2 SSOF-MSW Processing Unit 292
2.3 Site Development 293
2.4 SSOF-MSW Processing Unit - Description & Technical Specifications of the system / units 293

3 WEIGHBRIDGE 294

3.1 General Requirement 294
3.2 Data Sheet - Weighbridge 296

4 INFEED BUNKER 304

4.1 Design Requirement 304
4.2 Datasheet - Infeed Bunker 304

5 PRETREATMENT SYSTEM 306

5.1 Pretreatment Unit - General Requirement 306

6 ORGANIC EXTRACTION SYSTEM 307

6.1 Design Requirement 307
6.2 Datasheet - Organic Extraction system 307

7 GRIT REMOVAL SYSTEM 309

7.1 Design Requirement 309
7.2 Datasheet - Grit Removal system 310

8 BIO-METHANIZATION SYSTEM 311

8.1 Datasheet - Buffer Tanks 311

9 BUFFER TANK FEED PUMP 313

9.1 Design requirement 313
9.2 Datasheet - Buffer Tank Feed Pump 313

10 ANAEROBIC DIGESTER 315

10.1 Design Requirement 315
10.2 Datasheet - Anaerobic Digester 317

11 DIGESTER FEED PUMPS 322

11.1 Design Requirement 322
11.2 Datasheet - Digester Feed Pumps 323

12 BIO-GAS HOLDERS 327

12.1 Design Requirement 327

12.2 Datasheet - Biogas Holder 327

13 BIO-GAS FLARING SYSTEM 332

13.1 Design Requirement 332

13.2 Datasheet - Bio-Gas Flaring System 333

14 BIO-GAS PURIFICATION AND UPGRADATION SYSTEM 338

14.1 Design Requirement 338

14.2 Datasheet - Bio-Gas Purification and Upgradation System 339

15 ODOUR CONTROL SYSTEM 348

15.1 Design Requirement 348

15.2 Datasheet - CBG Odourising System 349

16 COMPRESSED BIO-GAS (CBG) SYSTEM 352

16.1 Design Requirement 352

16.2 Datasheet - Compressed Biogas System 352

17 DIGESTATE DEWATERING SYSTEM 359

17.1 Design Requirement 359

17.2 Datasheet - Solid Liquid Separator (SLS) 360

17.3 Datasheet - Digestate Transfer Pumps 366

17.4 Datasheet - Digestate Sump 367

17.5 Datasheet - Sludge Dewatering Equipment Feed Pumps 369

17.6 Datasheet - Sludge Dewatering Equipment 370

17.7 Datasheet - Centrate Storage Sump 372

17.8 Datasheet - Dewatering Equipment Feed Pumps 374

17.9 Datasheet - Dewatering Equipment 375

18 COMPOSTING FACILITY 377

18.1 Solar-Enhanced Green House Type Composting Facility 377

18.2 Datasheet - Green House 378

18.3 Datasheet - Solar Composting Machine 379

18.4 Compost Screening Plant 381

18.5 Datasheet - Composting and Bagging Unit 382

19 EFFLUENT TREATMENT PLANT (ETP) 390

19.1 Design Requirement 390

19.2 Effluent Treatment Cum Sludge Dewatering Plant 391

20 CONVEYORS 393

20.1 Design Requirement 393

20.2 Datasheet - Belt Conveyor 394

20.3 Chain Conveyor 401

21 LAB EQUIPMENT 406
21.1 Datasheet - Lab Equipment 406
22 THERMAL INSULATION 415
22.1 General 415
22.2 Scope Of Supply 415
22.3 Codes and Standards 415
22.4 Design Requirements 415
22.5 Construction requirement 416
22.6 Datasheet - Thermal Insulation 418
23 HEATING VENTILATION AND AIRCONDITIONING SYSTEM 420
23.1 General 420
23.2 Scope of Work 420
23.3 Description of the system 421
23.4 Ventilation System 424
23.5 General Technical requirements 425
23.6 Design criteria 425
23.7 Control philosophy 433
23.8 Codes and Standards 433
23.9 Inspection and Testing 434
23.10 Test at Manufacturer's works 434
23.11 Test at Site 434
23.12 Specified Designed Data for Air-Conditioning System 434
23.13 Specified Designed Data for Ventilation System 437
24 TECHNICAL SPECIFICATIONS FOR FIRE FIGHTING SYSTEM 437
25 TECHNICAL SPECIFICATIONS FOR INTERCONECTING PIPING & VALVES 438
25.1 Piping 438
25.2 Valves 442
26 SERVICE WATER TANK 445
26.1 Introduction 445
26.2 Design Requirement 445

1 INTRODUCTION

The detailed Scope of Work for process and mechanical is described in the following clauses. However, any task necessary to ensure the proper and satisfactory completion of the work, maintaining a high standard of workmanship, shall be considered included in the Scope of Work. This applies even if such tasks are not specifically mentioned or described below, with no additional cost for these items.

1.1.1 The bidder must select proven process systems and equipment and select suitable capacities of process systems and equipment for producing CBG using the Source Segregated Organic Fraction of Municipal Solid Waste as feedstock. It is not the intent of this specification to specify all technical and sizing / capacity requirements of or to set forth requirements adequately covered by applicable codes and standards. The bidder shall furnish high quality equipment meeting the quality assurance requirements of this specification and industry standards.

1.1.2 All equipment and components shall be designed to ensure safe, reliable and economical operation at the maximum throughput rates, thereby to achieving the guaranteed yield of CBG.

1.1.3 Minimum design capacity of Biogas Purifying & Upgradation System shall be 130% of the average hourly raw biogas production.

1.1.4 Raw biogas Storage capacity (combined capacity of the balloons mounted on all the operating digestors) shall be minimum of 4 hours of biogas production. If the storage capacity of balloons mounted on all the operating digestors is below the 4 hours of production, then standalone ballons shall be provided for the balance capacity so that the total storage capacity is 4 hours of biogas production. Standalone ballons shall be minimum of 2 x 50% (if provided).

1.1.5 The plant shall have minimum 2 Nos. of Digester.

1.1.6 Design factors such as sizing and capacity of the various systems and equipment to take care of the variation in the quality and quantity of Feedstocks / raw materials, and corresponding quality of biogas produced.

1.1.7 All equipment and materials shall be robust, recently manufactured and of a proven technology. Specifically, the same type of equipment should have been in use for more than two years without major breakdowns. Unproven, prototype or first-off equipment or components are not acceptable.

1.1.8 All equipment must be designed according to the specific requirements outlined in the design criteria of this specification.

1.1.9 All equipment must be designed and certified for operation in explosive environments and must be suitable for use in the CBG Plant.

1.1.10 All facilities must be designed for easy assembly, adjustment, and accessibility to ensure regular inspections, maintenance, and cleaning can be performed efficiently. The design should prevent material hang-ups, bridging, and spillage by using smooth surfaces and

appropriate angles, while also providing sufficient space and access points for thorough cleaning and maintenance.

1.1.11 Equipment maintenance access shall be provided by means of platforms, gangways and ladders from where there will be easily access for equipment elements, such as motors, scrapers, hoppers, emergency stop resets and all other susceptible access points during normal operation or maintenance routines. Additional arrangements such as scissor lifts will be accepted for specific difficult access locations.

1.1.12 Equipment shall be standardized, where possible, to facilitate spare parts management.

1.1.13 Safety features such as sirens and signboards shall be provided to warn personnel of plant automatic starting. All low beams (below 2.1 meters) on the steel structure supporting the equipment shall be marked with luminous yellow and black markings.

1.1.14 All non-manual cabins shall be designed ensuring the best possible conditions for working staff health, safety and welfare, reducing the exposure to hazards from other parts of the process, such as:

- Odour
- Bioaerosols
- Noise
- Dust
- Vibrations

1.1.15 Electrical and control panels will be centralized in a specific electrical room, except for those that are directly associated to mechanical equipment.

1.1.16 Provide access and sufficient manoeuvring and clearance areas for mobile equipment (cleaning, maintenance, baled materials handling).

1.1.17 The Plant will have one (1) common access point for cars and trucks with a motorized barrier provided with an intercom associated to the input lanes to allow communication with the guardhouse for trucks and cars. A traffic speed breaker will be implemented before main entrance barrier.

1.1.18 Before the weighbridges, there will be a parking area for trucks (for at least 4 nos. of trucks) for carrying out the spot-checking / inspection of MSW visually.

1.1.19 A guardhouse will be provided for waste trucks as well as cars control access as well as to accommodate the weighbridge operator.

2 Design Philosophy

2.1 Plant Operation Design Philosophy

The proposed CBG Plant shall be designed as per following considerations:

2.1.1 The entire Plant shall be designed taking into account all the possible variations (Daily, Seasonal, Occasional etc.) in Quality and Quantity of the Input of 200 TPD Source Segregated Organic Fraction of Municipal Solid Waste.

2.1.2 The Design of the Pre-feed system (MSW Processing & Pre-Treatment Units) shall have a factor of safety of 30% over and above the rated capacity of 200 TPD Source Segregated Organic Fraction of Municipal Solid Waste (SSOF-MSW). This factor of safety is to ensure that Pre-feed system is capable of handling occasional variations in incoming MSW quantities above 200 TPD.

2.1.3 Processing Units/Equipment shall be designed considering 1-Shift / 2- Shifts / 3-Shifts operation as tabulated below.

2.1.4 Pre-feed system starts from inlet to Infeed Bunker and ends at the inlet of Digestors.

Sl. No.	Description	1st Shift	2nd Shift	3rd Shift
1.	Operation of the CBG Plant:			
A.	SSOF-MSW Processing System	✓	✓	
B.	Organic Extraction System	✓	✓	---
C.	Bio-methanization System	✓	✓	✓
D.	Bio-Gas Upgradation System	✓	✓	✓
E.	Bio-Gas Compression System	✓	✓	✓
F.	Digestate Dewatering System	✓	✓	---
G.	Composting Facility	✓	✓	---
2.	Effluent Treatment Plant (ETP)	✓	✓	✓
A.	Other Activities:			
B.	Scheduled Maintenance of Equipment	---	---	✓
C.	Floor Washing + Vehicle Washing	---	---	✓
D.	Cleaning & Housekeeping	---	---	✓

2.2 SSOF-MSW Processing Unit

The proposed Plant shall be as per the land map enclosed at Annexure- 6 in the RFP Document.

2.2.1 Quantity of Input Waste

Table 1 Quantity of the Input Waste

S. No.	Description	Unit	Design Qty.
1	SSOF-MSW	TPD	200

Table 2 Typical Sample Calculation for arriving at the hourly Capacity of Waste Processing Units / Structure / Equipment / Machinery

Sl. No.	Description	Unit	Value
1	Quantity of Input SSOF-MSW	TPD	200
2	Maximum Processing Time	hr/day	16
3	Capacity required	TPH	12.5 (Minimum)
4	No. of Units provided	No.	1
5	Capacity of each Unit required	TPH	12.5
6	Factor of Safety considered	---	30%
7	Capacity of each Unit required	TPH	16.25 (or closest capacity above the value)

2.3 Site Development

The bidder shall carry out development of the complete infrastructure within the battery limit of the proposed CBG Plant. This shall include, but not limited to the following:

1. Main Gate(s)
2. Internal Roads with Pathways & Storm Water Drains
3. Internal Sewerage/Effluent Network
4. Internal Potable Water Supply and Distribution Network for human usage
5. Internal Service Water Supply and Distribution Network for various non-potable in-Plant usages e.g. Washing, Cleaning etc.
6. Internal Fire Fighting System including Fire Water Tank, Fire Brigade Connection, Fire Hydrant Pumps, Air Cushion Tank, Piping & Valves, Hose Boxes, Hose Reels with Drums, Hose Pipes, Nozzles, Sprinklers, Smoke Detectors, Manual Call Points, Fire Extinguishers, Hooters, Control Panel, Cables, Instruments etc. complete
7. Gardening/Landscaping

2.4 SSOF-MSW Processing Unit - Description & Technical Specifications of the system / units

Input Source Segregated Organic Fraction of Mixed-Municipal Solid Waste collected and transported in Garbage Trucks / Compactors, shall be delivered at the Infeed Bunkers located in the Processing & Pre-Treatment Shed. The Processing & Pre-Treatment Shed shall be an enclosed structure

(Conventional Steel Structure, Pre-Engineered Steel Structure or Self Supported Roofing Structure) containing SSOF-MSW Processing Plant, Pre Treatment Plant, Storage Areas for Rejects / Recyclables / Metals / Grits / Inert etc.

Here, the SSOF-MSW Processing Plant shall typically consist of infeed bunker(s), bag opener + oversize remover(s), metal separator(s), organic extraction system, necessary conveyers etc to separate the organic fraction.

However, the bidder must select suitable systems / equipment based on his proven experience for processing of Source Segregated Organic Fraction of Municipal Solid Waste to separate the organic fraction in an efficient manner.

The separated Organic Fraction shall be sent to the Bio-methanation Plant.

The Recyclables / Rejects / Metals segregated from the SSOF-MSW shall be collected in bins and stored separately for disposal.

3 WEIGHBRIDGE

3.1 General Requirement

3.1.1 The Facility shall have a separate Weighbridges (each for Entry and Exit) for weighing the quantum of municipal solid waste being brought in by individual trucks/compactors.

3.1.2 The weight and the origin/destination of the waste will be automatically registered.

3.1.3 The Weighbridge shall include an electronic, pit type, modular deck Weighbridge with digital Load Cells, electronic Digital Indicator along with Computer Interface. The Weighbridge shall be modular deck with each module made of RSJ Sections and RCC or Steel Deck. Load Cells shall be heavy duty digital Load Cells with high accuracy Load Measuring Gauges, advanced Lightening Protection Circuit and IP68 Junction Boxes. The Weighbridge Indicator shall be digital Indicator with LED Display, Keypad, Real Time Clock, in-built Ports for Computer Interface. Software shall be easy to operate, user friendly program capable of automatic weight transfer to Computer, including customized information like Date, Slip No., Vehicle No., Type of Material, Weight, Location of Collection etc.

3.1.4 Stamping by relevant authorities shall also be included in Bidders scope of work. Stamping at site as per weights & measures act shall be done by the Bidder.

3.1.5 Overload test with 150% (Safe overload 150% and ultimate overload 300%) of specified load and performance test at site shall be conducted by the Bidder.

3.1.6 The Real Time operating System (RTOS) supplied shall be proven, able to support all the equipment/peripherals execute the entire task as stipulated in this specification.

The background executive shall enable software development in time sharing mode by two or more programme simultaneously and shall run/Test any program without making it into an online program.

3.1.7 Utilities like report and display generation, data base management, file handling unit, communication, online system back up, online diagnosis, `screen editor, software development, online debugger and downloader, human machine interface software, log generator, data transfer from magnetic tape to disk and vice versa, test and maintenance program, anti-virus vaccine/detection utility shall be supplied. Licensed copies of operating system and system software shall be supplied.

3.1.8 The PC system must be provided with windows, operated software which should accept weight data from the weighing indicating unit and allow user to enter desired data.

3.1.9 The weight value must be displayed on the P.C. monitor. Display and print out of the following information is essential.

i. For truck weighing: Date with time in and time out of truck, individual weigh bill for each truck with truck number containing the gross, tare and net weight shall be made available. In addition, it shall provide Date wise consolidated report for a given period. It shall also provide Material / product wise, Supplier/Customer wise, Source/destination wise and Transporter / Contractor wise reports.

ii. Additional 4 fields to be provided to allow user to incorporate other information like L.R. No., challan no., invoice no., contractor ref. All data like weight data, supplier data, customer data, material data, vehicle data should be stored in the system hard disc which can be recalled as and when required. Display of such records must be available on the monitor screen.

iii. For all Software supplied by main Bidder or Sub Bidders shall provide access to Purchaser at all levels.

3.1.10 The supply of all field instruments, Load cells, sensors, Junction box, cabling, etc within the battery limit shall be in the Bidder's scope.

3.1.11 Supply of complete Power, control, Instrumentation, special, communication Cable between all the field instruments, Local control panels, JB, Microprocessor based control system, etc is in Bidder scope.

3.1.12 Supply of erection hardware, cable glands, hook up hardware, Cable tray, conduits, cable ties, structure and structure support.

3.1.13 Proper site levelling and drainage to prevent water accumulation. The platform should be constructed from durable materials such as reinforced concrete or steel, with a non-slip surface finish and sufficient load capacity. Structural integrity must be ensured with appropriate support beams and load cells, which should be protected and correctly placed. Approaches and ramps must be constructed with required length, slope, and surface material, providing adequate clearance for vehicle access.

3.1.14 Codes and Standards not indicated in the specification are acceptable subject to approval by the Owner/ Owner's Engineer if they are established to be equal or superior to the standards indicated in the specification. The codes and standards specified are indicative not exhaustive.

3.1.15 Surface Preparation and the Painting of the weigh bridge unit shall be as per this Specification Data Sheet. However, in case vendor wants to follow his own standard painting procedure, he shall submit his painting procedure along with his offer for review and acceptance by the Owner / Owner's Engineer.

3.2 Data Sheet - Weighbridge

3.2.1 The below datasheet/table outlines the minimum requirements for the Weighbridge system. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Weighbridge system complete and efficient shall also fall under the bidder's scope of work.

3.2.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Weigh bridge System (Full set)		Pit less type of microprocessor-based Road Weigh Bridge	
B.	Quantity & Capacity	Nos.	Weighbridge - Quantity 1 No. (with a provision of space to install 1 no. in future by the Owner) Capacity - 50 Tonnes Platform Dimensions - 3m x 12m Type of trucks / trailers for weighment: All types (up to 35 MT)	
C.	Maintenance Tools & tackles kit	Set	1 set to be supplied in a separate steel toolbox.	
2.	**Design Requirement**			
A.	Type of Service (outdoor or indoor)	-	Outdoor	
B.	Weighing Capacity - Gross	MT	Capacity - 50 Tonnes Platform Dimensions - 3m x 12m	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
C.	No. of trucks / trailers for weighment	-	Minimum 200 trucks / tractor trailers per day	
D.	Type of trucks / trailers for weighment	-	All types (up to 35 MT)	
E.	Maximum safe overload protection Without electrical damage	-	150% of rated capacity	
F.	Maximum load for mechanical damage	-	300% of rated capacity	
G.	Load cells type	-	Rocker pin (Compression type) / Shear beam type/ equivalent	
H.	Load cells protection	-	IP 68 and tested by a national test house and also have overload parameters	
I.	Number of Load cells per weigh bridge	Nos.	6 nos. (min) of Load cells or as per OEM's recommendation. Each with rating of maximum safe overload capacity. Suitable compensation must be built for temperature variation.	
J.	Minimum capacity of each load cell	-	2 X Capacity of weigh scale / number of load cells	
K.	Accuracy	%	Corresponding to OIML accuracy class C3	
L.	Repeatability		< ±0.010 % FSO	
M.	Minimum Graduation (Resolution)	kg	10	
N.	Load cell: Rated output	mV/V	1 to 3 mV/V or better	
O.	Combined Error	%	0.05% of rated output (maximum)	
P.	Hysteresis	%	0.05% of rated output (maximum)	
Q.	Slide Load Allowed	%	10% of rated load	
R.	Creep a) After 0.5 hours b) After 4 hours	%	 0.03% of rated output (maximum) 0.05% of rated output (maximum)	
S.	Zero Balance	%	±1% of rated output	
T.	Max. Temp. Range	°C	-2 to 70	
U.	Compensated Range	°C	10 to 50 (min.)	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
V.	Enclosure	-	IP 67/DIN 40050; completely waterproof; insensitive to vibration; lightning protected as per Indian Electricity Rules; welded stainless steel housing	
W.	System Interface	-	The Weigh Bridge Microprocessor based control system shall be interfaced with the Owner's control system. Consider Modbus RS485 output from weigh bridge control system Also consider Analog hardwired output from weigh bridge control system.	
X.	Relative Humidity	%	As per the site data	
Y.	Rated Voltage	V	As per the site data	
Z.	Operating Frequency	Hz	As per the site data	
AA.	Sound pressure level Lp (distance: <1m)	dB	≤ 85	
3.	**Constructional & Operational Features, Mountings & Fixtures**			
A.	Technology	-	Microcontroller based control system shall be capable of communicating remotely with backlit LCD display for local weight indication.	
B.	Platform MOC	-	Anti-skid steel	
C.	Visual display unit	-	Yes, based on SMT technology to be provided in weight indicator.	
D.	Totaliser	-	Yes, minimum 6-digit type to be provided in the weight indicator.	
E.	Weighing equipment	-	Desk top type and compact should be suitable for dusty, hot, humid conditions without an air conditioner.	
F.	Digital weight indicator	-	At least 20 mm high character display for backlit LCD display.	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
G.	Display modes	-	Weight and 16 mm for messages with a) Indicate weight b) Indicate calibration – Calibration to be checked automatically every 5 minutes.	
H.	Display of keyboard entered values	-	*	
I.	Protection	-	From electromagnetic and radio interference	
J.	Auto calibration	-	Calibrations check facility to be provided	
K.	Digital filtering system	-	To ensure correct weighment when weighing oscillatory loads	
L.	Annunciators	-	To indicate over capacity	
M.	Front panel controls	-	For balance, lamp test, semi auto tare, cancel tare and key board enable	
N.	Automatic, manual tare and zero facility	-	To be provided in digital weight indicator Provision for interfacing with a PC	
O.	Weighment & printouts	-	Name of the contractor Date and Time Serial Number Product Code Customer Code Truck Registration Number First (Gross) Weight (i) Second (Tare) Weight (ii) Net (pay load) Weight (iii) LxBxH (m) Weigh slip after every weighment (i.e.) I & II weighments. Real time clock required to provide date and time to printer. Facility for totalising the different material received.	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
P.	Weighbridge local Control Room.	-	Non-Air-conditioned	
Q.	Side post and post marking at entry and exit of weigh platform	-	Yes.	
R.	Operation, Monitoring and control of weigh bridge	-	Microprocessor based control system in weigh bridge control room consist of Processor, I/O modules, redundant communication modules, power supply modules, ethernet switches, relays, patch cords, communication cables, etc.	
S.	Test weight for calibration	-	Provided by bidder	
T.	Software	-	Supply and installation of Software for weighing, indicating and recording with perpetual license	
U.	Panel	-	1) A fully wired panel for housing all the electronics and located in the weigh bridge control room. 2) All the Standalone Panel shall be provided with Base frame and Anti vibration pad	
V.	Features for weigh electronic system (panel mounted)	-	Having the following minimum features but not limited to Analogue to digital converter enabling flicker free display Automatic Zero span calibration Auto balance Diagnostics load cell connectors Large LCD 10" graphical display Weight indicator Interface with PC Accepting digital input and providing digital output Providing Analog output	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
W.	To avoid vibration and distortion	-	Weigh bridge shall be supplied with arrangement and arresters to restrict the platform motion in longitudinal and lateral directions.	
X.	Load cell	-	SS 304, IP 68 protection or higher, hermetically sealed through electro-plasma welding, Compression load cell, built in surge protection.	
Y.	Positioning of Vehicles	-	Supply of Sensing equipment (design & equipment details to be provided by bidder).	
Z.	UPS system	-	UPS with Battery & stabilizer for the complete control system and instrumentation with sufficient capacity.	
AA.	Battery Backup duration	-	1 hour at nominal load.	
BB.	Earthing	-	Yes Supply of earthing cables as required for the complete system is in Bidder scope up to Electrical and Electronic earth pit is in Bidder scope	
CC.	Earthing material	-	Galvanised steel / Aluminium cables	
DD.	Earth resistivity of the system	ohm	> 1	
EE.	Material of Construction for: Main Beam Cross Beam Transverse Beam Chequered Plate	-	Mid Steel as per IS 2062 Gr B or better	
FF.	Heavy duty guide rails with Crash barrier on both sides of weighbridge	-	Yes. Surface mounted.	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
GG.	Guide rail - Coating	-	Epoxy yellow paint for visibility and corrosion resistance.	
HH.	Data backup	-	The system should maintain backup data in a specified path, either on a network or local system, to be used during failures or breakdowns. Backup data should also be provided on removable storage devices such as CDs and USB drives for manual backup operations. There should be provisions for recovering the software and database from these backups to ensure uninterrupted operation. The system must be capable of storing weigh records for a minimum period of 12 months, with the necessary hardware facilities built into the computer to support this requirement.	
4.	**Testing & Inspection**		In addition to full visual examination, System shall meet the listed following requirements.	
A.	Zero Load Test	-	Yes	
B.	Electronic Weighbridges Accuracy Test	-	Yes	
C.	Graduations of Notches Test	-	Yes	
D.	Balance Range Test	-	Yes	
E.	Span Test	-	Yes	
F.	Corner Test	-	Yes	
G.	Linearity and Hysteresis Test	-	Yes	
H.	Repeatability Test	-	Yes	
I.	Temperature Variation Test	-	Yes	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
J.	Electrical Interference Test	-	Yes	
K.	Material Test Certificate	-	Yes	
L.	Shop Test Certificates	-	Yes	
M.	Performance Test Certificates	-	Yes	
5.	Performance Guarantees		Weigh bridge along with its control shall be guaranteed for the rated capacity and accuracy for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
A.	Weighing capacity	MT	*	
B.	Accuracy	kg	Corresponding to OIML accuracy class C3	
6.	**Surface Preparation and Painting**		Painting shall be suitable for protecting the equipment as per the site condition.	
A.	Service life	-	25 years (minimum)	
B.	Equipment/ structures which are exposed to atmosphere	-	C4 category as per ISO 12944-2.	
C.	Equipment/structures which are covered by sheeting /brickwork	-	C3 category as per ISO 12944-2.	
7.	**Drawings & Documents to be submitted during detailed engineering stage**			
A.	GA drawing of weigh bridge with all the mountings & accessories	-	Yes	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	
D.	Materials test Certificates	-	Yes	
E.	Test certificates / reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

3.2.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope. The Weigh bridge should be stamped and approved from Weights & Measures department of the state.

4 INFEED BUNKER

4.1 Design Requirement

4.1.1 Input SSOF-MSW, collected and transported in Garbage Trucks / Compactors / shall be directly unloaded into the Infeed Bunker, specially designed to handle SSOF-MSW. It shall have adequate storage volume.

4.1.2 Also, it shall be provided with three (3) numbers of horizontal Screws at the bottom for mixing and one (1) number of inclined Screw for discharge of the waste to the downstream Organic Extraction System for further processing.

4.2 Datasheet - Infeed Bunker

4.2.1 The below datasheet/table outlines the minimum requirements for the Infeed Bunker (SSOF-MSW) system. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Infeed Bunker (SSOF-MSW) system complete and efficient shall also fall under the bidder's scope of work.

4.2.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Infeed Bunker Complete with the required accessories, supports etc.	
2.	Input Material	-	Input SSOF-MSW to the plant	
3.	Quantity of Input Material	TPD	200 (min.)	
4.	Bulk Density of Input Material	kg/m^3	700-800	
5.	Processing Time	Hr./day	16 (max.)	
6.	No. of Units to be provided	-	*	
7.	Throughput Rate of each Unit	TPD	*	
8.	Storage Time of each unit	Minutes	*	
9.	Volume of each Unit	m^3	*	
10.	Dimension of each Unit	-	*	
11.	Material of Construction:			
A	Support Legs, Base Frame	-	Stainless Steel AISI 304	
B	Body and Side Plates etc.	-	Stainless Steel AISI 304	
C	Screws	-	Stainless Steel AISI 304	
12.	Drawings & Documents to be submitted during detailed engineering stage			

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
A	GA drawing with all the mountings & accessories	-	Yes	
B	Technical Data Sheets	-	Yes	
C	Manufacturer's standard quality plan	-	Yes	
D	Materials test Certificates	-	Yes	
E	Test certificates / reports for various shop test conducted	-	Yes	
F	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

4.2.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

5 PRETREATMENT SYSTEM

5.1 Pretreatment Unit - General Requirement

The Pre-Treatment unit is intended to receive the separated Organic Fraction from the MSW Processing Plant, to extract the bio-digestible organics, to prepare the organic slurry by adding the required water, and to feed the organic slurry with the correct consistency and composition to the digestors. Here, the Pretreatment Plant shall typically consist of intermediate feed bunker(s), organic extraction system, metal separator(s), density separator(s) (wind sifter), rejects dewatering unit (screw press), grit / inert removal system, buffer tanks, slurry feed pumps, necessary conveyers, piping etc, to extract, prepare and feed the bio-digestible organics to the digestors.

However, the bidder must select suitable systems / equipment based on his proven experience for extraction and feeding of bio-digestible organics to the digestors, in an efficient manner.

Slurry Feeding – Proper slurry feeding methods and transfer pumps should be implemented before feeding the digesters to ensure the waste slurry is properly prepared for efficient treatment, with the correct consistency and composition.

5.1.1 Feed transfer pumps: Used for pumping the well mixed slurry, now containing both waste and water to the digesters.

5.1.2 The well-mixed slurry is transferred to the digesters, wherein, anaerobic digestion takes place to generate raw biogas.

6 ORGANIC EXTRACTION SYSTEM

6.1 Design Requirement

Output from the above Infeed Bunkers shall be fed into the Organic Extraction System. Service Water shall be added as per the requirement. The Organic Extraction System shall consist of Organic Extractor, Iron Separator, Wind Sifter and Screw Press as described below:

6.1.1 The Organic Extractor will separate the waste into two fractions – Organic Slurry and Inorganic Reject. The Organic Slurry (Substrate) shall be pumped to the downstream Grit Removal System for removal of sand/grit, whereas the Reject shall be taken to the downstream Wind Sifter.

6.1.2 All material transfer operations within the Organic Extraction System shall be carried out through enclosed/covered screw conveyors designed to prevent spillage, odour emission, dust generation, littering, vector nuisance, and ingress of rainwater during material handling and transfer operations.

6.1.3 The Iron Separator (Permanent Magnet) shall remover ferro-magnetic materials from the Reject Stream. It shall be so installed as to drop the collected metal pieces directly into the Bin below from where the same can be stored in the Recyclable Storage Area for later resale/reuse to the Metal Vendors.

6.1.4 The Wind Sifter will separate contaminants from the Reject (Plastic) with the use of an adjustable air stream. The light materials (Plastic) shall be blown over the Splitter Drum and conveyed to the downstream Screw Press. The heavy contaminants shall fall through the airflow and be returned to the Organic Extractor for further extraction of organic.

6.1.5 The Screw Press will squeeze out moisture from the Reject (Plastic). The squeezed-out Reject (Plastic) shall be conveyed to RDF Storage Facility for further disposal to the nearby Cement Plants for co-processing.

6.2 Datasheet - Organic Extraction system

6.2.1 The below datasheet/table outlines the minimum requirements for the Organic Extraction system However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Organic Extraction system complete and efficient shall also fall under the bidder's scope of work.

6.2.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Organic Extraction System comprising Organic Extractor, Organic Slurry (Substrate) Transfer Pump, Iron Separator, Reject Wind Sifter, Screw Press, Interconnecting Belt & Screw Conveyors, Staircase & Maintenance Platform, Electrical cum Control Panel with Profibus/Profinet Interface and all other Accessories etc. complete	
2.	Input Material	-	SSOF-MSW	
3.	Quantity of Input Material	TPD	200 (min)	
4.	Bulk Density of Input Material	kg/m^3	500 – 1000	
5.	Processing Time	hr/day	16 (max.)	
6.	No. of Units to be provided	No.	*	
7.	Throughput Rate of each unit	TPH	*	
8.	Material of Construction:			
A	Organic Extractor:			
•	Body/ Protection Material	-	Stainless Steel AISI 304	
•	Hammer Knives	-	Tempered Steel as per EN10025	
•	Screen Elements	-	Stainless Steel AISI 304	
B	Iron Separator:			
•	Support Legs, Base Frame	-	Structural Steel S235 as per EN 10025	
•	Body and Side Plates etc.	-	Structural Steel S235 as per EN 10025	
C	Wind Sifter:			
•	Body	-	Stainless Steel AISI 304	
•	Construction Parts	-	Stainless Steel AISI 304	
D	Screw Press:			

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
•	Body	-	Stainless Steel AISI 304	
•	Screw	-	Stainless Steel AISI 304	
•	Other Construction Parts /Guards	-	Stainless Steel AISI 304	
E	Screw Conveyors:			
•	Body	-	Stainless Steel AISI 304	
•	Screw	-	Stainless Steel AISI 304	
9.	Drawings & Documents to be submitted during detailed engineering stage			
A	GA drawing with all the mountings & accessories	-	Yes	
B	Technical Data Sheets	-	Yes	
C	Manufacturer's standard quality plan	-	Yes	
D	Materials test Certificates	-	Yes	
E	Test certificates / reports for various shop test conducted	-	Yes	
F	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

6.2.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

7 GRIT REMOVAL SYSTEM

7.1 Design Requirement

7.1.1 The Organic Slurry from Organic Extraction System shall be pumped to the Grit Removal System for removal of sand/grit, prior to feeding the same to the anaerobic Digesters. The de-gritted substrate shall be pumped to the Bio-methanization System for bio-methanization whereas Glass/Sand/Grit/Stone etc. shall be stored in the Storage Area for further disposal of the Sanitary Landfill Facility (SLF) by OIL.

7.2 Datasheet - Grit Removal system

7.2.1 The below datasheet/table outlines the minimum requirements for the Grit Removal system However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Grit Removal system complete and efficient shall also fall under the bidder's scope of work.

7.2.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Grit Removal System including Grit Extraction System, Grit Washing	
2.	Input Material	-	Organic Slurry from Organic Extraction System	
3.	Quantity of Input Material	m^3/day	*	
4.	Processing Time	hr/day	16 (max.)	
5.	No. of Units to be provided	-	*	
6.	Throughput Rate of each unit	-	*	
7.	Drawings & Documents to be submitted during detailed engineering stage			
A	GA drawing with all the mountings & accessories	-	Yes	
B	Technical Data Sheets	-	Yes	
C	Manufacturer's standard quality plan	-	Yes	

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
D	Materials test Certificates	-	Yes	
E	Test certificates / reports for various shop test conducted	-	Yes	
F	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

7.2.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

8 BIO-METHANIZATION SYSTEM

The de-gritted Organic Slurry from Grit Removal System shall be taken to the Bio-methanization System consisting of Buffer Tank followed by Anaerobic Digesters. The Bio-methanization consists of Buffer Tank, Buffer Tank Feed Pumps, Digester, Digester Feed Pumps, Bio-Gas Holders and Bio-Gas Flaring System.

8.1 Datasheet - Buffer Tanks

8.1.1 The below datasheet/table outlines the minimum requirements for the Buffer Tanks. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Buffer Tanks complete and efficient shall also fall under the bidder's scope of work.

8.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	Input Material	-	De-gritted Organic Slurry (Substrate) from Grit Removal System	
2.	Quantity of Input			

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
	Material	m^3/day	*	
3.	Dry Solids in Input Material	%	*	
4.	Hydraulic Retention Time	days	1 (minimum)	
5.	No. of Tanks	No.	1 (minimum)	
6.	Dimension (Length*Width) of each Tank	-	As per bidder's design	
7.	Liquid Depth of each tank	-	As per bidder's design	
8.	Free Board of each tank	m	0.50 (min.)	
9.	Volume of each Tank	-	As per bidder's design	
10.	Material of Construction:			
	Tank	-	RCC M30 with Polyurethane Coating of 1150 – 1300-micron DFT or Glass-Fused-to-Steel (Glass-Lined-Steel)	
	Staircase, Walkway/Platform	-	RCC M30 or Structural Steel	
11.	Drawings & Documents to be submitted during detailed engineering stage			
A	GA drawing with all the mountings & accessories	-	Yes	
B	Technical Data Sheets	-	Yes	
C	Manufacturer's standard quality plan	-	Yes	
D	Materials test Certificates	-	Yes	
E	Test certificates / reports for various shop test conducted	-	Yes	

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
F	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

8.1.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

9 BUFFER TANK FEED PUMP

9.1 Design requirement

9.1.1 The de-gritted Organic Slurry (Substrate) from Grit Removal System shall be pumped to the Buffer Tanks by positive displacement type eccentric Screw Pumps suitable for handling substrate having 10-12% solids consistency. Each Pump shall be provided with Base Frame, Helical Gear Motor, Variable Frequency Drive, Temperature Control Unit for Stator and Pressure Indicator.

9.2 Datasheet - Buffer Tank Feed Pump

9.2.1 The below datasheet/table outlines the minimum requirements for the Buffer Tank Feed Pump. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Buffer Tank Feed Pump complete and efficient shall also fall under the bidder's scope of work.

9.2.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Pump including Base Frame, Helical Gear Motor, Temperature Control Unit for the Stator and all other Accessories complete	

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
2.	Input Material	-	De-gritted Organic Slurry (Substrate) from Grit Removal System	
3.	Quantity of Input Material	m^3/day	*	
4.	Dry Solids in Input Material	%	*	
5.	Pumping Time	hours	16 (max.)	
6.	No. of Units	-	As per bidder's design including Store Standby) (min.)	
7.	Type	-	Positive displacement types of eccentric Screw Pump	
8.	Capacity of each Pump	-	*	
9.	Discharge Pressure of each Pump	-	*	
10.	Material of Construction:			
11.	Base Frame	-	Structural Steel as per IS 2062	
12.	Body	-	Cast Iron	
13.	Rotor, Shaft	- -	SS 316	
14.	Stator		NBR, self-aligned	
15.	Drawings & Documents to be submitted during detailed engineering stage			
A	GA drawing with all the mountings & accessories	-	Yes	
B	Technical Data Sheets	-	Yes	
C	Manufacturer's standard quality plan	-	Yes	
D	Materials test Certificates	-	Yes	

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
E	Test certificates / reports for various shop test conducted	-	Yes	
F	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

9.2.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

10 ANAEROBIC DIGESTER

10.1 Design Requirement

10.1.1 The AD technology shall utilize a Continuous Stirred Tank Reactor (CSTR) with a side wall-mounted multiple agitators / top mounted single vertical agitator. This technology must have a proven track record, having been successfully implemented and operated for more than two years post-installation.

10.1.2 The AD system should feature a vertical digester with a top-mounted storage balloon. However, the bidder is encouraged to propose any other proven methods that are suitable for the project, ensuring they meet the design requirements and operational efficiency based on the approval of the Owner.

10.1.3 Digesters shall be Wet Continuous System and Thermophilic Type with adequate Mixing and Heating System. The degradation of organic matter by anaerobic bacteria in bio-chemical reactions (i.e. Hydrolysis, Acidogenesis, Acetogenesis and Methanogenesis) shall generate Biogas, which shall contain 50-70% methane. The Biogas shall be stored in the double membrane type Bio-Gas Holder, anchored on the top of the Digester. After completion of the digestion process, the Digestate shall be produced as a final product, which shall be pumped to the Digestate Dewatering System.

10.1.4 Each Digester shall be provided with Mixers, Heating System, Biogas Holder, Pressure Door, Inlet/Outlet/Sampling Nozzles, Inspection Manhole, Pressure and Vacuum Regulating Valve (PVRV), Rupture Disc, Instruments for Level/Pressure/Temperature, Staircase Platform/Walkway with Handrails and all other Accessories etc. complete.

10.1.5 The AD process shall primarily be designed to operate under thermophilic conditions. However, during the operational stage, it should also be capable of functioning under mesophilic conditions if necessary.

10.1.6 Design of the AD system shall be 30% higher than the rated capacity of 200 TPD of SSOF-MSW CBG plant. The AD system shall be capable of handling SSOF MSW up to 260 TPD

10.1.7 A Hot Water Recirculation System comprising the following shall also be provided for continuous recirculation of Hot Water in the Digester Heating System to main thermophilic condition inside the Digesters shall be provided:

a. A Dual Fuel (High Speed Diesel / Biogas/ Biomass Briquette) Hot Water Generation System including Make-up Water Tank and Pump.
b. Hot Water Recirculation Pumps + Interconnecting Piping, duly insulated with Rockwool (100 K/gm3) + 16 SWG GI Binding Wire + 24 SWG Aluminium Sheet Cladding with self-tapping Screws + Valves.
c. Hydraulic Separator + Distribution Manifold for Hot Water Piping + Expansion Vessel.
d. Associated Instruments (Pressure / Temperature / Calorie etc.)

10.1.8 Circumferential stairs and platforms shall be provided to access the critical components such as pressure valves, monitoring equipment, agitation systems, and manholes of AD.

10.1.9 A ground-level entry point shall be provided suitable for facilitate the digester cleaning. The digesters will also include manholes, Bulleye and inspection windows to allow for regular inspection and maintenance.

10.1.10 The digester's temperature shall be regulated using a circulating water-based heating system. Common Hot water generator or Heat Pump will be provided to heat the circulating water to maintain the required process temperature in the Digestors. This system will utilize either internal heating coils (to heat the internal substrate directly in the digestor) or external pipe type heat exchangers (to heat the circulated substrate).

10.1.11 Adequate insulation must be provided to maintain the required temperature within the digester and enhance energy efficiency, considering the site's climatic conditions.

10.1.12 The AD system shall be equipped with an adequate number of agitation systems to prevent the formation of floating layers, sedimentation of inert materials, and phase separation of the digestate.

10.1.13 All electrical installations and Instruments shall be designed / provided as per Hazardous Area Classification for flammable gas and vapours conforming to IS 5572 and all its latest amendments.

10.1.14 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

10.1.15 A provision for one number additional digester shall be kept in the equipment layout of the plant.

10.2 Datasheet - Anaerobic Digester

10.2.1 The below datasheet/table outlines the minimum requirements for the Anaerobic Digester. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Anaerobic Digester complete and efficient shall also fall under the bidder's scope of work.

10.2.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply			
A.	AD system (full set including all major and minor components)	-	CSTR type - RCC / Steel construction	
B.	Quantity	Nos.	≥2 (as per the design capacity)	
C.	Maintenance tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	
D.	Included accessories	-	• Multiple Side Wall mounted Agitators / Single Top Mounted Vertical agitator with Explosion proof motor-VFD driven and necessary supporting frame. • Digestor top mounted biogas holders / Standalone biogas holders • Blowers for biogas holder • Level transmitter. • Pressure transmitter.	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
			• Pressure vacuum relief valve. • Over pressure & under pressure device. • Temperature transmitter. • Tank heating coils & control arrangement. • Inspection glasses. • Necessary nozzle provisions. • Manholes. • Stairs and platforms.	
2.	**Design Requirement**			
A.	Type of service	-	Outdoor	
B.	Input Material		De-gritted Organic Slurry from Grit Removal System	
C.	AD technology	-	CSTR	
D.	Feedstock supply	-	Similar Type Only	
E.	Tank shape	-	Cylindrical	
F.	Organic fed	-	Biomass slurry from buffer tanks	
G.	Temperature Range	-	Thermophilic / Mesophilic	
H.	pH monitored	-	Yes	
I.	Agitator System	-	Multiple Side Wall mounted Agitators / Single Top Mounted vertical agitator (and hydraulic gas mix system if required)	
J.	Effective Mixing Volume	m^3	*	
K.	Total Tank Volume	m^3	*	
L.	Hydraulic Residence Time	Days	Minimum 3 days excluding Bottom dead storage and Top Free Board – For Hydrolysis Tanks	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
			Minimum 27 days excluding Bottom dead storage and Top Free Board – For digestors (if separate Hydrolysis tanks are provided) Minimum 30 days excluding Bottom dead storage and Top Free Board – For digestors (if no separate Hydrolysis tanks are not provided)	
M.	Organic Loading Rate		*	
N.	Dry matter content	%	*	
O.	Density of Slurry	kg/m^3	*	
P.	pH level of slurry		*	
Q.	Temperature	°C	*	
3.	**Mixer/Agitator Details**	-	Refer Agitator datasheet.	
4.	**Heating Coil**			
A.	Placement of the coil (Inside or outside)	-	Inside	
B.	Material (Pipe, Plate, Elbow, Fastener, Clamp etc.,)	-	≥ Stainless steel 1.4571	
C.	Dimension (OD x thk)	mm	*	
D.	Coil Length	m	* (As per the design)	
5.	**External elements**			
A.	Insulation and cladding (wall)	-	Yes	
B.	Nozzles & Flanges	-	Yes, Bidder to provide a list for main nozzles with size	
C.	Stairs with rails for roof inspection	-	Yes	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
D.	Platform on roof for access to a different element (agitation system, valves, inspection windows, sensors)	-	Yes	
E.	Biogas holder on top (double membrane	-	Yes	
F.	Bull's eye A. Lighting for bull eye B. Lens camera for bull eye	-	Yes	
G.	Monitoring Island, Submerged level	-	Yes	
H.	Thermowell Analog Thermometer	-	Yes	
I.	Max Level watchdog	-	Yes	
J.	Liquid Level sensor	-	Yes	
6.	**Material of Construction**			
A.	Tank		• RCC M30 + Internal PU Coating of 1150-1300 micron DFT in Bio-Gas Storage Area (For RCC Digestors / Hydrolysis tanks); • Glass-Fused-to-Steel (Glass-Lined-Steel) (For Steel Digestors / Hydrolysis tanks)	•
B.	Staircase, Walkway / Platform		RCC M30 or Structural Steel	
C.	• Mixer • Mixer Propeller • Mixer Guidepost		• Structural Steel S235 as per EN 10025 • Stainless Steel AISI 304 • Stainless Steel AISI 304	•

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
	• Mixer Mounting Bracket • Mixer Service Box		• Stainless Steel AISI 304	
D.	Heating Coil in each tank		Stainless steel 1.4571	
E.	Manholes, Nozzles		Stainless Steel AISI 304	
7.	**Assembly Dimension**			
A.	Tank Diameter	m	*	
B.	Liquid Depth	m	*	
C.	Min. operating liquid depth	m	*	
D.	Free Board	m	*	
E.	Total Tank height	m	*	
F.	Gas storage height	m	*	
G.	Gas storage volume	m^3	*	
8.	**Testing & Inspection**			
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	
9.	**Performance Guarantees**	-	Digester along with its components shall be guaranteed for the rated capacity against the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
10.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
11.	**Drawings & Documents to be submitted during detailed engineering stage**			
A.	GA drawing of anaerobic digester, agitator with all the mountings & accessories	-	Yes	
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	
D.	Materials test Certificates	-	Yes	
E.	Test certificates / reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

10.2.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

11 DIGESTER FEED PUMPS

11.1 Design Requirement

11.1.1 The De-gritted Organic Slurry (Substrate) from Buffer Tanks shall be pumped to the Digesters by positive displacement type eccentric Screw Pumps suitable for handling substrate having 10-12% solids consistency. Each Pump shall be provided with Base

Frame, Helical Gear Motor, Variable Frequency Drive, Temperature Control Unit for Stator and Pressure Indicator.

11.2 Datasheet - Digester Feed Pumps

11.2.1 The below datasheet/table outlines the minimum requirements for the Digester Feed Pumps. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Digester Feed Pumps complete and efficient shall also fall under the bidder's scope of work.

11.2.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Pumps	-	Progressive Cavity Pump (Flooded Suction)	
B.	Quantity	Nos.	*As per the design and 1No. redundancy	
C.	Maintenance tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	
D.	Included accessories	-	Yes	
2.	**Design Requirement**			
A.	Type of Service (outdoor or indoor)	-	*	
B.	Location/Application	-	*Based on the design Slurry application 1. Feeding pumps for digester tank 2. Discharging pumps for digester tank 3. Recirculation pumps for digester tank 4. Feeding pumps for liquid digestate tank 5. Discharging pumps for liquid digestate tank 6. Feeding pumps for solid liquid separators	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
C.	Solid size	mm	*	
D.	Solid content in slurry	%	*	
E.	Capacity (Flow rate)	m^3/h	*	
F.	Suction pressure	-	Flooded	
G.	Operating temperature	°C	*	
H.	Design Temperature	°C	60	
I.	Discharge pressure	bar	*	
J.	Viscosity	Cps	*	
K.	Density	Kg/m^3	*	
L.	Differential Pressure	bar	*	
M.	Net Positive Suction Head	mLC	*	
N.	Vol./Mech./Overall Efficiency	%	*	
O.	Sound Power Level (1.5 m height from the equipment)	dBA	<85	
P.	Direction of Rotation from DE	-	*	
3.	**Motor**			
A.	Type		Squirrel Cage Induction	
B.	Make & Model		*	
C.	Efficiency Class		≥IE-2	
D.	Voltage and frequency	V & Hz	As per site condition	
E.	Motor Pole		*	
F.	Operating power	kW	*	
G.	Rated Power	kW	*	
H.	Rotation Speed	RPM	≤ 150 (to avoid excess wear caused by abrasive material such as sand, glass etc)	
I.	Gear transmission Ratio			
J.	Motor Enclosure		≥IP 55	
K.	Insulation Class		≥F - Temp. rise limited to Class B	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
L.	Area Classification		*	
M.	Lubrication	-	*	
N.	VFD	-	* As per design	
4.	**Material of Construction**			
A.	Pump Housing	-	Cast Iron	
B.	Rotating Parts	-	≥SS304	
C.	Rotor	-	≥SS304	
D.	Stator	-	*	
E.	Shaft Seal	-	*	
F.	O " Rings	-	*	
G.	Lantern	-	Cast Iron	
H.	Base Plate	-	Mild Steel	
5.	**Pump Construction**			
A.	Suction Flange	-	*	
B.	Discharge Flange	-	*	
C.	Suction Orientation	-	*	
D.	Discharge Orientation	-	*	
E.	Joint Type	-	*	
F.	Specific Standards	-	*	
G.	Special Certifications	-	*	
6.	**Assembly**			
A.	Construction	-	Block Construction	
B.	Coupling Type	-	Block with Plug-in Shaft	
C.	Coupling Guard	-	*	
7.	**Assembly Dimension**			
A.	Length	m	*	
B.	Width	m	*	
C.	Height	m	*	
D.	Weight	kg	*	
8.	**Accessories**			
A.	Dry Running Protection	-	Yes	
B.	Over Pressure Protector	-	Yes	
C.	Control Panel	-	Yes	
D.	Pressure Relief Valve	-	Yes	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
9.	**Protection**			
A.	Earthing	-	Yes	
10.	**Testing & Inspection**			
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	
11.	**Performance Guarantees**	-	Pumping system along with its control shall be guaranteed for the rated capacity against the rated speed of motions and for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
12.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
13.	**Drawings & Documents to be submitted during detailed engineering stage**			
A.	Technical Data Sheets	-	Yes	
B.	Manufacturer's standard quality plan	-	Yes	
C.	Materials test Certificates	-	Yes	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
D.	Test certificates / reports for various shop test conducted	-	Yes	
E.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

12 BIO-GAS HOLDERS

12.1 Design Requirement

12.1.1 Double membrane type Bio-Gas Holder shall be provided at the top of the Digesters/ stand-Alone for storage of Biogas produced in the Digesters. The outer membrane shall protect against climatic conditions. This membrane shall absorb all external loads such as wind, rain, hail and other climatic conditions. The actual gas storage shall be inside and thus protected against atmospheric conditions. The inner membrane shall store Biogas. This membrane shall float between the outer membrane and the brace system in an adjustable height, depending on the filling level. Additionally, a buffer storage system for raw biogas shall be provided with a storage capacity of 4 hours.

12.1.2 Each Bio-Gas Holder shall be provided with Support Air Blowers, Air Inflation System, Bracing System, Air Blower for De-sulphurisation System, Inlet/Outlet Nozzles, Pressure and Vacuum Regulating Valve, Instruments for Level/Pressure and all other Accessories etc. complete.

12.1.3 All electrical installations and Instruments shall be designed / provided as per Hazardous Area Classification for flammable gas and vapours conforming to IS 5572 and all its latest amendments.

12.2 Datasheet - Biogas Holder

12.2.1 The below datasheet/table outlines the minimum requirements for the Biogas Holder. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Biogas Holder complete and efficient shall also fall under the bidder's scope of work.

12.2.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Raw Biogas Holder (Full set)	-	Double membrane (Air membrane & Gas membrane) – Tank Top mounted or Standalone as applicable	
B.	Location	-	Hydrolysis Tanks / Digester tanks and / or Stand-Alone Storage (As per bidder's selection and design)	
C.	Quantity	Nos.	* As per corresponding tank quantity.	
D.	Maintenance Tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	
E.	Included accessories	-	• Blowers with motor. • UPS system. • LT-Ultrasonic • Inspection window • Over pressure & Under pressure valve. • Air regulating valve. • Centre pillar with supporting accessories.	
2.	**Standards & Codes**			
A.	Glass fibre reinforced polyester resin with steel frame	-	IS 12986 (Part 1)	
B.	Testing method for rubber and plastics coated fabrics	-	IS 7016	
3.	**Design Requirement**			
A.	Type of Service (outdoor or indoor)	-	Outdoor	
B.	External Form	-	Semi-spherical	
C.	Storage Capacity	m^3	*	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
D.	Working pressure	mBar	*	
E.	Duration of Storage	Hours	4	
F.	Support system	-	PP support mesh. Webbing with flanges.	
G.	Surface resistance	Ohm	*	
H.	Bleeder resistance	Ohm	*	
I.	UV resistance	-	*	
J.	Flame Retardant	mm/min	*	
4.	**Air Membrane (outer layer)**			
A.	Fabric Type	-	• PVDF lacquer polyester fabric with PVC coating on both sides. • The fabric will have flame retardancy certification: DIN 4102 class B1. • All welds should be entirely carried out by HF (High Frequency) welding.	
B.	Fabric protectivity	-	• UV Resistant • Microbial Resistant • Abrasion Resistant • Flame Retardant	
C.	Tear Strength	N	*	
D.	Tensile Strength	N/5cm	*	
5.	**Gas Membrane (Inner layer)**			
A.	Fabric Type	-	• PVDF lacquer polyester fabric with PVC coating on both sides. • The fabric will have flame retardancy certification: DIN 4102 class B1. • All welds should be entirely carried out by HF welding.	
B.	Fabric protectivity	-	• Microbial Resistant • Abrasion Resistant	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
			• Flame Retardant • H_2S and NH_3 resistance	
C.	Permeability	$cm^3/m^2/day$	*	
D.	H_2S and NH_3 resistance	ppm	*	
E.	Tear Strength	N	*	
F.	Tensile Strength	N/5cm	*	
6.	**Protection & Control**			
A.	Ultrasonic Level Transmitter	-	Yes	
B.	Inspection Window	-	Yes	
C.	Pressure Sensor	-	Yes	
7.	**Air delivery system (Air Blower)**			
A.	Air Blowers	-	For filling outer membrane with Flame proof motor.	
B.	Quantity	Nos.	2 (1W + 1S) for each balloon	
C.	Capacity	m^3/h	* (as per the design)	
D.	Pressure	mbar	*	
E.	Motor power	kW	*	
F.	Voltage & Frequency	V & Hz	*As per plant data	
G.	Protection	-	≥ IP55	
H.	Non-return valve	-	Yes	
I.	Flexible hose pipe to connect the air delivery system to the gasholder	-	Yes	
J.	UPS Supply with battery backup	-	Yes	
K.	Battery Backup duration	-	*As per the design	
L.	Mechanical PVRV	-	Yes	
8.	**Air Compressor**		Yes	
A.	Air compressor	-	Flame proof	
B.	Quantity	Nos.	2 (1W + 1S) for each balloon	
C.	UPS Supply with battery backup	-	Yes	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
9.	**Material of Construction**			
A.	Anchoring system - Flanges	-	≥ Laser cut flanges of SS 304	
B.	Anchoring system - Anchors	-	≥ SS 316	
C.	Protection & Control - Air Regulating Valve between air membrane and gas membrane	-	Body: Aluminium Flanges: ≥ SS 304	
D.	Gas Over & Under-Pressure Valve	-	SS 316	
10.	**Assembly Dimension**			
A.	Diameter	m	* (Corresponding to tank diameter)	
B.	Inner Membrane Height	m	*	
C.	Outer Membrane Height	m	*	
D.	Weight	kg	*	
11.	**Testing & Inspection**			
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	
12.	**Performance Guarantees**	-	Biogas holder along with its components shall be guaranteed for the rated capacity against the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
13.	**Drawings & Documents to be submitted during detailed engineering stage**			
A.	GA drawing of raw biogas holder with all the mountings & accessories	-	Yes	
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	
D.	Materials test Certificates	-	Yes	
E.	Test certificates / reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

12.2.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

13 BIO-GAS FLARING SYSTEM

13.1 Design Requirement

13.1.1 The flare system capacity must be designed to handle the maximum hourly production of biogas. Additionally, the system should be capable of flaring the total daily production volume of biogas in case of an emergency.

13.1.2 An automatic Bio-Gas Flaring System comprising Main Flare Burner, Pilot Burner with Pilot Line, Ignition System, Gas Train with Accessories and PLC based Automation System shall be provided for automatic flaring of Biogas in the event of breakdown/maintenance of Biogas Gensets. This Unit is mandatory keeping in view the safety norms for the Plant to prevent any gas pressure build-up in the System.

13.1.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

13.1.4 Bio-Gas Flaring System should strictly be used only in case of emergency and not as a routine practice.

13.2 Datasheet - Bio-Gas Flaring System

13.2.1 The below datasheet/table outlines the minimum requirements for the Bio-Gas Flaring System. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Bio-Gas Flaring System complete and efficient shall also fall under the bidder's scope of work.

13.2.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Biogas flaring unit (Full set including automation)	-	Closed Biogas Flaring System (Elevated flaring). The minimum stack height shall be as per prevailing norms issued by State Pollution Control Board / Central Pollution Control Board with respect to Emissions Discharge from time to time.	
B.	Quantity	No.	1 (min)	
C.	Maintenance Tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	
D.	Included accessories	-	• Main Flare Burner. • Pilot Burner with Pilot Line. • Flame arrestors for main line & pilot line. • HT electrode to spark the gas. • Temperature Sensors. • Ignition System. • Gas Train with Accessories. • Interconnecting Piping.	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
			• Valves and Instrumentation. • PLC based automation system. • Hooter. • Ladder with cage. • Necessary accessories	
2.	**Design Requirement**			
A.	Type of Service (outdoor or indoor)	-	Outdoor	
B.	Type		Auto Ignition	
C.	Design Flow Rate	m^3/h	150% of the Design Bio-Gas Flow (min.)	
D.	Working Flow Rate	m^3/h	*	
E.	Design Pressure	mBar	*	
F.	Working Pressure	mBar	*	
G.	Flare Stack Total Height	m	*	
H.	Combustion Temperature	°C	*	
I.	Control Panel		Weatherproof	
3.	**Flare Burner**			
A.	Make & Model	-	*	
B.	Type	-	Aspirated Type	
C.	Quantity	Nos.	*	
D.	Flow Rate	kg/h	*	
E.	Working Pressure	bar(g)	*	
F.	Line size	NB	*	
G.	Ignition	-	Pilot burner	
4.	**Pilot Burner & Accessories**			
A.	Make & Model	-	*	
B.	Type	-	Aspirator	
C.	Quantity	Nos.	*	
D.	Location	-	Integrated with Flare Burner	
E.	Flow Rate	kg/h	*	
F.	Working Pressure	bar(g)	*	
G.	Line size	NB	*	
H.	Ignition	-	Spark electrode	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
I.	Flame sensing	-	Thermocouple.	
J.	Operation	-	Automatic.	
5.	**Flame Arrestor-Main line**			
A.	Make & Model	-	*	
B.	Type	-	Anti-flash back element	
C.	Flow Rate	kg/h	*	
D.	Working Pressure	bar(g)	*	
E.	Line size	NB	*	
F.	End connection	-	*	
G.	Quantity	Nos	*	
6.	**Flame Arrestor-Pilot line**			
A.	Make & Model	-	*	
B.	Type	-	Anti-flash back element	
C.	Flow Rate	kg/h	*	
D.	Working Pressure	bar(g)	*	
E.	Line size	NB	*	
F.	End connection	-	*	
G.	Quantity	Nos	*	
7.	**Ignition System**			
A.	Make & Model	-	*	
B.	Ignition Electrode	-	Ceramic Electrode	
C.	HT Transformer	-	Yes	
D.	Primary voltage	V	*	
E.	Output voltage	V	*	
F.	Max. current	A	*	
G.	HV Transformer Box	-	Weatherproof Structure Mounted	
H.	Location	-	On Structure	
8.	**Control Valve Assembly (Gas Skid)**			
A.	Butterfly Valve	-	Yes	
B.	Electric Actuated Butterfly Valve (FLAME PROOF)	-	Yes	
C.	Pressure Guage	-	Yes	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
D.	Pilot Burner Gas Line	-	Yes	
E.	Pilot Solenoid Valve (Flame proof)	-	Yes	
F.	Drain Valve	-	Yes	
G.	Pressure Switch (Flame proof)	-	Yes	
H.	Pressure Relief Valve	-	*	
9.	**Moisture Separator**			
A.	Make & Model	-	*	
B.	Type	-	Cylindrical-Impingement	
A.	Size	-	*	
B.	Pressure Side Connection	-	Flange End	
C.	Inlet connection size	DN	*	
D.	Drain connection size	DN	*	
10.	**Derrick Structure**			
A.	Make & Model	-		
B.	Derrick Structure Height	m	*	
C.	Access	-	Ladder with cage.	
11.	**Local Control Panel**			
A.	Make	-	*	
B.	Indication Lamps	-	For flare on/trip, main, pilot valve open/close, Ignition on and fail, power on, Biogas Pressure low alarm and hooter.	
C.	Push Button	-	Flare manual start/stop, Reset, Ignition on/off	
D.	Selectors Switch	-	Flare system Auto/manual selection	
E.	Temperature Indicator/ Controller	-	Temperature controller with set point	
F.	Thermocouple Cable	-	As per flare height	
G.	Panel Protection	-	Weatherproof	
12.	**Protection**			
A.	Earthing	-	Yes	
13.	**Material of Construction**			

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
A.	Flare Burner Assembly	-	≥SS 316	
B.	Pilot Burner	-	≥SS 316	
C.	Main Gas Line Pipe	-	≥SS 304	
D.	Control Valve Assembly (Gas Skid)	-	≥SS 304	
E.	Pilot Gas Line	-	≥SS 304	
F.	Flare tip with shroud	-	SS 304 / SS 316	
G.	Moisture separator	-	SS 304	
14.	**Flare Burner Material of Construction**			
A.	Flare Pipe	-	≥SS 304	
B.	Burner	-	≥SS 316	
C.	Wind shield	-	≥SS 316	
D.	Mounting Flange	-	≥SS 304	
15.	**Flame Arrester**			
A.	Casing	-	≥ SS304	
B.	Element	-	≥ SS316	
C.	Gaskets	-	Teflon	
D.	Flanges	-	≥ SS304	
E.	End Connection	-	Flanged End-ANSI B16.5, 150#	
F.	Nut & Bolts	-	≥SS 304	
16.	**Derrick Structure**		≥Mild Steel Epoxy Painted	
A.	Ladder with the cage	-	Mild Steel Epoxy Painted	
B.	Platform	-	Mild Steel Epoxy Painted	
C.	MOC	-	Mild Steel Epoxy Painted	
D.	Painting	-	Epoxy Painting to all MS parts	
17.	**Assembly Dimension**			
A.	Length	m	*	
B.	Width	m	*	
C.	Height	m	*	
D.	Weight	kg	*	
18.	**Testing & Inspection**			
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
19.	**Performance Guarantees**	-	Flare system along with its control shall be guaranteed for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
20.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
21.	**Drawings & Documents to be submitted during detailed engineering stage**			
A.	GA drawing of flaring system with all the mountings & accessories	-	Yes	
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	
D.	Materials test Certificates	-	Yes	
E.	Test certificates / reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

13.2.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

14 BIO-GAS PURIFICATION AND UPGRADATION SYSTEM

14.1 Design Requirement

14.1.1 The Design Capacity of the purification and upgrading system shall be 130% of the biogas generated and shall be subject to the approval of the Owner. All the rotating equipment / heat exchangers / coolers shall be of 2 x 100% or 3 x 50% capacity.

14.1.2 Biogas, stored in Bio-Gas Holders, shall be passed through Biogas purification System for removal of Hydrogen Sulphide (H2S), Moisture, Carbon Dioxide (CO2) and other impurities.

14.1.3 CO2 removal can be based on any of the following technologies:

- Membrane Separation
- Pressure Swing Absorption
- Any other proven and established technology

14.1.4 The purified Biogas shall meet the specifications as mentioned below:

- Methane (CH_4): 97% minimum
- Carbon Dioxide (CO_2): 3% maximum
- Oxygen (O_2): 0.1% maximum
- Total Sulphur (including H_2S): 10 mg/m3 maximum
- Moisture: 5 mg/m^3 maximum

14.1.5 Also, as per IS 16087:2025, the following shall also be met as minimum standards for CBG generation:

- CBG shall be free from liquid over the entire range of temperature and pressure encountered in Storage and Dispensing System.
- CBG shall be free from particulate matter such as dirt, dust, etc.
- CBG shall be odorized similar to a level found in local distribution (Ref. IS:15319).

14.1.6 The purified Biogas shall be compressed up to 45 bar(g), if required, for injection into the **CGD** Pipeline.

14.1.7 The system proposed by the bidder must be based on proven designs and technology. The bidder should also provide references to plants where the proposed technology is successfully in operation, along with their bid.

14.2 Datasheet - Bio-Gas Purification and Upgradation System

14.2.1 The below datasheet/table outlines the minimum requirements for the Bio-Gas Purification and Upgradation System. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Bio-Gas Purification and Upgradation System complete and efficient shall also fall under the bidder's scope of work.

14.2.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sr. No.	Description	Unit	Remark
1	Design Bio-Gas Flow	Nm^3/hr	130% of Raw Bio Gas Produced
2	Type of Bio-Gas Purification Technology	---	As per bidder's design
3	Scope of Supply:		
	• Bio-Gas Feed Blowers. • Biogas purification System for removal of Hydrogen Sulphide (H_2S) and Carbon Dioxide (CO_2) and moisture. • High-Pressure Compressors (Discharge Pressure: xx bar) if required • CBG injection system at the terminal point within plant boundary for feeding compressed Biogas into CGD network at desired pressure up to 45 bar(g), along with Odorizing system as per **BRS-9** for mixing in CBG. • Interconnecting Piping, Valves, Instruments and all other Accessories etc. complete.		

All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Biogas purification and upgradation system	-	Full system including chemicals and accessories	
B.	Quantity	No.	1 Full set.	
C.	Maintenance Tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	
D.	Included Accessories	-	• Complete instrumentation package, • Pneumatically Actuated change over valves, • Pneumatic Air Compressor,	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
			• Emergency Stop Switches on Big Electric Motors, • Chiller (Water/Air Cooled), Cooling Tower with Water Pumps, • Control panel PLC base with RS 485 connectivity option to DCS, • Spare Module for PLC, Rotameter, • Intermediate Buffer Balloon	
2.	**Codes & Standards**			
I.	**Mechanical**			
A.	Pressure Vessel Design	-	ASME Sec VIII Div. 1	
B.	Piping Design	-	ASME B31.3	
C.	Shell-and-Tube Heat Exchanger	-	TEMA (Tubular Exchanger Manufacturers Association)	
D.	Blowers and Compressors	-	API 617 or ISO 10439	
E.	Storage Tanks	-	API 650 or IS 803	
II.	**Electrical**			
A.	Degrees of Protection (Enclosures)	-	IEC 60529 (IP Ratings)	
B.	Explosion Protection	-	IEC 60079 (ATEX for Hazardous Areas)	
C.	Electrical Installations	-	IEC 60364	
D.	Motor Efficiency	-	IEC 60034 / IE3 or better	
E.	Low-Voltage Switchgear	-	IEC 61439	
F.	Lightning Protection	-	IEC 62305	
G.	Cables for Power and Instrumentation	-	IEC 60228 / IS 7098	
III.	**Instrumentation and Control**			
A.	Gas Composition Analysers	-	ISO 6974 / ISO 6975	
B.	Pressure and Temperature Sensors	-	IEC 60770	
C.	Safety Instrumented Systems	-	IEC 61511	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
D.	SCADA and Automation	-	IEC 62264	
IV.	**Environmental and Safety**			
A.	Noise Emission Standards	-	ISO 3744 (< 85 dB at 1 m distance)	
B.	Environmental Compliance	-	ISO 14001	
C.	Hazardous Waste Management	-	IS 4576	
D.	Venting and Flaring	-	API 521	
3.	**Membrane Requirements for CO2 Removal- Design Requirement**			
A.	Membrane	-	Placed in container	
B.	Membrane Modules	-	Hollow fibre or spiral-wound membranes	
C.	Material of Construction	-	Stainless Steel (AISI 304/316) for components in contact with gas	
D.	Membrane Modules (Three Stages) along with heat exchanger and filtration system	-	Yes	
E.	Assembly membrane container includes	-	Ventilator, Heater, Flow switch LEL detector	
F.	Material of Construction	-	Stainless Steel (AISI 304/316) for components in contact with gas	
G.	Methane purity	%	≥97	
H.	Methane Recovery	%	≥99	
I.	Material (Pipes, Valves)		AISI 304/316	
J.	Pressure control valve biomethane	-	≥ SS316	
K.	Biogas booster Compressor	Nos.	yes	
L.	Online Gas Monitoring System with Analyser for H_2S, CO_2, CH_4 & O_2	-	Yes	
M.	Pressure control valve biomethane	-	*	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
N.	Pressure control valve off gas	-	*	
O.	Pressure safety valves	-	*	
P.	3-way valves and other valves	-	*	
Q.	Rotary Valve skid	-	*	
R.	Raw Biogas Flow Transmitter	Nos	1	
S.	Product Gas Flow Transmitter	Nos	1	
T.	Pressure transmitters	-	*	
U.	Temperature transmitters	-	*	
V.	Online Dew Point meter	Nos	1	
W.	Control and Automation	-	PLC + software placed in membrane container, Separate room for control cabinet (ventilated), Installation and programming control system, Wiring, Touch screen for monitoring, Remote control and monitoring (via internet connection)	
X.	Pressure regulators calibration	-	*	
Y.	Calibration piping	-	*	
Z.	Calibration accessories	-	Yes	
AA.	H_2S Removal system	-	H_2S removal Vessels, H_2S removal media	
BB.	Raw Biogas Suction Pot	Nos	*	
CC.	Dehumidification Unit	-	Yes	
DD.	Roots Blower with VFD & FLP motor	-	Yes	
EE.	Vacuum Pumps with Starter & FLP motor	-	Yes	
FF.	Surge Vessel	Nos.	*	
GG.	Heat Exchanger with moisture separator	-	*	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
HH.	Chilled water Dryer with moisture separator	-	Double-effect type	
II.	Cooling tower fan	Nos.	1	
JJ.	Cooling water circulation pump	-	*	
KK.	Chemicals recycle pumps	-	*	
LL.	Biogas Dryer with interconnected piping and valves	-	Twin Tower	
MM.	Tanks (HDPE)	-	Suitably sized tanks for Scrubber tank, Regenerator tank, Chemical mixing tank, water wash tank, Buffer tank	
NN.	Fine Filters	Nos	*	
OO.	Particulate Filter	-	2x100% considered	
PP.	Connecting piping and wiring	-	*	
QQ.	**Inlet (Raw) Biogas Specification**			
	• Gas Flow Rate	m^3/h	*	
	• Gas Pressure	bar (g)	*	
	• Methane (CH4)	%	*	
	• Carbon Dioxide (CO2)	%	*	
	• Hydrogen Sulphide (H2S)	PPM	*	
	• Moisture (H2O)		Saturated	
	• Nitrogen (N2)	%	*	
	• Oxygen (O2)	%	*	
RR.	**Outlet (Purified) Biogas Specification**			
	• Gas Flow Rate	m^3/h	*	
	• Gas Pressure	bar (g)	*	
	• Methane (CH4)	%	≥97	
	• Carbon Dioxide (CO2)	%	*	
	• Hydrogen Sulphide (H2S)	PPM	*	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
	• Moisture (H2O)	-	Dew point (–) 65 °C	
	• Nitrogen (N2)	%	*	
	• Oxygen (O2)	%	*	
SS.	Pressure control valve off gas	-	≥ SS316	
TT.	Pressure safety valves	-	≥ SS316	
UU.	3-way valves and other valves	-	≥ SS316	
VV.	Connecting piping and wiring (inside container)	-	≥ SS316	
WW.	Compressor Type	-	*	
XX.	Capacity of compressor	m^3/h	*	
4.	**H2S Removal Unit**			
A.	Type	-	Chemical Scrubbers (with NaOH or proprietary chemicals)/ activated carbon/ Iron Oxide-Based Scrubbers/ Biological Scrubbers	
B.	Usage	-	Individually or in combination depending on the specific requirements	
C.	Design Code	-	Non-ASME	
D.	H_2S Loading Capacity	kg H_2S/kg	*	
E.	H_2S scrubbing system with regenerative system.	-	A complete set up to scrub the gas of H_2S. This includes a scrubber, regenerator, ejector, filtration unit for sulphur filtration, intermediate storage tanks, pumps, plumbing and electricals.	
F.	MOC	-	Fiber Reinforced Plastic (FRP)/ Polypropylene (PP)/ Stainless Steel 304	
G.	Tanks	-	HDPE, suitably sized tanks for Scrubber tank, Regenerator	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
			tank, Chemical mixing tank, water wash tank.	
H.	Interconnecting piping	-	HDPE & CPVC	
I.	Operating Temperature	°C	As per the site condition	
J.	Operating Pressure	bar	As per the site condition	
K.	Operating pH	-	*	
L.	Weight	kg	*	
A.	Gas distributors	-	≥ SS316	
B.	Pressure relief valves	-	≥ SS316	
C.	Sample Ports	-	≥ SS316	
M.	Reactor Type for biological scrubbers	-	Fixed film or packed bed	
N.	Auxiliary Equipment for biological scrubbers	-	Nutrient dosing pumps, Blowers, Recirculating pumps, pH adjustment system	
O.	pH control systems	-	*	
P.	Weight	kg	*	
5.	**Moisture Removal Unit**			
A.	Type	-	Chiller-Based Units/Adsorption-Based Dryers/Compression-Expansion Systems	
B.	Usage	-	Individually or in combination depending on the specific requirements	
C.	Dew Point Reduction	°C	As per the site condition	
D.	Moisture removal efficiency	%	≥90	
E.	Media type (Adsorption)	-	Silica Gel, Molecular Sieves	
F.	Feed gas blower Type	-	*	
G.	MOC for blower	-	*	
H.	Blower Capacity	m^3/h	*	
I.	Ignition Protection Class	-	*	
J.	Motor Protection Class	-	IP 55	
K.	Back Drive Control	-	VFD	
L.	Operating Pressure	bar	*	
M.	Biogas cooler	-	Shell and tube heat exchanger	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
N.	Biogas flow meter	-	*	
O.	Biogas dryer	-	*	
P.	Desiccant Type	-	Activated Alumina & Mol. Sieve	
Q.	MOC Internal	-	Stainless Steel	
R.	Moisture Shell	-	Carbon Steel	
S.	Auxiliary Equipment	-	Condensate Collection Trays, Mist Eliminators, Dew Point Sensor.	
T.	ATEX-certified	-	Yes	
6.	**General Requirements**			
A.	Control Systems		Centralized PLC/SCADA system for process automation and monitoring	
B.	Safety Equipment		• Explosion-proof designs for all components. • Safety relief valves and flame arrestors in case of gas leaks	
C.	Maintenance Tools		• Spare parts for all critical components. • Maintenance kits with tools and lubricants for regular servicing	
7.	**Assembly Dimension**			
A.	Platform Length	m	*	
B.	Platform Width	m	*	
C.	Overall Weight	Kg.	*	
D.	Control room size required (L x W x H)	m	*	
8.	**Testing & Inspection**			
A.	Material Test Certificate		Yes	
B.	Performance Test Certificates		Yes	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
C.	Calibration Certificate		Yes	
D.	FAT/SAT		Yes	
9.	**Performance Guarantees**		Purification and Upgradation system along with its control shall be guaranteed for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
10.	**Surface Preparation and Painting**		Painting shall be suitable for protecting the equipment as per the site condition	
11.	**Drawings & Documents to be submitted during detailed engineering stage**			
A.	Technical Data Sheets		Yes	
B.	Manufacturer's standard quality plan		Yes	
C.	Materials test Certificates		Yes	
D.	Test certificates / reports for various shop test conducted		Yes	
E.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)		Yes	

All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

15 ODOUR CONTROL SYSTEM

15.1 Design Requirement

15.1.1 The Contractor shall ensure to bring in control of odour & flies in the premises. They shall use enzyme/bio-cultures based products and dust suppressant which will help to abate the odour and flies' nuisance.

15.1.2 Elimination of any unpleasant odours at the site by directly unloading the feedstock into the infeed bunkers, where it is mixed and homogenized. It is then conveyed to the downstream units using screw conveyors and a high-speed roll up door. Additionally, an odour control system should be installed on each infeed bunker.

15.1.3 An odour Control System, consisting of ventilation fans, ducting, and a bio-filter, will absorb odorous gases like H_2S and NH_3.

15.1.4 The Contractor shall also ensure to install odorization system and as per the standards CBG delivered shall be odorized similar to a level found in local distribution (see IS 15319). Rate of Dosing to be decided by OIL.

15.2 Datasheet - CBG Odourising System

15.2.1 The below datasheet/table outlines the minimum requirements for the CBG Odourising System. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the CBG Odourising System complete and efficient shall also fall under the bidder's scope of work.

15.2.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Odouriser	-	Complete odorizing system	
B.	Quantity	Nos.	*	
C.	Maintenance tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	
D.	Included accessories	-	• Chemical injection pump - pneumatic pump • Level gauge and transmitter • Rotameter • Electronic unit controller • Pressure gauge • Pressure regulator • Flame arrester • Vero meter	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
			• Odorant filter • Odorant storage tank • Flame control panel • Scrubber	
2.	**Design Requirement**			
A.	Odorant injection rate	mg/smc	*	
B.	Operating pressure	bar	*	
C.	Pump displacement	cc/stroke	*	
D.	Odorant density	g/cc	*	
E.	Odorant storage tank capacity	L	250	
F.	Scrubber material	-	*	
G.	Tubing outer diameter	mm	*	
H.	Pump quantity	Nos.	*	
3.	**Materials of Construction for Valves and fittings**			
A.	Odorant injection connection material	-	SS 316	
B.	Reducing union	-	SS 316	
C.	Ball valve (for biogas line)	-	SS 316	
D.	Female connector	-	SS 316	
E.	Male branch tee	-	SS 316	
F.	Equal tee	-	SS 316	
G.	Ball valve (for instrument air line)	-	SS 316	
H.	Flange	-	SS 316	
I.	Tubes and fittings	-	SS 316	
J.	Pump material	-	SS 316	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
4.	**Assembly Dimension**			
	Length	m	*	
	Width	m	*	
	Height	m	*	
	Weight	kg	*	
5.	**Performance Guarantee**	-	Odorizing system along with its control shall be guaranteed for the rated capacity for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
6.	**Drawings to be submitted**			
A.	GA drawing of the odorizing system with all the mountings & accessories	-	Yes	
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	
D.	Materials test Certificates	-	Yes	
E.	Test certificates / reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

16 COMPRESSED BIO-GAS (CBG) SYSTEM

16.1 Design Requirement

16.1.1 The compressor system shall be compatible with the designed purification system outlet pressure. The bidder shall provide a necessary booster compressor system if required.

16.1.2 The bidder shall supply compressor systems designed for operation in a biogas production environment, capable of achieving an outlet pressure up to 45 bar (g) for injection into the CGD pipeline.

16.1.3 A necessary odorizing system shall be provided to odorize the compressed biogas for distribution.

16.1.4 The bidder shall ensure that the biogas compression filling unit meets the statutory requirements of PESO and other government regulations.

16.1.5 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

16.2 Datasheet - Compressed Biogas System

16.2.1 The below datasheet/table outlines the minimum requirements for the Compressed Biogas System. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Compressed Biogas System complete and efficient shall also fall under the bidder's scope of work.

16.2.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Compressor system (Full set)	-	Positive displacement compressor mounted on skid	
B.	Quantity (with redundancy)	Nos.	*	
C.	Maintenance tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	
D.	Included accessories	-	• Frame oil lubrication • Closed cooling water system incl. air/water cooled heat exchanger	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
			• Pulsation dampener on suction side • Pulsation dampener on discharge side • Suction strainer • Non-return valve • Bypass Valves • Safety valves • Instrumentation and control cabinet • Gas piping • Frequency converter • CO2 flooding system • Compressor enclosure	
2.	**Codes & Standards**			
A.	Compressor design, materials manufacture, inspection and testing	-	≥ISO 13631	
B.	Design of compressor pulsation dampener	-	≥API 618	
C.	Design of cooling system for lubricating oil	-	≥ISO 10438-3	
D.	Design of compressor foundation	-	≥BS CP 2012-1	
E.	RTD (temperature measuring)	-	≥EN 60751	
F.	Pressure and differential pressure instruments	-	≥EN 837	
G.	Plant piping	-	≥ASME B31.3	
H.	Pipe flanges and pipe fittings	-	≥ANSI B 16.5	
I.	Injection of CBG into CGD pipeline network	-	≥OISD-STD-226	
J.	For compression, storing, handling and refuelling of CBG in cascades	-	≥OISD-STD-179	
K.	Cascading and storage	-	Gas cylinder rules, 2016 (PESO)	
3.	**Design Requirement**			

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
A.	Type of service (outdoor or indoor)	-	*	
B.	Type	-	Reciprocating	
C.	Make	-	*	
D.	Fluid Properties	-	CH_4: ≥ 97 % Other impurities: ≤ 3%	
E.	Flow Rate	Sm^3/hr	*	
F.	Service	-	Continuous (24 hrs/day)	
G.	Capacity flow variation	(%)	-/+ 5 (as per ISO1217)	
H.	Turndown ratio	%	*	
I.	Suction pressure	Bar(g)	*	
J.	Outlet pressure	Bar(g)	50	
K.	Suction/Discharge temperature	°C	*	
L.	Cooling type (water-cooled or air-cooled)	-	*	
M.	Drive	-	Direct-driven, VFD	
N.	No. of stages	Nos.	*	
O.	No. of cylinders	Nos.	*	
P.	Compressor motor rating	kW	*	
Q.	Blower rating	kW	*	
R.	Electrical motor	-	Flame proof induction motor	
S.	Noise level	dB	<85 (at 1m)	
T.	Speed	RPM	*	
U.	Oil for lubrication	-	*	
V.	Oil at the outlet	ppm	*	
W.	Lubrication type	-	Forced-feed (oil pump)	
X.	Auxiliary oil pump driver	-	Electric motor	
Y.	Suction gas strainer	-	≥SS (150 micron)	
Z.	Enclosures	-	*	
4.	**Piping**		Refer piping material specification	
5.	**Material of Construction**			
A.	Crank shaft	-	Forget Alloy Steel	
B.	Piston	-	Alloy Steel	
C.	Blower Shaft	-	Forging EN 24	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
D.	Rotor	-	FG 260	
6.	**Compressor Skid**			
A.	Compressor skid (metal frame)	-	* According to the weights of compressor and its auxiliaries and such that the skid is compatible with the foundation	
B.	Compressor skid foundation	-	Block foundation (concrete foundation)	
C.	Non-return valve	Nos.	* (at the final discharge)	
D.	Ball valve	Nos.	*	
E.	Blow off valve	Nos.	*	
F.	Isolating valve	Nos.	* (at inlet and outlet for maintenance & emergency, shall be both manual and automatic)	
G.	Pressure gauge quantity	Nos.	*	
H.	Over pressure limit	%	30	
I.	Temperature sensor quantity	Nos.	*	
J.	Lead type for RTD	-	3-wire RTD (simplex)	
K.	Material of RTD	-	Pt 100 (complying IEC 751 standard)	
L.	Mass flow meter quantity	Nos.	* (at inlet and outlet)	
M.	Gas detector	Nos.	*	
N.	Gas detector type	-	IR absorption with < 5 sec response time	
O.	Flame detector	Nos.	*	
P.	Flame detector type	-	UV/IR with spectral range over 185-260 nm.	
Q.	Spark arrester	Nos.	At the vent line	
7.	**Instrumentation**			
A.	Temperature sensor type	-	RTD	
B.	Pressure and differential pressure	-	At compressor inlet and outlet	
C.	Mass Flow meter	-	Yes (Coriolis type)	
D.	Pressure and Temperature Indication on gauge panel	-	Yes (both suction and final discharge)	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
E.	Pressure and Temperature transmitter at each stage	-	Yes (both suction and discharge)	
F.	Oil Pressure Indicator	-	Yes	
G.	Bull's eye type crankcase oil level indicator	-	Yes	
H.	Pressure gauge at gas recovery vessel	-	Yes	
I.	Vibration switch for compressor	-	Yes	
J.	Safety relief valve on each stage	-	Yes	
8.	**Controls**			
A.	Fault control of Low Lube oil pressure	-	Yes	
B.	Fault control of High discharge gas temperature at each stage	-	Yes	
C.	Fault control of High discharge gas pressure at outlet	-	Yes	
D.	Fault control of Low and High gas suction pressure	-	Yes	
E.	Fault control of High vibration	-	Yes	
9.	**Motor Details**			
A.	Motor Power	kW	*	
B.	Motor Type	-	Electrical	
C.	Motor Energy Efficiency class	-	≥ IE2	
D.	Protection class	-	≥ IP 55	
E.	Rated Speed	RPM	*	
F.	Noise level (measured at 1m distance)	dB	< 85	
G.	Design Temperature	°C	*	
H.	Operating Temperature	°C	As per the site condition	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
I.	Installation height	m	As per the site condition	
J.	Relative Humidity	%	As per the site condition	
K.	Operating Hour	-	* (based on the design)	
L.	Max. DMC (Deviation from Mean Current)	%	≤ 14	
M.	Insulation	-	Class F (Thermal Sensor PTC-set @150°C)	
N.	Explosion Protection	-	Yes (Ex d II B T 3 Motor)	
O.	ATEX certification	-	Yes	
P.	Soft start	-	Yes	
Q.	Line Filter	-	Yes	
R.	Direct Link Inductor	-	Yes	
S.	VFD control	-	* Yes (based on the design & application)	
T.	Operating Voltage & Frequency	V & Hz	As per the site condition	
10.	**Electrical Control Panel**			
A.	PLC based Panel with HMI	-	Yes	
B.	24V DC control circuit	-	Yes	
C.	Emergency stop button	-	Yes	
D.	Overload, fault Accept/Test/Reset push button	-	Yes	
E.	Indicating lamp	-	Yes	
F.	Alarm & Trip	-	Yes (for High discharge gas pressure, Low lubricating oil pressure, Low cooling water pressure/flow, Low gas suction pressure, High gas discharge temperature)	
11.	**Testing & Inspection**			
A.	Mechanical Test run	-	Yes, before initial operation	
B.	Compressor capacity test	-	Yes	
C.	Compressor discharge pressure test	-	Yes	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
D.	Compressor discharge temperature test	-	Yes	
E.	Compressor biogas quality	-	Yes	
F.	Power consumption	-	Yes	
G.	Noise	-	Yes	
H.	Vibration	-	Yes	
I.	Suction strainer, separator	-	Visual inspection	
J.	Pistons and crank gear	-	Visual inspection	
K.	Valves leakage rate test	-	Yes, according to ISO 5208 Ball valve: Rate A Other valves: Rate AA	
L.	Material test certificates	-	Yes	
M.	Shop test certificates	-	Yes	
N.	Performance test certificates	-	Yes	
12.	**Performance Guarantees**	-	Compressors along with its control shall be guaranteed for the rated capacity for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
13.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
14.	**Drawings to be submitted**			
A.	GA drawing of the compressor with all the mountings & accessories	-	Yes	
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
D.	Materials test Certificates	-	Yes	
E.	Test certificates / reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

17 DIGESTATE DEWATERING SYSTEM

Digestate from Digesters shall be pumped to the Digestate Dewatering System where it shall be separated into Solid (Dewatered Sludge) and Liquid (Centrate/Filtrate) phases in two (2) stages. The Dewatered Sludge shall be then transported to the Composting Facility to produce Compost whereas the Centrate/Filtrate shall be pumped to the Effluent Treatment Plant (ETP) for further treatment.

17.1 Design Requirement

17.1.1 The bidder must supply and install a double stage SLS system (Screw Press machine followed by Decanter or Volute Press or Belt Filter Press). This system should have a proven track record of effectiveness and successful implementation in previous projects.

17.1.2 The bidder is responsible for ensuring that the installation site has a suitable foundation capable of supporting the weight and includes a damping system to reduce vibrations. Also, structure shall support the operation of both the decanter and screw press together.

17.1.3 The SLS must be designed to handle the entire process feed system slurry with a solids content as per bidder mass balance. The bidder must ensure provisions are in place to add flocculants, which will facilitate the formation of flocs and make it easier to separate the solids.

17.1.4 The SLS system should include an automated conveyor system to transfer the solids separated by the screw press & decanter to the composting yard.

17.1.5 The SLS system must include the essential components such as:

i. Feed pump to deliver digestate slurry to the Screw press & decanter.

ii. Flow meter to monitor feed flow rate with necessary valves, instruments, piping & fittings.

iii. Solid separation and sludge guide chute.

17.1.6 The following outlines the minimum requirements for the SLS. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the SLS system complete and efficient shall also fall under the bidder's scope of work.

17.2 Datasheet - Solid Liquid Separator (SLS)

17.2.1 The below datasheet/table outlines the minimum requirements for the Double Stage SLS system. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Double Stage SLS system complete and efficient shall also fall under the bidder's scope of work.

17.2.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	SLS System	-	Double Stage SLS for dewatering the sludge. (Screw Press machine followed by Decanter)	
B.	Quantity	Nos.	* As per the Design	
C.	Maintenance Tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	
D.	Included accessories	-	1. Control panel. 1. Motors. 2. VFD driven motor suitable to respective application.	
Screw Press Requirement				
2.	**Design Requirement**			
A.	Type of Service (outdoor or indoor)	-	Indoor	
B.	Fluid type	-	Slurry/Digestate	
C.	Capacity	m^3/hr	*As per design.	
D.	Dry matter TS content	%	*As per design.	
E.	Presence of Corrosive/Toxic Components	-	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
F.	Installation height	m	* (based on the design)	
G.	Solid-liquid separation efficiency	%	*	
H.	Noise level (measured at 1m distance)	dB	< 85	
I.	Design Temperature	°C	0 - 60	
J.	Operating Temperature	°C	As per the site condition	
K.	Relative Humidity	%	As per the site condition	
L.	Operating Hour	h	* (based on the design)	
M.	Explosion Protection	-	* (based on the design)	
N.	ATEX-certified	-	* (based on the design)	
O.	Operating Voltage & Frequency	V & Hz	As per site condition	
P.	Solenoid Valve	-	Yes	
3.	**Motor Details**			
A.	Screw press Gear Motor	kW	*	
B.	Flocculation Gear motor	kW	*	
C.	Motor energy efficiency class	-	≥ IE3	
D.	Rated Speed	RPM	*	
E.	Protection class	-	≥ IP 55	
F.	VFD - Drive control	-	*	
G.	Motor - Insulation Class	-	≥ F Temp. rise limited to Class B	
4.	**Dewatering Zone - MOC**			
A.	Fixed plate	-	≥ SS316	
B.	Movable Rings	-	≥ SS316	
5.	**Thickening Zone - MOC**			
A.	Fixed plate	-	≥ SS316	
B.	Movable Rings	-	≥ SS316	
C.	Screw Shaft	-	≥ SS316	
6.	**Assembly Dimension**			
A.	Length	m	*	
B.	Width	m	*	
C.	Height	m	*	
D.	Weight without motor	kg	*	
E.	Weight with motor	kg	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
7.	**Screen**			
A.	Cleaning system	-	Yes	
8.	**Automatic Showering System for cleaning**		Yes	
A.	No. of Nozzle	Nos.	*	
B.	Each nozzle capacity	LPM	*	
9.	**Flanges and Connections**			
E.	Inlet digestate flange	-	Yes	
F.	Outlet liquid digestate flange	-	Yes	
G.	Outlet solid cake opening	-	Yes	
H.	Rinsing water inlet flange	-	Yes	
Decanter Requirements				
10.	**Design Requirement**			
A.	Type of Service (outdoor or indoor)	-	Indoor	
B.	Fluid type	-	Slurry/Digestate	
C.	Capacity	m^3/hr	*As per design.	
D.	Solid content in fluid	%	*As per design.	
E.	Max. density of compact wet cake	kg/m^3	*	
F.	Presence of Corrosive/Toxic Components	-	*	
G.	Installation height	m	* (based on the design)	
H.	Solid-liquid separation efficiency	%	*	
I.	Noise level (measured at 1m distance)	dB	< 85	
J.	Design Temperature	°C	0 - 60	
K.	Operating Temperature	°C	As per the site condition	
L.	Relative Humidity	%	As per the site condition	
M.	Operating Hour	-	* (based on the design)	
N.	Explosion Protection	-	*	
O.	ATEX-certified	-	*	
P.	Operating Voltage & Frequency	V & Hz	As per the site condition	
11.	**Decanter Inlet Design Parameter**			
A.	Flow	m^3/h	*	
B.	pH	-	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
C.	TSS	%	*	
D.	DS	%	*	
E.	Temperature	°C	*	
12.	**Decanter Outlet Design Parameter**			
A.	Flow	m^3/h	*	
B.	pH	-	*	
C.	TSS	%	≤ 1	
D.	TS	%	*	
E.	DS	%	*	
F.	Temperature	°C		
13.	**Bowl**			
A.	Maximum main speed	RPM	*	
B.	Bowl length	m	*	
C.	Bowl diameter	m	*	
D.	Conical Beach angle	degree	*	
E.	Solids discharge type	-	*	
F.	Solids transportation aids, cylindrical section	-	*	
G.	Solids transportation aids, taper section	-	*	
H.	Material - hubs	-	≥ AL 111 2377 (Duplex stainless steel)	
I.	Material - bowl shell	-	≥ AL 111 2349 (AISI 316)	
J.	Material - bolts	-	≥ A4-80 (AISI 316)	
K.	Material - seals	-	*	
L.	Liquid outlet, type	-	*	
M.	Liquid outlet, radius	-	*	
14.	**Conveyor**			
A.	Material - flights	-	≥ AL 111 2349 (AISI 316)	
B.	Material - hub	-	≥ AL 111 2327 (Lean duplex stainless steel)	
15.	**Wear Protection**			
A.	Bowl solids discharge	-	≥ Wear liner in tungsten carbide	
B.	Bowl feed zone liner	-	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
C.	Conveyor flights	-	≥ Flame sprayed tungsten carbide	
D.	Conveyor feed zone	-	≥ Tungsten Carbide wear liners	
E.	Frame / casing	-	≥ Wear liner in upper casing	
16.	**Frame and Casing**			
A.	Material - casing / cover	-	≥ Stainless steel (AISI 316)	
B.	Inside surface of casing	-	Liners of stainless steel at discharge areas - painting in neutral compartment	
C.	Gaskets / seals - casing	-	*	
17.	**Motor**			
A.	Motor Energy Efficiency class	-	≥ IE3	
B.	Protection class	-	≥ IP 55	
C.	Rated Speed	RPM	*	
D.	Main Drive power	kW	*	
E.	Main Drive Control	-	VFD	
F.	Back Drive power	kW	*	
G.	Back Drive Control	-	VFD	
H.	Back Drive Parts	-	*	
I.	Gear Box type	-	*	
J.	Gearbox, torque	Nm	*	
K.	Gearbox Ratio	-	*	
L.	Max. differential speed	RPM	*	
M.	Max. differential torque	Nm	*	
N.	G-force at operating speed	-	≥ 3500	
O.	Motor Design	-	Squirrel cage induction	
P.	Thrust Force	kN	*	
Q.	Soft start	-	Yes	
R.	Variable Frequency Converter	-	Yes	
S.	Direct Start	-	No	
18.	**Protection**			
A.	Earthing	-	Yes	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
B.	Damper	-	Yes	
19.	**Assembly Dimension**			
A.	Length	m	*	
B.	Width	m	*	
C.	Height	m	*	
D.	Weight without motor	kg	*	
E.	Weight with motor	kg	*	
General Requirement				
20.	**Operation Data**			
A.	Feed	-	Digestate from Digesters	
B.	Digestate Density	t/m^3	Based on bidder's Mass Balance	
C.	Max. inlet particle size	mm	Based on bidder's process	
D.	TS content of digestate	%	Based on bidder's Mass Balance	
E.	Quantity of Digestate to Dewatering	t/h	Based on bidder's Mass Balance	
21.	**Testing & Inspection**			
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	
22.	**Performance Guarantees**	-	SLS (solid liquid separation) along with its control shall be guaranteed for the rated capacity against the rated speed of motions and for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
			deficiency shall be made good at the bidder's cost.	
23.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
24.	**Drawings & Documents to be submitted during detailed engineering stage**			
A.	GA drawing of solid liquid separation system with all the mountings & accessories	-	Yes	
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	
D.	Materials test Certificates	-	Yes	
E.	Test certificates / reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

17.3 Datasheet - Digestate Transfer Pumps

17.3.1 Digestate from Digesters shall be pumped to the Digestate Sump by positive displacement type eccentric Screw Pumps suitable for handling digestate having solids. Each Pump shall be provided with Base Frame, Helical Gear Motor, Variable Frequency Drive, Temperature Control Unit for Stator and Pressure Indicator.

17.3.2 The below datasheet/table outlines the minimum requirements for the Digestate Transfer Pumps. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Digestate Transfer Pumps complete and efficient shall also fall under the bidder's scope of work.

17.3.3 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Pump including Base Frame, Helical Gear Motor, Temperature Control Unit for the Stator and all other Accessories etc. complete	
2.	Input Material	-	Digestate from Digesters	
3.	Quantity of Input Material	m^3/day	*	
4.	Total Solids in Input Material	-	*	
5.	pH of Input Material	-	*	
6.	Pumping Time	hr/day	12 (max.)	
7.	No. of Units to be provided	No.	As per bidder's design including 50% store standby (min.)	
8.	Capacity of each Unit to be provided	m^3/hr	As per bidder's design including 10% Factor of Safety	
9.	Type of each Unit	-	Positive displacement types of eccentric Screw Pump	
10.	Discharge Pressure of each Unit to be provided	kg/cm^2	As per bidder's design	
11.	Capacity of each unit	-	As per bidder's design	
12.	Material of Construction:	-		
A.	Base Frame	-	Structural Steel as per IS 2062	
B.	Body	-	-	
C.	Rotor, Shaft	-	SS 316	
D.	Stator	-	NBR, self-aligned	
E.	Capacity of each Unit to be provided	$m3$/hr	As per bidder's design including 10% Factor of Safety	

17.4 Datasheet - Digestate Sump

17.4.1 Digestate from Digesters shall be pumped to the Digestate Storage Sump. It shall be constructed in Reinforced Cement Concrete of grade M30 or higher. It shall be equipped with Air Blowers + Coarse Bubble Air Grid or Submersible Mixers for efficient mixing of its content, Nozzles and Instruments.

17.4.2 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope. The technical specifications are as follows

17.4.3 The below datasheet/table outlines the minimum requirements for the Digestate Sump. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Digestate Sump complete and efficient shall also fall under the bidder's scope of work.

17.4.4 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Tank with Mixing System, Nozzles, Staircase, Platform/Walkway with Handrails, Level Measuring Instrument and all other Accessories etc. complete	
2.	Input Material	-	Digestate from Digesters	
3.	Quantity of Input Material	m3/day	*	
4.	Total Solids in Input Material	-	*	
5.	pH of Input Material	-	*	
6.	Hydraulic Retention Time to be provided	day	1/2 (min.) excluding Free Board	
7.	No. of Tank to be provided	No.	1 (min.)	
8.	Volume of each Tank to be provided	m^3	*	
9.	Dimension of each Tank to be provided	-	*	
10.	Liquid Depth of each Tank to be provided	m	*	
11.	Free Board of each Tank to be provided	m	0.50 m (min.)	
12.	Total Depth of each Tank to be provided	m	Liquid Depth + Free Board	

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
13.	Mixing Rate	$m^3/hr/m^3$	1.50 m3/hr/m3 (min.)	
14.	Mixing System	-	Air Blowers + Coarse Bubble Air Grid or submersible Mixers	
15.	Material of Construction:			
	Tank	-	*	
	Air Blower: a. Type b. Base Frame c. Body + Lobes + Rotor d. Shaft	-	a. Twin/Tri Lobe, Roots, Positive Displacement b. Carbon Steel c. CI IS 210 Gr. FG 260 d. Carbon Steel C40 / EN e. 24/19	
	Mixer: a. Type b. Propeller c. Guidepost + Mounting d. Bracket	-	a. Submersible b. Structural Steel S235 as per EN 10025 c. Stainless Steel AISI 304	
	No. of Tank to be provided	No.	1 (min.)	
	Volume of each Tank to be provided	m3	As per bidder's design	
	Dimension of each Tank to be provided	-	As per bidder's design	

17.5 Datasheet - Sludge Dewatering Equipment Feed Pumps

17.5.1 Digestate from Digestate Sump shall be pumped to the Press Screw Separators by positive displacement type eccentric Screw Pumps suitable for handling digestate having 3-4% Total Solids. Each Pump shall be provided with a Base Frame, Helical Gear Motor, Variable Frequency Drive, Temperature Control Unit for Stator and Pressure Indicator. The technical specifications are as follows,

17.5.2 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

17.5.3 The below datasheet/table outlines the minimum requirements for the Sludge Dewatering Equipment Feed Pumps. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the

equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Sludge Dewatering Equipment Feed Pumps complete and efficient shall also fall under the bidder's scope of work.

17.5.4 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Pump including Base Frame, Helical Gear Motor, Temperature Control Unit for the Stator and all other Accessories etc. complete	
2.	Input Material	-	Digestate from Digesters	
3.	Quantity of Input Material	m^3/day	*	
4.	Total Solids in Input Material	-	*	
5.	pH of Input Material	-	*	
6.	Pumping Time	hr/day	12 (max.)	
7.	No. of Units to be provided	No.	As per bidder's design including 50% standby (min.)	
8.	Capacity of each Unit to be provided	m^3/hr	As per bidder's design including 10% Factor of Safety	
9.	Type of each Unit	-	Positive displacement types of eccentric Screw Pump	
10.	Discharge Pressure of each Unit to be provided	kg/cm^2	As per bidder's design	
11.	Material of Construction:			
A.	Base Frame	-	Structural Steel as per IS 2062	
B.	Body	-	CI	
C.	Rotor, Shaft	-	SS 316	
D.	Stator	-	NBR, self-aligned	

17.6 Datasheet - Sludge Dewatering Equipment

17.6.1 Digestate from Digestate Sump shall be pumped to the Press Screw Separators which shall separate the Digestate into Solid (Dewatered Sludge) and Liquid (Centrate)

phases. The Dewatered Sludge shall be then transported to the Composting Facility to produce Compost whereas the Centrate shall be taken to the Centrate Sump-1 and then pumped to the downstream Dewatering Equipment for further dewatering.

17.6.2 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

17.6.3 The below datasheet/table outlines the minimum requirements for the Sludge Dewatering Equipment Feed Pumps. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Sludge Dewatering Equipment Feed Pumps complete and efficient shall also fall under the bidder's scope of work.

17.6.4 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Belt Filter Press: Belt Filter Press including Flocculator, Dewatering Polyelectrolyte Dosing System, Online Dynamic Mixer, Filtrate Collection Tray, Filtrate Collection Tray, Stand-alone Electrical cum PLC Panel and all other Accessories complete	
2.	Input Material	-	Digestate from Digesters	
3.	Quantity of Input Material	m^3/day	*	
4.	Total Solids in Input Material	-	*	
5.	pH of Input Material	-	*	
6.	Processing Time	hr/day	12 (max.)	
7.	No. of Units to be provided	No.	As per bidder's design	
8.	Capacity of each Unit to be provided	m^3/hr	As per bidder's design including 10% Factor of Safety	
9.	Type	-	Multi-stage type Belt filter press	

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
10.	Material of Construction:			
A.	Belt filter Press Frame, Structure	-	Stainless Steel AISI 304L	
B.	Belt	-	Polyester (918 microns)	
C.	Belt Guide & Support	-	Stainless Steel AISI 304L	
D.	Filtrate collect Tank	-	Stainless Steel AISI 304L	
E.	Roller Shaft & Flanges	-	Carbon Steel E24+ Rilsan Coating	
F.	Hardware	-	SS 316	

17.7 Datasheet - Centrate Storage Sump

17.7.1 Centrate from Press Screw Separators shall be taken to the Centrate Sump. It shall be constructed in Reinforced Cement Concrete of grade M30 (min.). It shall be equipped with Air Blowers + Coarse Bubble Air Grid or Submersible Mixers for efficient mixing of its content, Nozzles and Instruments.

17.7.2 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

17.7.3 The below datasheet/table outlines the minimum requirements for the Centrate Storage Sump. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Centrate Storage Sump. complete and efficient shall also fall under the bidder's scope of work.

17.7.4 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Tank with Mixing System, Nozzles, Staircase, Platform/Walkway with Handrails, Level Measuring Instrument and all other Accessories etc. complete	

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
2.	Input Material	-	Centrate / Filtrate from Digestate Dewatering Equipment	
3.	Quantity of Input Material	m^3/day	As per bidder's design	
4.	Total Solids in Input Material	-	*	
5.	pH of Input Material	-	*	
6.	Hydraulic Retention Time to be provided	day	*	
7.	No. of Tank to be provided	No.	1 (min.)	
8.	Volume of each Tank to be provided	m^3	As per bidder's design	
9.	Dimension of each Tank to be provided	-	As per bidder's design	
10.	Liquid Depth of each Tank to be provided	m	As per bidder's design	
11.	Free Board of each Tank to be provided	m	0.50 m (min.)	
12.	Total Depth of each Tank to be provided	m	Liquid Depth + Free Board	
13.	Mixing Rate	m^3/hr	1.50 m^3/hr/m^3 (min.)	
14.	Mixing System	-	Air Blowers + Coarse bubble air grid or submersible mixers	
15.	Material of Construction:			
A.	Tank	-	RCC M30	
B.	Air Blower: a. Type b. Base Frame c. Body + Lobes + Rotor d. Shaft	-	a. Twin/Tri Lobe, Roots, b. Positive Displacement c. Carbon Steel d. CI IS 210 Gr. FG 260 e. Carbon Steel C40 / EN 24/19	

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
C.	Mixer: a. Type b. Propeller c. Guidepost + Mounting Bracket	-	a. Submersible b. Structural Steel S235 as per EN 10025 c. Stainless Steel AISI d. 304	

17.8 Datasheet - Dewatering Equipment Feed Pumps

17.8.1 Dewatering Equipment Feed Pumps shall be positive displacement type eccentric Screw Pumps suitable for handling digestate having solids. Each Pump shall be provided with a Base Frame, Helical Gear Motor, Variable Frequency Drive, Temperature Control Unit for Stator and Pressure Indicator.

17.8.2 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

17.8.3 The below datasheet/table outlines the minimum requirements for the Dewatering Equipment Feed Pumps. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Dewatering Equipment Feed Pumps. complete and efficient shall also fall under the bidder's scope of work.

17.8.4 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Pump including Base Frame, Helical Gear Motor, Temperature Control Unit for the Stator and all other Accessories etc. complete.	
2.	Input Material	-	Centrate from Press Screw Separators	
3.	Quantity of Input Material	m^3/day	*	
4.	Total Solids in Input Material	-	*	
5.	pH of Input Material	-	*	

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
6.	Pumping Time	hr/day	12 (max.)	
7.	No. of Units to be provided	No.	As per bidder's design	
8.	Capacity of each Unit to be provided	m^3/hr	As per bidder's design including 10% Factor of Safety	
9.	Type of each Unit	-	Positive displacement types of eccentric Screw Pump	
10.	Discharge Pressure of each Unit to be provided	kg/cm^2	As per bidder's design	
11.	Material of Construction	m^3/hr		
A.	Base Frame	-	Structural Steel as per IS 2062	
B.	Body	-	CI	
C.	Rotor, Shaft	-	SS 316	
D.	Stator	-	NBR, self-aligned	

17.9 Datasheet - Dewatering Equipment

17.9.1 Dewatering Equipment shall be either of the following types:

a. Solid Bowl type Decanter Centrifuge
b. Multi-stage type Belt Filter Press

17.9.2 The Dewatered Sludge shall be transported to the Composting Facility to produce Compost whereas the Centrate / Filtrate shall be pumped to the Effluent Treatment Plant (ETP) for further treatment.

17.9.3 The below datasheet/table outlines the minimum requirements for the Dewatering Equipment Feed Pumps. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Dewatering Equipment Feed Pumps. complete and efficient shall also fall under the bidder's scope of work.

17.9.4 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply		• Decanter Centrifuge including Flocculator, Dewatering Polyelectrolyte Dosing System, Online Dynamic Mixer, Main Drive, Back Drive, Stand-alone Electrical cum PLC Panel and all other Accessories etc. complete. • Belt Filter Press including Flocculator, Dewatering Polyelectrolyte Dosing System, Online Dynamic Mixer, Filtrate Collection Tray, Wash Water Pump, Air Compressor, Stand-alone Electrical cum PLC Panel and all other Accessories complete.	
2.	Input Material	-	Ammonia Stripped Effluent from Dewatering Equipment Feed Sump	
3.	Quantity of Input Material	m^3/day	*	
4.	Total Solids in Input Material	-	*	
5.	pH of Input Material	-	*	
6.	Processing Time	hr/day	12 (max.)	
7.	No. of Units to be provided	No.	As per bidder's design	
8.	Capacity of each Unit to be provided	m^3/hr	As per bidder's design including 10% Factor of safety	
9.	Type of each Unit	-	Solid Bowl type Decanter Centrifuge or Multi-stage Belt Filter Press	
10.	Discharge Pressure of each Unit to be provided	kg/cm2	As per bidder's design	
11.	Material of Construction:			
	Decanter Centrifuge	-	a. Carbon Steel	

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
	a. Frame b. Cover c. Bowl d. Screw		b. Stainless Steel AISI 316 c. Lean Duplex Stainless Steel d. Stainless Steel AISI 316 with Tungsten Carbide Wear Liners and Tungsten Carbide Coating on Leading Flights near Small End	
	Belt Filter Press a. Frame + Structure b. Belt c. Belt Guide Support d. Filtrate Collect Tank e. Roller Shaft & Flanges	-	a. Stainless Steel AISI 304L Polyester (900 microns min.) b. Stainless Steel AISI 304L c. Stainless Steel AISI 304L d. Carbon Steel E24	

18 COMPOSTING FACILITY

The solid digestate from solid-liquid separators shall be transported to the composting plant facility. At the composting plant, it shall undergo aerobic decomposition. After composting, the Compost shall be screened using a Drum Screen and stored in the Compost Storage Shed for further sale by OIL.

18.1 Solar-Enhanced Green House Type Composting Facility

18.1.1 The composting facility shall be of Solar Green House type compromising closed polycarbonate sheds which allow the solar radiation into the sheds, suitable ventilation system, spreader cum turner machines etc. Bidder shall indicate the required Polycarbonate sheds and the number of spreaders cum turner machines etc., which shall be subject to the approval of the Owner. All the associated civil, mechanical, electrical and C&I works shall be in the scope to the bidder.

18.1.2 Compost produced in Composting Facility shall be pass through Compost Screening and then stored in the Compost Storage Shed for further sale to the Fertilizer Plants.

18.1.3 The produced FOM must comply with the latest FCO standards (Except for Electrical Conductivity and Heavy Metals Content which are not applicable for MSW based FOM)

18.1.4 The leachate generated in the area shall follow the natural flow of the plot and be collected in a designated pit as per the plot plan. This leachate shall then be recirculated to the hydrolysis tank for biogas production.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Input Material	- - -	Dewatered Sludge from Digestate Dewatering System	
2.	Quantity of Input Material	TPD	*	
3.	Dry Solids in Input Material	- - -	*	
4.	Quantity of Dry Solids	TPD	*	
5.	Average Outlet Dryness required	- - -	70% dry solids minimum	

18.1.5 Solar Composting Facility shall be provided to achieve minimum 70% dry solids consistency. It shall be a state-of-the-art, essentially a covered Facility and shall operate in all seasons including monsoon. It shall consist of the following:

18.2 Datasheet - Green House

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Minimum Height of Side Wall	m	*	
2.	Minimum Height of Roof Ridge	m	*	

Sl. No.	Description	Unit	**Data (Data marked thus * to be filled by the Bidder)**	**Vendor Data (Duly filled in by the Bidder)**
3.	Flooring of Green House	----	RCC M30	
4.	Covered area of the facility L x B	Sq. m.	As per bidder's design	
5.	Roof Ventilation Flap		Shall be provided for opening the Roof on one side over the entire Length. It shall be driven by motor and 2 limit switches. It shall be of 1.50 m width	
6.	Axial Fans	---	Shall be mounted inside the Green House at 60 Degree angle downwards. Each fan shall have a Free Blowing Capacity of 8,000 m^3/hr	
7.	Additional Requirements	---	Should be designed to withstand the wind conditions prevalent at the Site	
8.	Material of Construction:			
	Structural Steel Work	---	Hot Dipped Galvanized Steel Sections	
	Roof + Gable Wall + Side Walls	---	1.50 mm thick (min.) UV Coated Corrugated Polycarbonate Sheets	

18.3 Datasheet - Solar Composting Machine

18.3.1 Solar Composting Machine shall have the ability to till and convey in both (forward and backward) directions with the same speed and efficiency. It shall have the ability to till and convey dewatered sludge with a height up to 40 cm and to stack up and convey dried sludge up to 80 cm. It shall have interchangeable sludge tilling tools bolted on the frame and shall use combs and knives for palletisation of sludge.

18.3.2 The Machine shall till and convey dewatered sludge over the entire width of the drying hall in one operation (while it moves forward or backward once). The tilling and conveying tool of the Machine shall not be in contact with the floor of the Green House.

18.3.3 The Machine shall have a self-driven unit with cylindrical mounted shovels able to turn in both directions and be adjusted down to 10 mm above the ground. The movement of the Machine shall be chainless. The Machine shall move at a maximum speed of 2.0 m/min while turning dewatered sludge and at a maximum speed of 8.0 m/min when running freely.

18.3.4 The Machine shall have standardized motors with integrated gear boxes, steel construction with anti-corrosion painting with colour finishing, total thickness of painting shall be 100µm. Safety line on each side shall be provided. The machine shall be equipped with acoustic and digital start up signals.

18.3.5 There shall be a control switchboard mounted on the Machine itself. It shall have a minimum of IP 54 Protection, shall be well ventilated and shall be able to operate up to a maximum ambient temperature of 50 °C. It shall be equipped with PLC, Frequency Converters for the continuous control of the turning motors with MPI-Bus communication to the stationary control switchboard described below:

- The bus connection should contain an overload protection. Apart from above, the Machine shall include one (1) stationary switchboard per machine mounted in the front end of the Green House. The control switchboard shall be equipped with PLC, graphical touch panel, emergency stop equipment, overload protected internal MPI-bus connection to the machine mounted switchboard and to the other turning machines.
- The complete control system shall be fully tested and ready to be connected for use. The control shall be programmed with fixed functions for several scenarios to handle different sludge conditions with manual operating functions for the motor drives, automatic functions as solar radiation dependent sludge turning, time-controlled start of machine function for separate weekdays and control of ventilation dependent on conditions of air.
- All functions shall be operated from an easy-to-use HMI on the touch panels integrated in the doors of the stationary control panels.

18.3.6 Each Machine shall have one (1) combined Sensor for Temperature and Humidity, including 4-20 mA signal amplifier, one (1) Pyranometer and one (1) Climate Sensor for Temperature, Humidity, Wind and Rain.

18.3.7 The Machine shall include an energy supply system designed to glide freely over the entire length of the Green House. The energy supply system shall include all necessary accessories such as trolleys, track supports and sliding C-rails.

18.3.8 As a minimum, the Solar Composting Machine shall confirm to following minimum standards:

Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
Diameter of Turning Drum	mm	*	
Total Width	mm	*	
Total Length	mm	*	
Free Height required above Machine	mm	*	
Free Distance required between the Walls	mm	*	
Rotating Speed	RPM	30-60 (Variable)	
Maximum Travelling Speed	m/min	8.0	
Maximum Working Speed	m/min	2.0	
Drum's Lifting Range	mm	*	
Drum Driver	No.	2	
Travelling Drive	No.	2	
Lifting Drive	No.	1	
Material of Construction:			
Framework + Turning Drum + Combs and Knives + Side Walls	---	Mild Steel	
Coating:			
Framework and Turning Drum	---	Zink Dust Primer, Paint Coat	
Combs and Knives	---	Hot Dip Galvanized	

18.4 Compost Screening Plant

18.4.1 Compost produced in Solar-Enhanced Composting Facility shall be pass through Compost Screening Plant to remove Glass, Inert, Plastic etc. and then stored in the Compost Storage Shed for further sale by OIL.

Sl. No.	Description	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply		Screen including Support Frame, Feeding Hopper and all other Accessories etc. complete	
2.	Input Material	---	Compost produced in Solar-Enhanced Composting Facility	
3.	Quantity of Input Material	TPD	*	
4.	Bulk Density of Input Material	kg/m^3	*	
5.	Processing Time	hr/day	12 (max.)	
6.	No. of Units to be provided	No.	*	
7.	Capacity of each Unit to be provided	TPH	As per bidder's design including 25% Factor of Safety	
8.	Type of each Unit	---	As per bidder's design	
9.	Throughput rate of each Unit	:	As per bidder's design	
10.	Material of Construction:			
	Support Legs + Base Frame	---	Structural Steel S235 as per EN 10025	
	Body and Side Plates etc.	---	Structural Steel S235 as per EN 10025	
	Screen Deck	---	Structural Steel S235 as per EN 10025	

18.4.2 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

18.5 Datasheet - Composting and Bagging Unit

18.5.1 The below datasheet/table outlines the minimum requirements for the entire Composting and Bagging Unit. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Composting and Bagging system to complete and efficient shall also fall under the bidder's scope of work.

18.5.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Composting and Bagging Unit System (full set)	-	Full system from composting, windrowing, co-composting to bagging unit.	
B.	Quantity	Nos.	*As per the Design	
C.	Maintenance tools & tackles kit	set	1set to be supplied in a separate steel toolbox.	
D.	Included accessories	-	1. Truck Loader 2. Windrow Turner 3. Conveyors 4. Feed Hopper 5. Trommel Screen 6. Lump Breaker 7. Rejection discharge 8. Directional Chute 9. Discharge hopper 10. Load cell 11. Sewing Belt Conveyor 12. Centralize Control Panel	
Manure Conveying & Bagging				
2.	**General specification**			
A.	Type	-	*	
B.	Application	-	*	
C.	MOC of contact parts	-	MS Painted	
D.	MOC of non-contact parts	-	MS Painted	
E.	Operation type	-	Continuous	
F.	Operating Temperature	-	Ambient	
G.	Full system design operating hours	hr	16h/day	
H.	Capacity of filling of 50kg bags in 1 hr	-	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
I.	Bulk Density	kg/m^3	*	
J.	Moisture Content in final compost	%	*	
3.	**Feeding Hopper**			
A.	Capacity	Litre	*	
B.	Size (Inlet)	mm x mm	*	
C.	Outlet	mm x mm	*	
D.	Thickness	mm	*	
E.	Height	mm	*	
F.	MOC	-	MS	
4.	**Trommel Screen**			
A.	Type	-	Horizontal	
B.	Capacity	TPH	*	
C.	Diameter	mm	*	
D.	Length	mm	*	
E.	Mesh hole size	mm	*	
F.	Mesh wire thick	mm	*	
G.	Mesh type	-	Wire mesh	
H.	Ribbon & baffles assembly	-	Inside mesh for material movement	
I.	Drive type	-	Direct drive	
J.	Gear box type	-	*	
K.	Gearbox Output RPM	-	*	
L.	Gear box make	-	*	
M.	Motor (Non-FLP)	-	*	
N.	Motor make	-	*	
O.	Motor starter	-	VFD	
P.	Brush	-	*	
Q.	Wheel	-	*	
R.	Universal Coupling	-	*	
5.	**Belt Conveyor - 1 (From Feeding Hopper to Trommel)**			
A.	Working Length	m	*	
B.	Transfer Capacity	TPH	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
C.	Belt Width	mm	*	
D.	Belt Thick	mm	*	
E.	Belt details	-	M24 Grade, Black Rubber Belt	
F.	Convey MOC	mm	MS	
G.	Drive & Non drive pulley	mm	*	
H.	Gear box type	-	*	
I.	Gearbox RPM	-	*	
J.	Motor	-	*	
K.	Motor Make	-	*	
L.	Motor Starter	-	VFD	
6.	**Belt Conveyor - 2 (From Trommel Bottom to Agitator)**			
A.	Working Length	m	*	
B.	Transfer Capacity	TPH	*	
C.	Belt Width	mm	*	
D.	Belt Thick	mm	*	
E.	Belt details	-	M24 Grade, Black Rubber Belt	
F.	Convey MOC	-	*	
G.	Drive & Non drive pulley	-	*	
H.	Gear box type	-	*	
I.	Gearbox RPM	-	*	
J.	Motor	-	*	
K.	Motor Make	-	*	
L.	Motor Starter	-	VFD	
7.	**Belt Conveyor - 3 (Transfer Over Size Material into Storage Bay)**			
A.	Working Length	m	*	
B.	Transfer Capacity	TPH	*	
C.	Belt Width	mm	*	
D.	Belt Thick	mm	*	
E.	Belt details	-	M24 Grade, Black Rubber Belt	
F.	Convey MOC		MS	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
G.	Drive & Non drive pulley	mm	*	
H.	Gear box type	-	*	
I.	Gearbox RPM	-	*	
J.	Motor	-	*	
K.	Motor Make	-	*	
L.	Motor Starter	-	DOL	
8.	**Belt Conveyor - 4 (For Stitching Machine)**			
A.	Working Length	m	*	
B.	Transfer Capacity	TPH	*	
C.	Belt Width	mm	*	
D.	Belt Thick	mm	*	
E.	Belt details	-	M24 Grade, Black Rubber Belt	
F.	Convey MOC	-	MS	
G.	Drive & Non drive pulley	mm	*	
H.	Gear box type	-	*	
I.	Gearbox RPM	-	*	
J.	Motor	-	*	
K.	Motor Make	-	*	
L.	Motor Starter	-	VFD	
9.	**Bag Filling Machine**			
A.	Bag filling capacity	TPH	*	
B.	Bag size	kg	*	
C.	No. of bag per hour	Bags	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
D.	Filling hopper	Litre	*	
E.	Agitator Location	-	Inside filling hopper	
F.	Agitator Motor	-	*	
G.	Agitator gearbox	-	*	
H.	Agitator gearbox make	-	*	
I.	Bag clamping arrangement	-	*	
J.	Clamping Cylinder	-	*	
K.	Solenoid Valve	-	*	
L.	Loadcell	-	*	
M.	Weight Controller	-	General measure	
N.	Control Valve (for bag filling)	-	*	
O.	Control valve motor & gear box	-	*	
P.	Gearbox RPM	-	*	
Q.	Gear box make	-	*	
R.	Motor make	-	*	
S.	Control valve (Belt Conveyor) starter	-	VFD	
T.	Foot switch	-	For clamping & Stitching machine	
10.	**Stitching Machine**			
A.	Stitching Machine (Manual)	-	Double thread, Mechanical Thread cut	
B.	Speed	bags/ min		
C.	Spring balancer	-	Yes	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
11.	**Crusher**			
A.	Capacity	TPH	*	
B.	Feeding Hopper Capacity	Litre	*	
C.	Motor	-	*	
12.	**MCC Cum Control Panel**			
A.	Control panel size	-	*	
B.	Control Panel MOC	-	MS Painted	
C.	VFD Make	-	*	
D.	PLC Make & Model	-	*	
E.	HMI Make	-	*	
F.	DOL Make	-	*	
G.	Push Button/ Indictor	-	*	
H.	Cable (Panel Wiring)	-	*	
I.	Field Cable	-	*	
13.	**Manure Screening MOC**			
	Feed Hopper	-	IS2062	
	Belt Conveyor (1,2,3 and 4)	-	IS2062	
	Trommel Screen	-	IS2062	
	Lump Breaker	-	IS2062/ SS304	
	Rejection discharge chute	-	IS2062	
14.	**Bagging System MOC**			

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
	Directional Chute	-	IS2062	
	Conveyor belt	-	IS2062	
	Discharge Hopper	-	IS2062	
	Load cell	-	IS2062	
	Sewing Belt Conveyor	-	IS2062	
	Centralize Controlling Panel	-	IS2062	
15.	**Testing & Inspection**			
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	
16.	**Performance Guarantees**	-	Manure Conveying & Bagging along with its control shall be guaranteed for the rated capacity for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
17.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
18.	**Drawings & Documents to be submitted during detailed engineering stage**			

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
A.	GA drawing with all the mountings & accessories	-	Yes	
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	
D.	Materials test Certificates	-	Yes	
E.	Test certificates/reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

19 EFFLUENT TREATMENT PLANT (ETP)

19.1 Design Requirement

19.1.1 Centrate / Filtrate from Digestate Dewatering System shall be treated into an Effluent Treatment Plant (ETP). If required Centrate / Filtrate (liquid digestate) can be recycled fully or partially to the pre-treatment / organic extraction without treating in ETP. But ETP should have the capacity to treat all the Centrate / Filtrate (liquid digestate) from the Dewatering System considering that no liquid digestate is recycled before ETP

19.1.2 The ETP shall comprise the following:

- Effluent Treatment cum Sludge De-watering Plant
- Ammonia Stripping System (Air Stripping or Steam Stripping).
- Ultrafiltration (UF) System.
- Sequential Batch Reactor (SBR) System.

19.1.3 The Treated Effluent shall be reused in Organic Extraction System, Washing of Floors, Equipment and Machinery etc. The excess Treated Effluent shall be discharged as per the General Discharge Standards of Environmental Pollutants as per the Environment (Protection) Rules, 1986 and its subsequent amendments by OIL.

19.1.4 Design Flow

Sl. No.	Design Parameters	Unit	Indicative Value* (* Bidder to provide actual values)
1	Design Flow	m^3/day	*

19.1.5 Raw Effluent Quality

Sl. No.	Parameters	Unit	Indicative Value* (* Bidder to provide actual values)
1	pH	--	*
2	Biochemical Oxygen Demand (BOD_5)	mg/l	*
3	Chemical Oxygen Demand (COD)	mg/l	*
4	Total Suspended Solids (TSS)	mg/l	*
5	Ammonia	mg/l	*
6	Alkalinity	mg/l	*

19.2 Effluent Treatment Cum Sludge Dewatering Plant

19.2.1 Suitable effluent treatment cum sludge dewatering plant shall be provided to treat the following effluents from the plant:

a) Liquid digestate from the solid liquid separators
b) Wash water from cleaning of floors, equipment, vehicles etc
c) Leachate / drains from the Waste Processing Plant and from the compositing area - These will be collected into the drain pits and will be recycled to the process or will be sent to the ETP.

19.2.2 The plant shall consist of Equalizing Tank, Ammonia Stripper (Air stripping) Unit, Sludge Dewatering System (Centrifuge type decanters), Bio reactors, Ultra Filtration (UF) Unit etc. where in the Liquid digestate will be treated for removing the ammonia and for decreasing the COD, BOD etc. The TSS / Sludge will also be separated and transferred to the composting facility. Treated water will be recycled to the waste processing unit and will also be used for cleaning purpose in the plant. Excess water will be drained to the nearest sewage network.

19.2.3 Ammonia Stripping System

All the effluents shall be collected in the equalizing tank from where they are sent to the Ammonia Stripping System for removal of Ammonia by Air Stripping Process.
Ammonia Stripped Effluent shall be then taken to a Sump and then pumped to the downstream Dewatering Equipment for further dewatering.

19.2.4 Sludge Dewatering System

Suitable sludge dewatering system consisting of centrifuge type decanters shall be provided to dewater the effluent from the ammonia stripping system. The Dewatered Sludge shall be transported to the Composting Facility to produce Compost whereas the Centrate/Filtrate shall be pumped to the Bioreactors (ETP) for further treatment.

19.2.5 Bioreactors and Ultrafiltration Units

Bioreactors and Ultrafiltration Units shall be provided to treat the centrate / filtrate from the Sludge Dewatering System to meet the standards as per the General Discharge Standards of Environmental Pollutants as per the Environment (Protection) Rules, 1986 and its subsequent amendments.

The capacity and configuration of the effluent treatment cum sludge dewatering plant shall be indicated by the Bidder and shall be subject to the approval of the Owner. All the rotating equipment shall be of 2 x 100% or 3 x 50% capacity. In case of agitators / mixers, n+1 configuration (where n = design number) shall be provided.

Note:

The above Design Flow and Raw Effluent Quality are indicative. The bidder shall ascertain and design the ETP based on the Wastewater generated from various Processes/Sources in the proposed Plant.

20 CONVEYORS

20.1 Design Requirement

The waste shall be conveyed from one Processing Unit to another with the help of Conveyors. Number, Type and Capacity of Conveyors shall be provided during detailed engineering of the Plant as per following specifications.

20.1.1 When heavy material is to be transported, extra impact plates shall be placed in the infeed section of the Conveyor.

20.1.2 All the construction parts shall be computer aided manufactured, lasered and bent to ensure maximum quality.

20.1.3 The Conveyor shall consist of a drive and a tail section. Between these two sections, the Conveyor shall be built from sectional modules.

20.1.4 At the infeed, the Conveyor shall be provided with side plates. These side plates shall be equipped with hatches for cleaning.

20.1.5 The left and right-side frames shall be connected with each other with idler sets and steel supports plating.

20.1.6 At all infeed positions of the Conveyor, there shall be chutes to guide the material away from the side of the belt.

20.1.7 A motor shall drive the Conveyor. It shall be mounted directly on the drive drum shaft.

20.1.8 Side plates shall be provided to the drive section and tail section.

20.1.9 The tail section shall be totally closed with a cover and cleaning hatch on both sides of the steel frame.

20.1.10 The drive drum shall be of adequate diameter based on the length, width and inclination of the Conveyor. The drive drum shall be covered with 8 mm rubber ETR70 to improve traction of the belt. A scraper with a scraper blade shall be placed beneath the drive drum. No scraper blade is required when using cleats or chevron.

20.1.11 A plough scraper with a scraper blade shall be placed right before the tail roller to clean material away from the inside of the belt.

20.1.12 The standard conveyor belt shall have a top layer of minimal 3 mm. It has minimal 2 internal layers and an under layer of minimal 1.5 mm. The belt shall be wear-resistant.

20.1.13 In case of Chain Conveyor, the chain sprockets shall have adequate teeth to guarantee smooth running.

20.1.14 The chain tensioning shall be equipped with a spring to prevent tension peaks on the chain and also makes the adjustment less frequent.

20.1.15 All bearings shall be self-adjusting to prevent misalignment of the bearings.

20.1.16 On an upgoing Chain Conveyor, the motor shall have a brake to prevent running backwards.

20.1.17 The base frame shall be modular, so it can be extended when necessary. The side guiding shall be bolted on top of the base frame, so for maintenance, the side guiding can be taken off and the chain is made available.

20.1.18 The pitch of the chain shall be adequate with proper rollers per m of chain.

20.1.19 The chain tensioning shall be equipped with a spring to prevent tension peaks on the chain and makes the adjustment less frequent.

20.1.20 All bearings shall be self-adjusting to prevent misalignment of the bearings

20.2 Datasheet - Belt Conveyor

20.2.1 The below datasheet/table outlines the minimum requirements for the entire Belt Conveyor system. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Belt Conveyor system to complete and efficient shall also fall under the bidder's scope of work.

20.2.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Conveyor system (with auxiliaries)	-	Belt Conveyor (Horizontal and Inclined)	
B.	Quantity	Nos.	*As per the Design	
C.	Maintenance Tools & tackles kit	set	1 set to be supplied in a separate steel toolbox. Bidder to furnish the list.	
D.	Included accessories	-	Yes	
2.	**Design Requirement**			
A.	Service	-	Continuous	
B.	Normal Capacity	TPH	*	
C.	Design Capacity	TPH	*	
D.	Material to be handled	-	Feedstock/FOM	
E.	Material Size	-	*	
F.	Conveyor Profile	-	Horizontal/ Inclined	
G.	Length (Horizontal)	-	*	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
H.	Lift of the conveyor	-	*	
I.	Inclination	-	*	
J.	Belt Width	-	*	
K.	No. of Inlets	-	*	
L.	Feed from	-	*	
M.	Discharge to	-	*	
N.	Belt speed	m/s	≥0.8	
O.	Belt Rating/Ply	-	≥315/3	
P.	Belt Fabric	-	≥All Nylon (N/N)	
Q.	Top Cover Thickness	mm	≥3	
R.	Bottom Cover Thickness	mm	≥1.5	
S.	Cover grade	-	≥M24	
T.	Percentage elongation of conveyor belt	-	≤2% of span between idlers	
U.	Troughing angle of belt	deg.	*	
3.	**Details of Pulley**			
I.	**Head Pulley**			
A.	Material	MoC	IS:2062	
B.	Thickness	mm	*	
C.	Outer diameter	mm	*	
D.	Rubber Lagging	mm	*	
E.	Lagging type	-	Diamond Groove type	
F.	Lagging Hardness	-	*	
G.	Width	mm	*	
H.	Sleeve	-	*	
I.	Shaft Material / Type	-	EN8 / Solid Shaft	
J.	Shaft diameter at bearing	mm	*	
K.	Bearing Diameter / Life	-	*	
L.	Plummer block	-	*	
II.	**Tail Pulley**			
A.	Material	MoC	IS:2062	
B.	Thickness	mm	*	
C.	Outer diameter	mm	*	
D.	Rubber Lagging	mm	*	
E.	Lagging type	-	Plain	
F.	Lagging Hardness	-	*	
G.	Width	mm	*	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
H.	Sleeve	-	*	
I.	Shaft Material / Type	-	EN8 / Solid Shaft	
J.	Shaft diameter at bearing	mm	*	
K.	Plummer block	-	*	
III.	**Snub Pulley**			
A.	Material	MoC	IS:2062	
B.	Thickness	mm	*	
C.	Outer diameter	mm	*	
D.	Rubber Lagging	mm	*	
E.	Lagging type	-	Plain	
F.	Width	mm	*	
G.	Sleeve	-	*	
H.	Shaft Material	-	EN8	
I.	Shaft diameter at bearing	mm	*	
J.	Plummer block	-	*	
IV.	**Bend Pulley**			
A.	Material	MoC	IS:2062	
B.	Thickness	mm	*	
C.	Outer diameter	mm	*	
D.	Rubber Lagging	mm	*	
E.	Lagging type	-	Plain	
F.	Lagging Hardness	-	*	
G.	Width	mm	*	
H.	Sleeve	-	*	
I.	Shaft Material / Type	-	EN8 / Solid Shaft	
J.	Shaft diameter at bearing	mm	*	
K.	Plummer block		*	
V.	**Pressure Pulley**			
A.	Material	MoC	IS:2062	
B.	Thickness	mm	*	
C.	Outer diameter	mm	*	
D.	Rubber Lagging	mm	*	
E.	Lagging type	-	Plain	
F.	Width	mm	*	
G.	Shaft Material	-	EN8	
H.	Shaft diameter at bearing	mm	*	
I.	Plummer block	-	*	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
4.	**Details of Idler**			
I.	**Carrying Idler**			
A.	Type		Single Roll Flat	
B.	Shell/Tube Diameter	mm	*	
C.	Shell/Tube Length (Each Roll)	mm	*	
D.	Shaft Dia. At bearing	mm	*	
E.	MoC	-	EN8	
F.	Spacing	-	*	
II.	**Return Idler**			
A.	Type	-	Single Roll Flat	
B.	Shell/Tube Diameter	mm	*	
C.	Shell/Tube Length (Each Roll)	mm	*	
D.	Shaft Dia. At bearing	mm	*	
E.	MoC	-	EN8	
F.	Spacing	-	*	
III.	**Impact Idler**			
A.	Type	-	Single Roll Flat	
B.	Shell/Tube Diameter	mm	*	
C.	Shell/Tube Length (Each Roll)	mm	*	
D.	Shaft Dia. At bearing	mm	*	
E.	MoC	-	EN8	
F.	Spacing	-	*	
G.	Rubber Lagging Dia / Material	-	*	
IV.	**Self-aligning carrying Idler with guide rollers**			
A.	Type	-	Single Roll Flat	
B.	Shell/Tube Diameter	mm	*	
C.	Shell/Tube Length (Each Roll)	mm	*	
D.	Shaft Dia. At bearing	mm	*	
E.	MoC	-	EN8	
F.	Spacing	-	*	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
V.	**Self-aligning return Idler with guide rollers**			
A.	Type	-	Single Roll Flat	
B.	Shell/Tube Diameter	mm	*	
C.	Shell/Tube Length (Each Roll)	mm	*	
D.	Shaft Dia. At bearing	mm	*	
E.	MoC	-	≥EN8	
F.	Spacing	-	*	
5.	Details of take up type			
A.	Type		Screw	
B.	Travel		*	
C.	Screw Dia. & Thread Pitch	-	*	
D.	Screw MOC	-	≥EN8	
E.	Motor Power	-	*	
F.	Motor Speed	-	*	
G.	Motor Duty	-	≥IE-3	
H.	VFD	-	*	
I.	Motor Make	-	*	
J.	Hold back/brakes arrangement	-	Integral	
K.	Gear box type	-	*	
L.	Gear box Ratio	-	*	
M.	Service factor	-	*	
N.	Primary Coupling type	-	*	
O.	Coupling model / Make	-	*	
P.	Secondary Coupling type	-	Geared	
Q.	Model of Coupling	-	*	
R.	Coupling Make	-	*	
6.	Belt Cleaner			
A.	Internal cleaner type	-	V-Plough Type	
B.	External Cleaner	-	Primary & Secondary	
C.	External cleaner type Primary	-	Spring Loaded - Pu blade	
D.	External cleaner type Secondary	-	Sprung back elastomount - HDTS tip	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
E.	External cleaner mounting location	-	Within discharge chute	
7.	Skirting			
A.	Skirt Length	m	Full Length of Conveyor	
B.	Skirt plate Thickness	mm	*	
C.	Skirt Rubber	-	Double Lip TYPR Natural Rubber	
D.	Top seal plate	-		
8.	**Details of other accessories**			
A.	Deck Plate below carrying idler	-	At feeding points - 3.15 mm thick MS plate	
B.	Stringer and Gallery	-	Yes	
C.	Stringer MoC	-	Rolled Section and Cold Form Sections	
D.	Stringer Member Size	-	*	
E.	Hood (Throughout the conveyor)	-	Corrugate Crimped Hood	
F.	Hood MoC	-	Galvalume	
G.	Hood Thickness	mm	≥0.45	
9.	**Bearing**			
A.	Bearing Make	-	*	
B.	Plummer block male	-	*	
C.	Bearing Type	-	Spherical Roller Double Row Self Aligning	
10.	**Discharge Chute**		*	
A.	Plate Thickness	mm	*	
B.	Plate MoC	-	IS:2062	
C.	Liner	-	SS-410 Material Contact Places	
D.	Hardware Grade	-	4.4	
11.	**Safety Switches**			
I.	**Zero Speed Switch (ZSS)**			
A.	Make	-	*	
B.	Type	-	Proximity type	
C.	Location	-	At tail end	
D.	Contact	-	2NO + 2NC	
II.	**Belt Sway Switch (BSS)**			

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
A.	Make	-	*	
B.	Type	-	Roller	
C.	Location	-	*	
D.	Contact	-	2NO + 2NC	
E.	Spacing	-	*	
III.	**Pull Chord Switch (PCS) for belt conveyor**			
A.	Type	-	Lever Type	
B.	Location	-	*	
C.	Contact	-	2NO + 2NC	
D.	Spacing	-	*	
E.	Walkway	-	*	
12.	**Protection**			
A.	Earthing	-	Yes	
B.	Guards for all rotating parts	deg.	360°	
13.	**Testing & Inspection**			
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	
14.	**Performance Guarantees**	-	Belt Conveyors along with its control shall be guaranteed for the rated capacity against the rated speed of motions and for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
15.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
16.	**Drawings & Documents to be submitted during**			

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
	detailed engineering stage			
A.	Technical Data Sheets	-	Yes	
B.	Manufacturer's standard quality plan	-	Yes	
C.	Materials test Certificates	-	Yes	
D.	Test certificates / reports for various shop test conducted	-	Yes	
E.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

20.3 Chain Conveyor

20.3.1 The below datasheet/table outlines the minimum requirements for the entire Chain Conveyor system. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Chain Conveyor system to complete and efficient shall also fall under the bidder's scope of work.

20.3.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Conveyor system (with auxiliaries)	-	Chain Conveyor	
B.	Quantity (with redundancy)	Nos.	*As per the Design	
C.	Commissioning Spare	set	1	
D.	Maintenance Tools & tackles kit	set	1	
2.	**Design Requirement**			
A.	Service	-	Continuous	
B.	Normal Capacity	TPH	*	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
C.	Design Capacity	TPH	*	
D.	Material to be handled	-	Feedstock/FOM	
E.	Material Size	-	*	
F.	Conveyor Profile	-	Horizontal	
G.	Length (Horizontal)	-	*	
H.	No. of Feed Points	-	*	
I.	No. of outlets	-	*	
J.	Feed from	-	*	
K.	Discharge to	-	*	
L.	Chain speed	-	*	
M.	Hardware grade	-	4.6	
3.	**Material Characteristics**		*	
A.	Abrasiveness	-	Mild Abrasive	
B.	Material Size	mm x mm	Less than 1 mm	
C.	Material Temperature	^{o}C	Ambient	
D.	Moisture	%	*	
4.	**Construction Details**			
A.	Length (Feed to Discharge Length (C/C) - Horizontal)	m	*	
B.	Length (Sprocket C / C length Horizontal)	m	*	
C.	Total Length of conveyor End Plate	m	*	
D.	Inclination	deg.	*	
E.	Chain Conveyor Width	mm	*	
F.	Chain Conveyor Height	mm	*	
G.	Size of slat (Width x height)	mm x mm	*	
H.	Thickness of slat	-	3 with stiffeners	
I.	Slat Fixing Arrangement	-	Bolted with nyloc nut	
5.	**Trough/ Casings**			
A.	Material	-	*	
B.	Top Cover Plate Thickness	mm	*	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
C.	Side Plate Thickness	mm	*	
D.	Bottom Plate Thickness	mm	*	
E.	Chain Runner Material / Thickness	mm	*	
F.	Liner for Bottom Plate	mm	*	
6.	**Chain Specification**			
A.	Pitch	-	*	
B.	Breaking strength per strand	-	*	
C.	No. of strands	-	*	
D.	Strand centre to centre	-	*	
E.	Chain make	-	*	
F.	Chain Material	-	*	
7.	**Shaft**			
A.	Shaft material		EN-8	
B.	Drive shaft Diameter at Bearing	mm	*	
C.	Plummer block centre to centre	mm	*	
D.	Driven shaft Diameter at bearing	mm	*	
8.	**Head Sprocket**			
A.	MoC	-	Cast Steel	
B.	No. of Teeth on Sprocket	-	*	
C.	P.C.D. of Sprocket	-	*	
9.	**Tail Sprocket**			
A.	MoC		Cast Steel	
B.	No. of Teeth on Sprocket	Nos.	*	
C.	P.C.D. of Sprocket	mm	*	
D.	Sprocket with key other with bush	-	Yes	
10.	**Details of take up type**		Screw Take up	
A.	Take up length	mm	*	
B.	Dia. Of screw & Pitch of Thread	mm x mm	*	
C.	Screw MOC		EN-8	
11.	**Drive details**			
A.	Motor Power	kW	*	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
B.	Motor Speed	RPM	*	
C.	Motor Duty	-	IE-3	
D.	Make of motor	-	*	
E.	Gear box type	-	*	
F.	Gear Ratio	-	*	
G.	Service factor	-	*	
H.	Primary Coupling type	-	*	
I.	Secondary Coupling Type	-	Geared	
J.	Model of Coupling / Make	-	*	
K.	Coupling Diameter	mm	*	
L.	Pitch of Chain & Type (Simplex / Duplex)	mm	*	
M.	No. of Teeth of Drive Sprocket (Power Transmission)	Nos.	*	
N.	No. of Teeth of Driven Sprocket (Power transmission)	Nos.	*	
O.	Make of Transmission Chain & Sprocket	-	*	
12.	**Bearing and Housing**			
A.	Bearing Type	-	*	
B.	Plummer block & Bearing Make	-	*	
C.	Tail Shaft Take Up Unit Block	-	*	
D.	UCT Unit Make	-	*	
13.	**Discharge Chute**			
A.	Plate Thickness	mm	*	
B.	Plate MoC	-	IS:2062	
14.	**Supporting Structure**		Yes	
A.	MoC	-	IS:2062	
15.	**Safety Switches**			
I.	**Zero Speed Switch (ZSS)**		Yes	
A.	Make	-	*	
B.	Type	-	Proximity type	
C.	Location	-	At tail end	
D.	Contact	-	2NO + 2NC	
16.	**Protection**			
A.	Earthing	-	Yes	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
B.	Guards for all rotating parts	Deg.	360°	
17.	**Testing & Inspection**			
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	
18.	**Performance Guarantees**	-	Chain Conveyor along with its control shall be guaranteed for the rated capacity against the rated speed of motions and for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
19.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
20.	**Drawings & Documents to be submitted during detailed engineering stage**			
A.	Technical Data Sheets	-	Yes	
B.	Manufacturer's standard quality plan	-	Yes	
C.	Materials test Certificates	-	Yes	
D.	Test certificates / reports for various shop test conducted	-	Yes	
E.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

21 LAB EQUIPMENT

This section is intended to cover the various lab equipment used in CBG plant. The list of minimum equipment to be supplied is furnished in this specification shall be complete in every respect & suitable for satisfactory operation of the CBG plant.
The sizes of machines / equipment and their capacity shall be selected by the Contractor based on the requirement specific to the equipment and systems being proposed by them.

21.1 Datasheet - Lab Equipment

21.1.1 The below datasheet/table outlines the minimum requirements for the Lab Equipment. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Lab Equipment to complete and efficient shall also fall under the bidder's scope of work.

21.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Laboratory Hot Air Oven (Total Solids Content) - Design Requirement**			
A.	Quantity	Nos.	*	
B.	Capacity	cm	*	
C.	Construction	-	Double walled construction. Outer body made of mild steel powder coated. Inner body made of Stainless-steel grade SS 304	
D.	Insulation		Glass wool insulation between two walls.	
E.	Temperature range	°C	50 - 250	
F.	Accuracy	°C	+/- 1	
G.	Temperature controlled by	-	Thermostatic	
H.	Shelves	-	*	
I.	Heater	-	Special nichrome heater designed for long life	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
			and saving of power consumption.	
2.	**Digital Muffle Furnace (Volatile solids content) - Design Requirement**			
A.	Quantity	Nos.	*	
B.	Capacity	cm	*	
C.	Construction	-	Double walled construction. Outer body made of mild steel powder coated. Inner body made of ceramic muffle make	
D.	Insulation	-	Special type ceramic insulation between body.	
E.	Coil	-	*	
F.	Temperature range	°C	Up to 1150.	
G.	Accuracy	°C	+/-1	
H.	Temperature controlled by	-	PID with dual LCD display for viewing set and current temperature	
I.	Safety	-	Special type thermocouple fuses to protect overheating. Overtemperature protection with separate display and controller	
J.	Sensor	-	K type calibrated sensor.	
3.	**Benchtop pH meter (pH measurement)**			
A.	Quantity	Nos.	*	
B.	pH meter, electrode stand, universal power adapter, literature CD, printed quick start guide, computer interface cable and meter test certificate.	-	Yes	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
C.	Waterproof BNC connector (ammonia combination)	-	Yes	
D.	BNC inputs: pH, ORP or ion selective electrode	-	Yes	
E.	Pin-tip (reference electrode)	-	Yes	
F.	8 pin MiniDIN (ATC temperature probe)	-	Yes	
G.	Stirrer input (stirrer probe)	-	Yes	
H.	Accessories for pH meter	-	Yes	
I.	Ion selective electrode, 1 m cable (ammonia combination)	-	Yes	
4.	**Digital automatic potentiometric titration apparatus (VFA, Acidity and alkalinity)**			
A.	Quantity (Full set)	Nos.	*	
B.	Glass electrode	Nos.	*	
C.	Calomel reference electrode	Nos.	*	
D.	Platinum electrode	Nos.	*	
5.	**Wood moisture meter (Moisture content in wood)**			
A.	Quantity	Nos.	*	
B.	Battery voltage	V	*	
C.	Dimensions	mm	*	
D.	Battery type	-	*	
E.	Weight	g	*	
F.	Accessories carrying case, 9 V battery and operational manual.	-	*	
G.	Operating humidity	% RH	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
H.	Accuracy	%	±1	
I.	Country of origin	-	*	
J.	No. of Batteries	Nos.	*	
K.	Display type	-	LCD (10 mm)	
L.	Display digit	-	2	
M.	Measurement range	%	5 - 40	
N.	Items in Pack	Piece	*	
O.	Resolution	-	0.01	
6.	**Vortex mixer (Mixing/Sample preparation for analysis)**			
A.	Quantity	No.	*	
B.	Type	-	Vortex mixer with brushless motor and suitable for interchanging mixing heads	
7.	**Electronic balance (Lab sample weighing)**			
A.	Quantity	Nos.	*	
B.	Capacity	kg	*	
C.	Accuracy	mg/g	100/0.1	
D.	Display type	-	Double display with tare facility	
E.	Battery backup	h	8	
8.	**Water still manesty pattern (Distilled water equipment for lab analysis)**			
A.	Quantity	No.	*	
B.	Capacity	l/h	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
C.	Material of construction of the entire unit	-	Stainless steel	
D.	Condenser	-	Shall be opened easily for periodic cleaning	
E.	Mounting type	-	Wall mounting	
F.	Heating elements	-	Without tubing and the entire heating element shall be easily replaceable	
9.	**COD digestors - Digital (COD analysis)**			
A.	Quantity	Nos.	*	
B.	Construction	-	1. Double wall construction with insulation for minimum heat loss. 2. Outer cabinet made of mild steel duly coated.	
C.	COD tubes	-	3. Aluminium block with holes.	
D.	Temperature controller	-	Solid state digital temperature controller with appropriate heater and insulation.	
E.	Selectable time	-	Up to 120 min. with alarm to set the digestion period.	
F.	Sample analyses after digestion	-	Colorimetric or titrimetric method	
G.	Temperature range	°C	Above ambient to 180	
H.	Resolution	°C	1	
I.	Display	-	Digital 12 mm red LED	
J.	Control	-	Digital electronic temperature controller	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
K.	Heater rating	W	*	
L.	Sensor material	-	*	
M.	Timer	Min.	Selectable 15, 30, 45, 60, 90 and 120 min with alarm	
N.	Glass tube quantity and diameter	Nos. & mm	*	
O.	Volume of each sample	ml	*	
P.	Number of COD tubes	Nos.	*	
10.	**Saccharometer: portable - handheld (Methane measurement)**			
A.	Quantity	Nos.	*	
11.	**UV Visible spectrophotometer (COD and protein, sugar, carbohydrates, lignin, etc. analysis)**			
A.	Quantity	Nos.	*	
12.	**Research centrifuge (Protein, carbohydrate and lipid estimation)**			
A.	Quantity	Nos.	*	
B.	Centrifuge accessory: Angle head	Nos.	*	
13.	**Oil free vacuum pump 1/16 HP, TID 25 (Sample filtration/preparation)**			
A.	Quantity	Nos.	*	
14.	**Soxhlet apparatus (Biomolecules analysis/extraction)**			
A.	Quantity	Nos.	*	
B.	Condenser for Soxhlet apparatus	Nos.	*	
C.	Allihn 400 mm	Nos.	*	
D.	Liebig 400 mm	Nos.	*	
15.	**Autoclave (semi-automatic) and accessories (Lignin analysis)**			

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
	Quantity	Nos.	*	
16.	**Quantities of lab glass wares and other accessories**			
	Desiccators set - Plain, clear glass (300 mm)	Nos.	*	
	Silica crucibles		*	
	• 25 ml	Nos.	*	
	• 100 ml	Nos.	*	
	Crucible tong		*	
	• SS tong 8"	Nos.	*	
	• SS tong 12"	Nos.	*	
	Thermometer: Temperature range -10 to 110 °C with 0.5 °C allowable deviation	Nos.	*	
	Conical flasks with narrow mouth		*	
	• 500 ml	Nos.	*	
	• 1000 ml	Nos.	*	
	Beakers		*	
	• 250 ml (Low form)	Nos.	*	
	• 500 ml	Nos.	*	
	• 1000 ml	Nos.	*	
	Measuring cylinders (Hexagonal):		*	
	• 50 ml	Nos.	*	
	• 100 ml	Nos.	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
	• 500 ml	Nos.	*	
	• 1000 ml	Nos.	*	
	Volumetric flask		*	
	• 100 ml	Nos.	*	
	• 250 ml	No.	*	
	• 500 ml	Nos.	*	
	Round bottom flask (B-24)			
	• 500 ml	Nos.	*	
	• 1000 ml	Nos.	*	
	Measuring jug (Euro design)			
	• 1000 ml	Nos.	*	
	• 5000 ml	Nos.	*	
	Wash bottle: 500 ml	Nos.	*	
	Funnel: 75 mm	Nos.	*	
	Dropping bottles: 60 ml	Nos.	*	
	Syringes: Plastic sterile with needle	Nos.	*	
	Spatula: SS spatula 8"	Nos.	*	
	Buchner funnel: 125 mm	Nos.	*	
	All Glass filter assembly: Millipore	Nos.	*	
	Retort stand: 9" x 6": Clamp boss head	Nos.	*	
	Heating mantle			
	• 500 ml	Nos.	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
	• 1000 ml	Nos.	*	
17.	**Quantities of lab chemicals and reagents**			
	KOH pellets (85% purified): 500 g	Nos.	*	
	Lead acetate paper strips	Nos.	*	
	Number of pH buffer capsules			
	1. pH 4.0 powder	Nos.	*	
	2. pH 7.0 powder	Nos.	*	
	3. pH 9.0 powder	Nos.	*	
	pH strips: Between 1 to 14	Nos.	*	
	Ethanol (laboratory grade): 500 ml	Nos.	*	
	Nitric acid (69-70%): 500 ml	Nos.	*	
	Sulfuric acid (98%): 2.5 L	Nos.	*	
	Ammonia water (25%w/v solution): 500 ml	Nos.	*	
	Cotton apron full	Nos.	*	
18.	**Personal Protective Equipment**			
	Gloves			
	1. Nitrile gloves of size - S, M, L, Box of 100	Nos.	*	
	2. Heat resistance asbestos gloves	Nos.	*	
	Safety masks: Special quality chemical gas mask with filter	Nos.	*	
	Safety goggles	Nos.	*	
	Tissue paper roll (Lab consumables)	Nos.	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
19.	**Lab testing and analysis**			
	Digital temperature	Nos.	*	
	Digital timer	Nos.	*	
	Magnetic stirrer	Nos.	*	
20.	**Data recording**			
	New desktop	Nos.	*	
	Printer	Nos.	*	
	UPS 600 VA	Nos.	*	

22 THERMAL INSULATION

22.1 General

This section is intended to provide the scope, design, constructional and functional requirements of thermal insulation for piping, valves, fittings and equipment's for the purpose of heat conservation, temperature maintenance, process stabilization, personnel protection.

22.2 Scope Of Supply

22.2.1 Thermal insulation

22.2.2 Marine grade aluminium Cladding material & Other Accessories materials.

22.2.3 Cladding sheet, all other ancillary materials i.e. Wires, Straps, Zinc coated Screws, Wire netting, Joint sealing compound, Ceramic mill boards, MS flats, Lugs, Bolts & Nuts etc. shall be of commercial quality.

22.3 Codes and Standards

ASTM C680 : Estimate of the Heat Gain or Loss

IS: 8183 : Bonded Mineral Wool - Specification

22.4 Design Requirements

Insulation Material

22.4.1 Thermal insulation shall be required for all hot piping and equipment with fluid temperature greater than 60°C and for piping and equipment for the following cases:

i. Conservation Energy and thereby increase system thermal efficiency

ii. Maintaining the process temperature

iii. Personnel protection

iv. Prevention of condensation

22.4.2 Piping and equipment shall be insulated with Mineral (Rock) wool material conforming as per the relevant code & provided as below:

i. Mineral (Rock) Wool material of density 150kg/m^3 shall be provided for piping and Fittings.

ii. Mineral (Rock) wool material of density 100kg/m^3 shall be provided for Valve Boxes and Equipment's.

iii. Insulation material shall be finally covered with cladding material.

Cladding material & Other Accessories materials

22.4.3 Cladding of Marine grade aluminium shall be required for piping and equipment for the following purpose:

i. Cladding over hot thermal insulation to protect insulation surface against moisture in air or rain, to prevent physical damages etc.

22.4.4 Insulation material shall have backup stainless steel hexagonal wire netting for interface temperature greater than 400°C & galvanized steel for interface temperatures less than & equal to 400°C. The insulation shall be backed with hexagonal wire mesh on one side.

22.4.5 Insulation material shall be wrapped and held in place using binding and lacing wires. The binding and lacing wires shall be of stainless-steel material for interface temperature greater than 400°C & galvanised steel for interface temperatures less than & equal to 400°C.

22.4.6 Insulation supporting arrangements for vertical piping and equipment's shall be provided.

22.4.7 The straps for securing Aluminium cladding sheet shall be of Aluminium material.

22.5 Construction requirement

Construction requirement of Insulation

22.5.1 Insulation work on piping and equipment shall be done after the system has been completely tested, cleared and cleaned of loose scale, rust, grease etc. and after application of primer.

22.5.2 Insulation materials shall be dry. If the materials become wet after application, they shall be dried or replaced before weather proofing work.

22.5.3 When applying cold insulating materials, care shall be taken to ensure that the material is applied at the recommended applied density.

22.5.4 When applying multi-layer material for cold insulation all joints shall be staggered, and each layer shall be separately secured in place. Unless otherwise specified, at least the final two layers shall be provided with a suitable vapour barrier where the operating temperatures are above 0°C.

22.5.5 For cold insulation, the lugs or other insulation supports used shall not be more than 75 percent of the total insulation thickness used in order not to puncture the vapour barrier.

22.5.6 Sampling lines shall be insulated. Controllers and instruments which are located indoors, together with tubing connected there to, shall not be insulated.

Piping

22.5.7 The Insulation material shall be properly butted to each other so that the fibres are interlocked at all longitudinal and horizontal joints.

22.5.8 All joints, gaps shall be densely filled with loose mineral wool. The mattresses shall be securely laced together at all joints with GI tie wires.

22.5.9 Where pipe work is being insulated, the valves and flanges shall be covered with removable box type insulation and a separate width of aluminium jacket shall be used over the insulation. The removable covers shall be secured in place by means of bands with quick release clips.

22.5.10 A small hole to act as a leakage indicator shall be formed in flange lagging.

22.5.11 For horizontal surface the longitudinal joints shall always be either at the bottom or on sides. When more than one layer of insulation is required, the circumferential joints shall be staggered by at least 50 mm.

22.5.12 Bends shall be insulated in the same manner as straight pipe except that the insulation shall be applied in mitred segments to conform to the contour of the bend.

22.5.13 Expansion joints properly filled with loose mineral wool shall be included to allow movement and expansion of the pipe without producing random tracking of insulation.

22.5.14 In the case of the greater insulation thickness (at least from 60mm upwards) spacer shall be provided to ensure a uniform insulating thickness on all sides and a perfect circular shape of the sheet metal jacket.

Equipment

22.5.15 For vertical surfaces of vessels and equipment, the insulation material shall be laced together along all joints and to the support rings immediately above them. This shall be further secured by 20mm wide 23 SWG, horizontal aluminium bands at about max 1 meter pitch. For dished ends of vessels, the insulation shall be secured by readily

tensioned 20mm wide 23 SWG marine grade aluminium bands fixed centrally to a wire ring at the outer ends to band round the body of vessel.

22.5.16 For insulation of equipment, supports of same metal as vessel, projecting to a point not more than half the thickness of the insulating materials shall be welded to the vessel to support the vertical insulation. The support shall be uniformly pitched at 500 mm. A support shall be located above each vessel flange at a sufficient distance above the flange bolts to allow for their easy removal.

22.5.17 Small cylindrical surfaces are insulated with mattress section. The edges of each mattress shall be butt jointed closely together, in order to eliminate gaps and secured with GI strap bands of 15 mm wide, 0.5 mm at intervals of 250 mm. The mats to be stitched together at the horizontal joint using 0.7 mm thick GI wire.

22.5.18 If the insulation is in several layers, joints shall be staggered. Each layer must be secured separately.

22.5.19 For Equipment / Pressure vessel nozzles including manholes, hand holes and their covers, line flanges, valves and other fittings, if any, shall be insulated with removable metal jacketed sections. The jackets shall permit removal and replacement of these parts without causing damage to the insulation.

Construction of Cladding

22.5.20 All joints of the cladding shall be bent true to shape, properly grooved and overlapped (min 25 mm) and neatly screwed with self-tapping rust proof screws of size M4 x 12 mm. The self-tapping screws shall be cadmium plated and shall be flat or round headed. In addition, to these screws the sheet metal joints shall be sealed with bituminous mastic or equivalent joining compound.

22.5.21 The application of the cladding such that the vapour barrier of the cold insulation shall be effective and prevent moisture migration into the body of the insulation which will cause deterioration in the insulation value, physical damage to the insulation and corrosion of the cold surface.

22.5.22 During application of the vapour seal over cold insulation, special care is to be taken that it shall be carried down over all exposed edges of the insulation.

22.6 Datasheet - Thermal Insulation

22.6.1 The below datasheet/table outlines the minimum requirements for the Thermal Insulation. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Thermal Insulation to complete and efficient shall also fall under the bidder's scope of work.

22.6.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

23 HEATING VENTILATION AND AIRCONDITIONING SYSTEM

23.1 General

This specification includes the Design, Manufacture, Supply, Erection, Testing & Commissioning of Ventilation and Air conditioning system. The proposed Ventilation and Air conditioning system shall be designed as per the design criteria and material specification given in this specification.

23.2 Scope of Work

The scope of work covered under this specification include but not limited to design, fabrication, manufacture and assembly, inspection, shop testing at manufacturers works and transportation to site, supply, erection of the system as specified herein.

23.2.1 Package type AC Units or Air-cooled DX type air-conditioning system (up to 40TR)

23.2.2 Centralized AC system (More than 40TR) with air cooled condensing units and DX coil AHUs.

23.2.3 Split type air-conditioning units (Up to 10TR)

23.2.4 Ventilation system for the entire plant buildings

23.2.5 All control, measuring and monitoring equipment necessary for matching to specific designs of equipment and units.

23.2.6 Hot dip galvanized ductwork.

23.2.7 All necessary pipework, expansion joints, valves, automatic actuators, supports, fastenings, etc.

23.2.8 All necessary base frames, base plates, anchor bolts, supports, covers, etc.

23.2.9 Civil foundations, embedment, insert plates

23.2.10 All necessary painting, corrosion protection and preservation measures as required.

23.2.11 Complete detailed labelling of all installations as required.

23.2.12 All consumables such as lubricants, chemicals, etc. for the first

23.2.13 One set of special tools and equipment for maintenance, inspection, and repair in steel boxes, including identification and operating instructions as well as equipment for storing dismantled parts during inspection.

23.2.14 All services as required such as transport erection, commissioning, and test on completion, training on site, supervision of operation and maintenance during the guarantee period.

23.2.15 All pipe and pump-sizing information contained in these contract documents is indicative only. Contractor shall take full responsibility for system sizing based upon

actual equipment to be provided. Contractor shall confirm sizing of all chemical systems and components, including, pipes, pumps, and ancillary systems.

23.2.16 All materials and components of valves, pumps, piping and other equipment and appurtenances shall be compatible with the respective chemicals herein.

23.2.17 Equipment shall be fabricated, assembled, installed, and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer as approved by the engineer.

23.2.18 To facilitate the owner's future operation and maintenance, products shall be of the same major manufacturer, with devices of the same type and model as far as possible.

23.2.19 The contractor shall design and provide cables, conduits, cable trays, installation material and fittings to connect motor and electrical and instrumentation devices furnished under this part of this specification.

23.3 Description of the system

23.3.1 Air cooled DX type air-conditioning system will be provided for the following areas:

ii. Control room

iii. VFD panel room

iv. Any other areas/building as required within the Plant area (more than 10 TR)

23.3.2 Each Air-cooled DX type air-conditioning system consists of condensing unit, air handling unit etc,

23.3.3 2x100% (1working + 1standby) Air Cooled Direct Expansion (DX) type Air Conditioning system shall consist of Microprocessor controlled air cooled DX unit consists of the hermetically sealed/semi-hermetic compressor will be of the scroll compressor type directly driven by 3-phase unit mounted starter, automatic capacity control etc /electric motor and suitable for use with refrigerant R407C or ecofriendly gases. The condenser will be of air-cooled type and will be constructed with seamless copper tubes & aluminium fins type with cooling coil capacity equal to the total refrigeration capacity required plus compressor and condenser power, designed as per ASHRAE-15 standards.

23.3.4 2x100% (1working + 1standby) Air Handling Units will be provided. The air handling fan will be DIDW centrifugal type complete with belt drive and electric motor. Each unit shall include a primary source of refrigeration for cooling and dehumidification, means for circulation and cleaning air. Copper refrigerant piping complete with insulation between the indoor and outdoor units as required will be provided. First charge of refrigerant and oil will be supplied with the unit. Cooling coils will be of direct expansion type and made of heavy gauge copper with aluminium fins. Rows will be staggered in the direction of air flow. Separate tubing from the distributor shall feed refrigerant

uniformly to different sections of the coil. Refrigerant piping will be of heavy gauge copper pipe complete with thermostatic expansion valve, liquid strainer, dehydrator, liquid line shut off valve, high- and low-pressure gauges. Face and by-pass dampers of opposed blade type will be provided for DX coil AHU. The area of the bypass damper will be minimum 30% of the coil face area. Damper operating linkage and the operating motor will be located outside the casing. Based to the actual air conditioning load inside Control room, Control equipment room & switchgear room of Switchyard control building, flow of return air will be bypassed through the damper to maintain the inside room conditions. Condensate tray will be formed to slope from all directions to drain connection. Condensate tray of adequate size, made of corrosion-resistant coating will be provided. Condensate tray will be insulated with polystyrene or polyurethane insulation. Non-return damper shall be provided in AHUs.

23.3.5 Pre-filters will be provided in suction of each AHU. Pre-filter at the suctions to remove dust particles down to 10-micron size with 90% efficiency. Fine filter along with differential pressure gauge will be provided in the common supply air ductwork on downstream of AHU's. Fine filters to remove dust particles down to 5-micron size with 99% efficiency at the outlet. All filters will be of panel type.

23.3.6 Electric strip heaters of adequate capacity with controls will be provided in the common supply air ductwork on downstream of AHUs for heating purpose during monsoon and winter seasons.

23.3.7 Pan type humidifiers with controls, overflow and drain connection will be provided in the AHU room. Suitable duct connection with thermal insulation will also be provided from Pan Humidifier to supply air duct.

23.3.8 Cooling coils will be of direct expansion type and made of heavy gauge copper with hydraulically bonded aluminium fins. Rows will be staggered in the direction of air flow. The room temperature will be achieved by thermostats sensing the temperature in the return air path. Thermostats will send signal to solenoid valve to Specific de-humidification cycle (Split Liquid / Split Suction) shall operate by reducing the operating surface temperature in a section of one of the Refrigeration coils by means of a solenoid valve in the Liquid line / Suction line. Full air flow of the unit will be always maintained to ensure consistent air distribution to the conditioned space. Humidity will be controlled by electric heater & pan type humidifier through room humidistat.

23.3.9 Air distribution system will comprise of GSS sheet (grade 275 of IS:277) ducting for distributing conditioned dehumidified air along with supply air diffusers and return air grilles with volume control dampers, fire dampers and necessary splitters etc., suitable fixtures for grilles/diffusers and supports for ducting complete with Thermal insulation of duct with 50mm thick resin bonded fibre glass wool of density 48kg/m3 and TF quality finished with 26SWG aluminium cladding. For Exposed ducting, 50 mm thick resin bonded fibre glass wool (density 48kg/m3 and TF quality) finished with 26SWG aluminium cladding and acoustic Insulation of initial 6 meters of supply air duct from

AHU air outlet will be acoustically insulated with 25mm thick fiberglass rigid board of density 48kg/m3 and will be covered with 26SWG aluminium perforated sheet will be provided.

23.3.10 Power, control cable and earthing, all instruments and local control panels along with controls, every individual DX-type condensing unit will have its integral control system for safe and trouble-free operation of the units will be provided as per manufacturer's standard.

23.3.11 Controllers will be provided for control room, control and monitoring of AC units and shall have the following facilities:

v. Standby units shall come into operation automatically when the running main unit fails.

vi. Main and standby units will be changed over periodically.

vii. Following alarms will be provided:

viii. Compressor On/OFF condition of each unit

ix. Compressor failure of each unit

x. Power OFF to AC unit

xi. High temperature in room

xii. Cutout for low water level in humidifier

xiii. Cutout due to overload of all motors

xiv. High temperature cutout for electric strip heater

xv. Stopping of AHU fan in case of fire

xvi. Chocking of fine filters

23.3.12 Split type air-conditioning units will be provided for the following areas,

i. Lab Room,

ii. Small VFD panel room / control room (up to 10TR),

iii. Any other areas/building as required within the Plant area (up to 10TR).

23.3.13 Split type air-conditioning units shall consist of the followings,

i. Outdoor unit comprising of Compressor and Condenser

ii. Indoor unit comprising of DX-Cooling coil, Blower, and Coarse filter.

iii. Outdoor unit consisting of hermetic / semi-hermetic rotary/scroll type compressor, on anti-vibration mounts, air cooled condenser of seamless copper with aluminium fins, design & construction. Condenser coil will be copper tube, with mechanically bonded aluminium fins with weatherproof coating. Condenser fan will be aluminium propeller type, directly connected to motor. Condenser fan motor will be permanently lubricated, with integral thermal overload protection. Refrigeration circuit with R410a/R-134a/ecofriendly

refrigerant filling, refrigerant drier, thermostatic expansion valves unit control panel barrier all control interlocks, power supply contactor etc. Air cooled condensing unit casing will be steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Brass service valves, fittings, and gage port will be provided on exterior of casing.

iv. Indoor unit consisting of direct expansion cooling and dehumidifying coil, which will be standard staggered tube arrangement with seamless copper tube and aluminium plate fin mechanically bonded to copper shall be sized, design and construction, three speed forward curved DIDW centrifugal fan unit, insulated drain pan, coarse filter panel, casing of aesthetically designed ABS moulded plastic construction for direct mounting unit. Indoor unit will be walling mounted type. Refrigerant piping from outdoor unit to the indoor unit will be thermally insulated.

v. The conditioned air shall directly discharge into the space depending upon the space orientation, distribution effectiveness and architectural requirement. The split unit shall be located suitably within the conditioned space and hence directly taking return air from the space without any ductwork.

23.4 Ventilation System

23.4.1 Ventilation system will be provided for all the cable spreader rooms, battery rooms, pump houses, Equipment area building, ETP Building, Admin building, DG Building, Stores, which are manned by operating and maintenance personnel.

23.4.2 Ventilation system will be provided for various buildings or rooms to control indoor air quality by diluting and displacing indoor pollutants; it can also be used for purposes of thermal comfort to achieve desired indoor conditions.

23.4.3 The ventilation system will be provided for the cable vault, battery room in the control buildings and pump houses, to achieve inside design conditions for proper performance of equipment and personnel.

23.4.4 The following type of ventilation system will be provided.

i. Ambient air ventilation (Dry) system

ii. Supply air ventilation system

iii. Exhaust ventilation system

23.4.5 Supply air ventilation system for Cable Vault. Fresh air is supplied through a wall mounted fan-filter unit comprising of tube axial fan, intake louver, cowl, bird screen, short ducting and pre filters, complete with supports and hardware. Supply air ventilation system shall consist of:

i. Wall mounted fan-filter unit for supply of fresh air, comprising of tube axial fan, drive motor, intake louver, cowl, bird screen, short ducting and pre filters, protective screen, complete with supports and Hardware.

ii. Wall mounted gravity dampers for exhausting the air.

23.4.6 Simple Exhaust Ventilation System for pump house, DG building, Battery room, stores and Toilets etc.

23.4.7 The rooms will be provided with wall mounted axial flow exhaust fans complete with drive motor, cowl with bird screen and gravity dampers. Fresh air to the above areas will be provided through wall/ door mounted intake louvers or through infiltration. Toilets will be provided with propeller fan for exhaust system. Simple Exhaust Ventilation System shall consist of:

i. Wall mounted axial flow exhaust fans comprising of drive motor, cowl with bird screen and Gravity dampers, protective screen, complete with supports and hardware.

ii. Wall / door mounted intake louvers (or otherwise through infiltration).

iii. Simple Exhaust Ventilation System for Battery room:

23.4.8 The battery room will be maintained at negative pressure to prevent leakage of fumes to outside from the battery rooms. The hot air from the battery rooms will be exhausted by means of 2x100% bifurcated tube axial fans with flame proof motor to avoid direct contact of motor with toxic gases/acid fumes. Ducting, grilles, fans, motors provided for battery rooms will be painted with acid and fume resistant paint.

23.5 General Technical requirements

23.5.1 Each air conditioning and ventilation plant shall be a self-contained, functionally reliable unit, which is suitable for the appropriate building, with respect to performance and choice of system and with respect to the special arrangement, the dimensions, and the weights.

23.5.2 Separate plant rooms are to be provided for the air-conditioning equipment viz. all equipment shall be placed in such a manner that sufficient space (as recommended by the manufacturer) is available for servicing and maintenance.

23.5.3 All equipment, ducts, pipes, controls, etc. shall be fully treated against corrosion and sealed against moisture, sand, and dust ingress.

23.5.4 All plant including ducts and pipes as well as machines shall be vibration isolated or otherwise treated that:

23.5.5 No excessive vibration is felt in the floors or walls of the rooms served by any machine.

23.5.6 The mechanically induced vibration levels in floors, walls and ceilings of rooms are sufficiently small as to avoid the radiation of sound power to the rooms at such a level as to exceed the relevant criteria.

23.5.7 All refrigeration machines shall use ozone friendly refrigerant.

23.6 Design criteria

23.6.1 Design Input

A. Outdoor Design Conditions:

Season	Dry Bulb Temp. (°C)	Wet Bulb Temp. (°C)
Summer	As per Site condition	As per Site condition
Monsoon	As per Site condition	As per Site condition
Winter	As per Site condition	As per Site condition

23.6.2 Design Criteria for Air-conditioning

A. Indoor Design Conditions:

i. Dry bulb temperature : As per Site condition

ii. Relative humidity : As per Site condition

B. Minimum design margin of 10% will be considered while sizing the AC Plant related equipment like condenser water pumps, air handling units etc.

C. 12.5%, 10% & 10% margins on sensible heat, latent heat & overall heat respectively will be considered while calculating heat load.

D. Heat dissipation of panels will be considered in the equipment sizing calculation for summer and monsoon season. 50% of equipment load will be considered for winter load calculations.

E. For fresh air quantity, number of air changes per hour will be min.1.5 or 34 CMH/person, or suitable to maintain over pressure of 2 mmwc, whichever is higher.

F. For Chemical Lab, air conditioning system will be designed duly considering 100% fresh air Lighting load 2 watts/ft2 or actual whichever is higher will be considered for heat load calculations.

G. The redundancy shall be considered for the air conditioning shall be 100% for Package and AHU type AC units. For Split AC unit, the redundancy shall be one no. of additional quantity from the required quantity. Also, the redundancy of the Split AC unit is not required for the rooms like office room, meeting room and conference room.

H. Heat dissipation of panels will be considered in the equipment sizing calculation for summer and monsoon season. NO equipment load will be considered for winter load calculations.

I. To reduce the air conditioning load, the exposed roof slabs (Including beams and column etc.) of air conditioning areas, air handling units room and Packaged Air conditioners (PAC) rooms will be insulated with 50 mm thickness fibre glass insulation of density 48 kg/m3 finished with 26 swg aluminium cladding.

J. AHU room's walls ,Packaged Air Conditioners room's walls and first 6 meters of supply air duct from AHU/PAC air outlet will be acoustically insulated with 25 mm thick fiberglass crown 150 of density 48 kg/m3 and will be covered with 26 G aluminium perforated sheet. Perforation area will be 30% of free area.

K. Thermal Insulation Design Criteria

Equipment / Material	Thermal Insulation
Ducting	25 mm thick fibre glass of density 48 kg/m3 and TF quality finished with 26 swg aluminium cladding. For Exposed ducting, 50 mm thick fibre glass rigid board (density 48 kg/m3 and TF quality) finished with 26 swg aluminium cladding.
Refrigerant Piping for Split Air Conditioners and Packaged air conditioners	13 mm thick Nitrile foam.
Drain Piping from AHU / Indoor unit	25 mm thick EPS (TF quality) of density 16 kg/cu.m. covered with Sand Cement Plaster.
AHU	Double skin with PUF
Precision Package AC	As per Manufacturer standard

L. For heat load calculations, the occupancy as follows will be considered

i. General/Office Areas — 1 Person per 3 m2

ii. Control Rooms/Control Equipment Rooms — 1 Person per 20 m2

iii. Conference Rooms — 1 Person per 1.5 m2

M. False ceiling will be provided in all air conditioning areas.

N. Air conditioning system design noise level will be of NC 35-45 within Control room, Control equipment room, instruments and electronic room and offices.

O. Face velocity across air inlet louver will not exceed 2.5 m/s

P. Velocity across volume control damper will not exceed 10.5 m/s

Q. Duct design velocity will be 7.62 m/s (max) for main duct, 6.00 m/s (max) for branch duct and 2.00 m/s for diffuser / grills

R. Coil face area for air handling units will be designed considering a face velocity of not more than 2.5 m/s

S. Water piping of gravity flow line will be sized for a maximum water velocity of 1.5 m/sec.

T. Refrigerant suction, discharge/hot gas lines & liquid lines will be sized such that the total pressure drop is equivalent to not more than 1.1 deg C in saturation temperature of refrigerants. However, refrigerant velocity will not be greater than 0.5 m/sec in liquid line.

U. Calculation of friction loss in piping system: WILLIAM & HAZEN formula will be used with C value as 100.

V. All the pumps will have 10% margin on capacity and head over the actual requirement.

W. All fire dampers for air conditioning system application will be provided / operated with solenoid actuator.

X. The type of air conditioning system for various buildings is given in schedule of the type of system.

Y. Motor operated valves will be provided as per system requirement for chilling machines, pumps, cooling towers to facilitate remote operation of entire air conditioning plant and to select stand by unit.

Z. Plant for all air-conditioned areas will operate continuous (24 hours a day, 7 days a week except during loss of normal power failure)

AA. All windows in the air-conditioned area will be provided with light-coloured venetian blinds.

BB. The Air-conditioning spaces will be maintained at positive pressure of 2 mmwc to avoid any infiltration of dust.

CC. The air distribution system will be sized to have a constant frictional drop up to 0.8 Pa/m.

DD. All carbon steel sheets under air conditioning system ducting application will be hot dip galvanized, or spray galvanized unless otherwise specified and minimum zinc deposition will conform to grade 120 of IS:277.

EE. The air-conditioning spaces will be maintained at positive pressure to avoid infiltration of dust.

FF. Noise level within the air-conditioned space will be restricted to 35-45 NC level.

23.6.3 Design Criteria for Ventilation System

A. The ventilation system will be designed to maintain the dry bulb temperature not exceeding 50C above design ambient summer temperature (heat load basis) or based on number of air changes per hour, whichever is higher.

B. No. of air changes per hour as mentioned below table for various area,

Area description	Air changes per hour
Cable vault	10
Electrical / mechanical Equipment room or building	15
DG Set Room	20
Pump house	15
Battery room	30
Compressor room	20
Toilets	15
Chemical lab	40
All other buildings	20

C. Ventilation system for all areas will operate on 100% fresh air basis.

D. A minimum 10% margin will be considered while sizing the equipment capacity.

E. All the equipment of ventilation system will be designed for continuous duty for continuous operation of 24 hours a day, all indoor and outdoor installed units.

F. Supply air fans, exhaust air fans for ventilations of each area will be provided with local starter panels.

G. Pre-filter will be washable HDPE type having efficiency not less than 90% for particles down to 10 microns and Fine filter will be synthetic non-woven washable type having efficiency not less than 99.9% for particles down to 5micron size.

H. The speed of the fans will be 1440rpm for impeller diameter 450mm or less and 960rpm for impeller diameter above 450mm.

I. For the fans having static pressure rise of 30mmWC or above, the speed limitations will be 1440rpm (Impeller diameter will be above 450mm) and 2800 rpm (Impeller diameter will be less than and equal to 450mm). The critical speed will be well above the operating speed.
J. The velocity of air in ventilation ducts will not exceed 12 m/sec and through grills do not exceed 3m/sec and the duct will be rectangular shape. The construction of ducting will be as per IS: 655.
K. All ducts for ventilation system will be manufactured of at least 1 mm thick G.I sheet. Ducts of large side exceeding 1300mm dimension will be manufactured of 1.25mm G.I. sheets. G.I. thickness will be as per IS: 277.
L. Lighting load of 2 W/ft2 will be considered for all areas in the ventilation system design calculations.
M. All the ventilation fans will be stopped automatically during fire.
N. Supply air fans/Exhaust air fans / Roof exhausters will be in multiplicity.

23.6.4 Centrifugal Fans:

i. Centrifugal fans for AHU shall be DIDW forward curved designed & selected to operate within 9% and 25% of system throttling line. Fan shall be driven with V-belt by a totally enclosed motor and the fan outlet velocity shall not exceed 9 m/sec.

ii. Impeller shall be die-formed aerofoil or laminar type of self-cleaning and non-overloading characteristics. The impeller shall be statically and dynamically balance according to ISO standard.

iii. The fan casing shall be of welded construction and provided with flanges on inlet & outlet side for duct connection.

iv. The fan impeller & casing etc. shall be protected by a suitable corrosion resistant finish. All fans shall be suitable for 2 years continuous operating without servicing.

23.6.5 Fan Filter Unit (Ventilation)

i. Unit consisting of either tube axial fan or centrifugal fans, prefilter section, louvers, casing etc. The prefilter section shall comprise of 50 mm thick washable filter panel suitably arranged in holding frames. The filter shall have a minimum efficiency of 90% down to 20 microns size.

ii. The unit casing shall be galvanised sheet steel construction, weather proofed or stored enamelled against corrosion with mounting frames or facility to either fix on support with the wall or suspend from ceiling. The casing shall be provided with an outlet flange to facilitate duct connection.

23.6.6 Wall mounted Axial Flow Fan

i. Directly driven axial flow fans with die cast aluminium impeller dynamically balanced, fitted with three-phase induction motor.

ii. The fan casing shall be of galvanised steel material, fan shall be provided with exhaust / inlet cowl. Bird-screen, back-draft damper, (where necessary) grouting frame and cadmium plated fixing bolts.

23.6.7 Roof Mounted Axial Flow Fans

i. Casing of galvanised steel, fixing bolts cadmium-plated, impeller blades of aluminium casting dynamically balanced, fitted with three-phase electric motor.

ii. Cover rainproof finished with protecting flap, exhaust-connecting piece with flexible branch and automatic baffle-plate, terminal protection box outside.

iii. Cases shall be formed in such a manner to ensure a weatherproof construction and fitting to the building structure. Adequate access to motor terminals and lubricating points shall be provided by means of hinged cowls or otherwise as appropriate. Back-draught dampers shall be provided with all roof-mounted axial flow fans.

23.6.8 Air Distribution System

i. Ductwork: The ductwork inside the building shall be manufactured form hot-dip galvanised sheet metal and duct construction shall be as per IS: 655.

ii. All connections to equipment shall be made with angle-flanged joints plate rooms and for long runs, angle-flanged joints shall be included at 10-meter intervals.

iii. All ductwork support ties to the structure shall be made resilient with the use of 12mm thick non-intercellular neoprene strip, gaskets, or washers. All ductwork connections to air handling equipment shall be made via 10 cm long EPDM Coated canvass flexible connections or similar equal and approved material.

iv. Bends and offsets shall have a minimum throat radius equal to the width of the duct. Where shorter radius bends than the width of the duct are taken internal splitters or turning vanes shall be used.

v. Adequately sized air-tight access doors with quick release fasteners shall be provided where necessary.

23.6.9 Air Ducts Made of Plastic Material:

Straight ducts and shaped parts with rectangular cross-section made of PVC-hard or polypropylene, shall be fire-resistant. Wall thickness minimum 3mm, duct connections by glued sleeves, hanging and supporting as described under galvanised air ducts before.

23.6.10 Supports for Ductwork:

i. Supports shall generally comprise hot-dipped galvanised mild steel sections and drop rods assembled in a suitable manner to permit adjustment for height and alignment of the ducts, and to prevent the transmission of vibration and/or noise.

ii. Ducts shall be supported by the stiffening angles or angle flanges but where this is impractical, supporting angles shall be fixed to the ducts. All ductworks shall be supported in such a manner that no weight is imposed upon the plant to which it is connected.

iii. All mild steel sections used for the construction of ductwork supports shall be hot dip galvanised.

23.6.11 Supply and Exhaust Air Grilles:

i. In conventional attractive design, lamellas adjustable, aerofoil shape, all parts correctly sanded, broad front frame to allow airtight mounting. Frame and lamella made from steel with agreed stove enamel finish or similar, conserved in nature colour. Covered screw mounting with use of mounting frame shall be provided.

ii. Air-flow control by means of counter-moving, coupled lamellas, with sets of adjustable air deflection blades and an opposed blade damper located at the rear, adjustable from the front side, made of phosphatized sheet metal and varnished black.

23.6.12 Supply Air Diffusers:

i. Square construction for mounting in anodised false ceilings. Air vanes in lamella form for air distribution to all sides, made from Powder coated aluminium. Connection boxes in air-foiled construction made of galvanised sheet metal with built-in throttling device and circular connecting piece.

ii. Ceiling diffusers shall be of the adjustable eyelash deflection blade type and shall have an opposed blade damper located at the rear. The diffuser shall be fixed to the ductwork by a purpose-made sub-frame assembly.

23.6.13 Fire Dampers:

Fire dampers shall be provided at various at locations in VAC system as per NFPA 90A recommendation dampers designed shall be as per UL-555 and consisting of the housing, made of galvanised sheet metal, lamellas made of special insulating material, lamella bearings in stainless steel resp. brass sleeves, serving control elements arranged on the outside such as levers and position indicators, manual release, notching arrangement, inspection door, thermal release by melting solder at 72°C, electrical and position switch for indicating of position on the switch board, and with potential free contact for fire alarm panel of fire detection system. Fire dampers shall be UL approved.

23.6.14 Dampers:

i. Consisting of frames of galvanised sheet metal, air foiled lamellas, adjustable from the outside by a lever and positioning device.

ii. Lamella clutches by aluminium cogs mounted inside, bearing sleeves closed to the outside, including mounting flange for connection to an air-duct or mounting into an A/C-chamber.

23.6.15 Air Quantity Regulating Flaps:

i. Air quantity regulating flaps for balancing, during first step of operation, of the mathematically--determined air quantities in each duct branch. These throttling devices shall be arranged in supply air ducts as well as in return air ducts.

ii. Weather Louvers: Consisting of hot-dipped galvanised angle-iron frame with built-in rain-rejecting aluminium lamellas as well as bird protection screen of galvanised iron. Mounting frame of galvanised profile steel.

iii. Disc Valves: Made of plastics with conical-formed entrance ring and valve plate in air-foiled design. The entrance ring shall be designed in such a manner that no dirt-ring can form around the valve. The valve plate shall be equipped with a filter of sound-absorbing material reducing noise transmission.

23.6.16 Thermal Insulation:

i. The entire supply air ducting for air conditioning system shall be insulated with 25 mm (24 kg/m3) resin bonded fibre glass covered thermal insulation. The Portion of supply air ducting passing through outdoor / non air-conditioned space shall also be insulated with 100 mm/ 50 mm thick resin bonded fibre glass thermal insulation respectively.

ii. Only portion of return air ducting passing through non air-conditioned space shall be provided with 25-mm thick (24 kg/m3) resin bonded fibre glass thermal insulation.

iii. Insulation shall be fixed as per manufacturer's recommendation. The fibre glass insulation roll shall have 0.5 mm thick aluminium facing. and shall be laid with staggered joints, sealed with aluminium tapes. Insulation roll shall be attached to ducts with Bitumen (85/25 or 85/40) or CPRX sticking compound and insulation. Due care shall be taken to avoid damage to vapour arrestor & insulation.

iv. For the portion wet ventilation system ducting exposed to outdoor ambient, thermal insulation with 50 mm thick expanded polystyrene slab Tf quality (Normal density) covered with layers of PVC sheets pasted, hexagonal wire netting 15 mm thick sand cement plaster and finally covered with 0.5 mm aluminium / GI sheet shall be provided.

23.6.17 Acoustic Insulation: Acoustic Insulation of 12 mm thick rigid fibre glass board covered with 1 mil thick fibre glass cloth or Kraft paper shall be provided on the inside of supply ducting up to 6 mt from each air-conditioning system air handling units/fan coil units.

23.6.18 Noise Attenuation: The Equipment and Air distribution system for control and office room air conditioning shall be designed such that the Noise level in rooms shall not exceed NC 50 of ASHRAE.

23.7 Control philosophy

23.7.1 All necessary operational controls, regulating controls, automation, measuring and monitoring required to cope with the equipment duty are to be so designed and arranged such that operation of the plant can be fully automatic or, if required fully manual. All necessary interlocking and alarm circuits shall be arranged so as to eliminate any possible damage to the plant due to malfunctioning of instruments or any probable operational mistakes.

23.7.2 It must be possible to start the Air-conditioning and ventilation plant from local skid/floor/wall mounted control cum annunciation panels. Only those alarm which are required to indicate malfunctions or failure of the AC units Plant shall be transmitted to the central control room.

23.7.3 Instrumentation has to be provided as far as required for safe and satisfactory operation and supervision of the plant. Adaptation of the specified scope and design of the control and instrumentation equipment shall be done where needed for matching the special versions and requirements of apparatus and plant equipment.

23.8 Codes and Standards

23.8.1 This system and all associated piping shall be designed, manufactured, inspected, tested, to well established engineering practices and safety codes of the latest applicable British / American / ISO standards.

23.8.2 Design, manufacture, inspection and testing of the equipment shall unless otherwise specified, conform to the latest edition of the codes and standards mentioned below:

i. American Society of Heating, Refrigeration, and Air Conditioning Engineers – ASHRAE

ii. American Refrigeration Institute (ARI)

iii. American National Standard for Centrifugal pumps, Hydraulic Institute, U.S.A

iv. Sheet Metal Manufacturers Association (SMACNA)

v. Heating and Ventilating Contractor's Association (H.V.C.A.).

vi. NFPA – National fire protection association

vii. Air movement and Control Association International - AMCA

viii. ANSI B73.1: Specification for Horizontal, end suction, centrifugal pumps for chemical process.

ix. IS 325 - Three phase induction motors

x. IS 655 - Metal Air ducts

xi. IS 2312 - Propeller type AC ventilation fans

xii. IS 3588 - Electric axial fans

xiii. IS 4894 - Centrifugal fans

xiv. UL 555 - Fire dampers

23.9 Inspection and Testing

The Inspection and Testing requirement of equipment and components of the HVAC system shall be as specified in the equipment data sheet and the in accordance with respective chapter of this bid document.

23.10 Test at Manufacturer's works

The HVAC system shall be provided with following guarantees on performance during testing at manufacturer's works.

23.10.1 Blowers and fans

i. All centrifugal pumps shall be provided with the following guarantee in performance.

ii. Capacity, head and efficiency.

iii. Power consumption

iv. Noise level limited to 85 dBA at 1.5 m from the motor.

v. No negative tolerance is acceptable on capacity and head.

23.10.2 Unitary Air-conditioners

All unitary air-conditioners shall be provided with the following guarantee in performance.

i. Capacity, efficiency.

ii. Power consumption

iii. Noise level limited to 85 dBA at 1.5 m from the motor.

23.11 Test at Site

Guarantees and Rejections of the HVAC system for "Test After completion" at site shall be in accordance with respective chapter of this bid Specification.

23.12 Specified Designed Data for Air-Conditioning System

SL No.	Description	Unit	Data
23.	Air-cooled DX type air-conditioning system		

SL No.	Description	Unit	Data
A.	Type	-	Air-cooled DX type AC Units
B.	Compressor		
	3. Type	-	Hermetically/Semi-hermetic sealed scroll type
	4. Refrigerant	-	R407C or equivalent refrigerant
C.	Motor rating	-	Minimum 10% more than the power required by the compressor.
D.	Condenser		Air cooled type – Fin and fan type
	5. Condenser coils	-	Copper tube with aluminium fins
E.	Air handling unit		DX type AHU
	6. Casing Type	-	Double skin, sandwich panel
	7. Casing Material	-	18 SWG : GI sheet (class 275 of IS:277) with 25 mm thick polyurethane insulation in between (minimum density 40 kg/m3).
	8. Type	-	DX type
	9. Coil construction	-	Copper tube with aluminium fin mechanically bonded
	10. Fin spacing	-	Should not exceed 13 per inch.
	11. Coil face velocity	-	2.5 m/s
	12. Fan Type	-	DIDW forward/backward curved centrifugal fan
	13. Fan casing	-	Galvanized Steel Sheet, 3 mm thick
	14. Fan Shaft	-	EN8
F.	Fan Impeller		Mild steel spray galvanized with minimum zinc deposition conforming to Class 275 of IS: 277.
	1. Drive	-	Motor driven, coupled with fan through V-belt and Pulleys
	2. Fan Outlet Velocity	-	< 11m/s
	3. Filters	-	
	4. Type	-	Pre Filter
	5. Filter material	-	Washable HDPE type
	6. Filter efficiency	-	90% down to 10microns
	7. Velocity across filter	m/s	Not more than 2.5m/sec.

SL No.	Description	Unit	Data
	8. Pressure drop	-	Initial pressure drop - Not to exceed 5.0mmWC at rated flow, final pressure drop – Up to 7.5mmWC.
	9. Type	-	Fine Filter
	10. Filter material	-	Synthetic non-woven washable type
	11. Filter efficiency	-	99.9% down to 5micron size
	12. Fine filter – Face Velocity	-	Not more than 1.2m/sec for 150mm and not more than 2.4m/sec for 300mm.
	13. Pressure drop	-	Initial pressure drop - Not to exceed 10mmWC at rated flow, final pressure drop-Up to 18mmWC.
23.	Split type air-conditioning units		
A.	Type	-	Air-cooled Split type air conditioning units
B.	Maximum operating ambient temperature	°C	50°C
C.	Star rating	-	Minimum 5 star
D.	Refrigerant gas	-	R410A/R134a or Equivalent
E.	Rated power supply - input	W	*
F.	Control	-	Cordless Remote – Microprocessor control (LCD display)
G.	Indoor Unit	-	
H.	Dimensions (WxDxH)	mm	*
I.	Cooling Coil	-	Internally grooved copper tubing with aluminium fins
J.	Blower fan	-	Cross flow type
K.	Filter media	-	Non-woven synthetic type, washable
L.	Efficiency	-	90% down to 20 microns
M.	High/Med/Low	CFM	*
N.	Indoor Noise level	dB(A)	35 to 40
O.	Outdoor Unit	-	
P.	Electric Power supply	-	*
Q.	Compressor type	-	High EER Rotary / Equivalent

SL No.	Description	Unit	Data
R.	Condenser coil	-	Internally grooved copper tubing with aluminium fins
S.	Condenser fan	-	Propeller
T.	Connection pipe	-	Copper to Copper pipes
U.	Dimensions (WxDxH)	-	*

Note: Mark * - Data will be provided by the equipment supplier based on their products.

23.13 Specified Designed Data for Ventilation System

S. No.	Description	Data
23.	Axial flow fans	
A.	Service	Supply/Exhaust
B.	Casing	Mild steel plate to ASTM A36
C.	Impeller	Cast Aluminium
D.	Shaft	EN 8
E.	Inlet cone/Outlet cone	Mild steel
23.	Pre-filter	Supply fans
A.	Filter media	High Density Polyethylene (HDPE) media
B.	Frame	18SWG GSS
C.	Filter efficiency	90% down to 20 microns
D.	Velocity across filter	Not more than 2.5 m/sec
E.	Pressure drops	Initial pressure drop - Not to exceed 5.0 mmWC at rated flow, Final pressure drop – Up to 7.5 mm WC.
23.	Fine filter	Supply fans
A.	Filter media	Synthetic non-woven washable type
B.	Frame	18SWG GSS
C.	Filter efficiency	99.9% down to 5-micron size
D.	Face Velocity	Not more than 1.2 m/sec for 150 mm and not more than 2.4 m/sec for 300 mm.
E.	Pressure drop	Initial pressure drop - Not to exceed 10 mm WC at rated flow, Final pressure drop-Up to 18 mm WC.

24 TECHNICAL SPECIFICATIONS FOR FIRE FIGHTING SYSTEM

An adequate Firefighting System shall be designed, installed and maintained in accordance with the guidelines specified in Fire Protection Manual by Tariff Advisory Committee (TAC) and complying with PESO requirements.

25 TECHNICAL SPECIFICATIONS FOR INTERCONECTING PIPING & VALVES

All interconnecting Piping, Gates, Valves, Specials and other appurtenances, auxiliaries and accessories required as per Process Design and Scope of Work. In case of Rising Mains, thrust blocks shall be provided wherever required. The material of construction for major interconnecting Piping shall be as follows:

25.1 Piping

25.1.1 Piping: Guideline for Velocity:

S. No.	Service	Design Velocity m/s	Limitations
1a	Gravity Lines for Sewage & Water	0.6 – 1.2 Designed as pipeline flowing full.	Min. Velocity shall not be less than 0.6 m/sec. Max. Velocity up to 1.2 m/sec is allowable at Peak Flow.
1b	Pressure Lines for Sewage & Water	0.6 – 2.5	Min. Velocity shall not be less than 0.6 m/sec. Max. Velocity up to 2.5 m/sec is allowable at Peak Flow.
2	Air (Pressurized Lines)	18 – 22	Max. Velocity shall not be more than 25 m/sec in any section.
3	Biogas	8 – 12	Max. Velocity shall not be more than 12 m/sec in any section.
4	Scum / Sludge / Substrate Lines	0.6 – 1.5	Irrespective of flow, Diameter shall not be less than 150 mm for Gravity Lines.
5	Chemical Feed Lines	0.6 – 1.5	Irrespective of flow, Diameter shall not less than 20 mm.

Notwithstanding the above, the Bidder shall submit a Pipeline Schedule with Tag No., Flow, Size, Type, Material of Construction etc. with detailed P & ID for approval of the Engineer-in-charge prior to any further engineering or procurement/fabrication and installation.

Generally, the Material of Construction shall be selected based on the following guidelines. The Bidder can make suitable selection depending on Service, Type of Flow (i.e. Gravity or Pressurized) and Diameter of Pipe.

25.1.2 Piping: Guidelines for MOC

Sr. No.	Service	Type of Flow	MOC
1	Wastewater	Gravity	CI / DI K-9 / RCC NP-3 Class
2	Waste Water	Pressurized	CI / DI K-9
3	Sludge / Substrate	Gravity / Pressurized	**Above Ground:** MS Sand/Shot Blasted, Epoxy Painted **Under Ground:** SS 304
4	Service Water	Gravity / Pressurized	GI "C" Class
5	Hot Water	Gravity / Pressurized	GI "C" Class, insulated and clad with GI/Aluminium Protective Plates
6	Air Lines	Pressurized	**Above Ground:** MS Sand/Shot Blasted, Epoxy Painted **Under Ground:** MS Sand/Shot Blasted and Coated with Anticorrosive Material **Under Water:** SS 304 / UPVC Schedule 40
7	Biogas	Gravity / Pressurized	**Above Ground:** SS 304 **Under Ground:** HDPE
8	Chemicals	Gravity / Pressurized	As per Chemical Compatibility Chart

25.1.3 Pipe Work

The pipe works for the plant involves procuring, supply, laying and jointing of suitable size electrically welded steel, cast iron, ductile iron, UPVC, RCC and PSCC pipes along with matching specials etc. as required. All pipe work and fittings shall be a class rating in excess of the maximum pressure attained in service including any surge pressure. The pipe work installation shall be so arranged to offer ease of dismantling and removal of pumps or major items of equipment. All pipe work shall be adequately supported with purpose-made fittings, wherever necessary. Flange adapters and union shall be fitted in pipe work runs, wherever necessary, to permit the simple disconnection of flanges, valves and equipment. The Contractor shall be responsible for ensuring that the internal surfaces of all pipe work are thoroughly cleaned before and during erection and commissioning. Cleaning shall include removal of dirt, rust, scale and welding slag due to site welding. Before dispatch from manufacturers works, the ends of the pipe, branch pipes etc., shall be suitably removed until immediately prior to connections adjacent pipes, valves or pumps. All small-bore pipes shall be blown through with compressed air before connection is made to instruments and other equipment. No point of passage of pipes through floors or walls shall be used as a point of support, except with the approval of OIL/PMC's representative. All underground-buried mild steel piping unless found otherwise necessary, shall be protected by the application of hot coal tar enamel and fiberglass wrapping. The coating shall consist of one coal` tar primer one coat, wrapping of fibre glass one more coat of enamel and the final wrap of enamel impregnated fibre glass. However, all water supply plumbing pipelines shall be of GI class B and either anchored externally with SS AISI fasteners or appropriately buried below the ground with a sand cushion of 20 cm all round. All sanitary piping shall be of UPVC class 4 suitably buried

below the ground with a sand cushion of 20 cm all round. Changes in direction on the ground shall be achieved with inspection chambers of 45 cm x 45 cm and heavy-duty CI/Steel reinforced fiberglass chamber covers.

25.1.4 CI Pipes

The C I Pipe and specials their laying and jointing and their dimensions shall conform to IS 1536, IS 1538 and IS 3114 with their latest revisions. The quality of cast iron shall meet grade 15 of IS 210 and be free from flaws, air bubbles, cracks, sand holes and other defects and shall be truly cylindrical and of uniform thickness. The methods for sampling of C.I. pipes and fittings shall conform to IS 11606. Pipe work outside the buildings shall use Tyton ring joints and inside, double flanged joints. All underground pipes shall be provided with granular bedding. Thrust blocks wherever required in the opinion of OIL/PMC's representative shall be provided in accordance with relevant specifications of the BIS.

Tests:

Following tests shall be carried out on the C.I. pipes:

1. **Mechanical Tests:**

As specified in I.S. 1536 during manufacture of the pipes.

2. **Hydrostatic Test at Works:**

The pipes shall be tested hydrostatically at the pressure specified in Table 1 for spigot and socket pipe and as per Table 2.0 for flanged pipes of IS 1536. The pressure shall be applied internally and shall be steadily maintained for a period of minimum 10 seconds and the pipes shall be moderately struck with a 700 gm hammer. The pipes shall withstand the pressure test and shall not show any sign of leakage, sweating, cracks or fracturing or other defects.

3. **Testing at Site:**

The following site tests shall be carried out after a new pipe is laid, jointed and partially backfilled.

(a) **Pressure Test:**

The pressure test at a field test pressure specified in clause 7.2.1 of IS 3114 shall be carried out. Pipes and joints shall be absolutely water tight under the test. The procedure for testing shall be as per clause 7.2.1 of IS 3114.

(b) **Leakage Test:**

The leakage test shall be conducted as per clause 7.3 of IS 3114 and the leakage should be within the specified allowance as calculated using formula given in clause 7.3.2 of IS 3114.

(c) Water required for any type of testing shall be arranged by the Contractor, at his own cost.

Markings:

The following markings on the pipe shall be cast, stamped or indelibly painted:

- Manufacturer's name or identification mark
- The nominal diameter

- Class reference
- Mass of pipe
- The I.S. Code reference
- The year of manufacture

The marking shall be done outside the socket or towards the end of barrels of the pipe. The coating on the pipes, both internally and externally shall be provided as per **Clause 15.0 of IS: 1536**.

25.1.5 Galvanized Iron Pipe

The procurement, supplying, laying, jointing and testing at works and site of Galvanized Iron (G.I.) pipes and fittings shall be in accordance with IS 1239 (Part I and II) and its latest revisions. The general requirements relating to the supply of mild steel tubes shall conform to IS 1387. The sulphur and phosphorus requirements in steel shall not exceed 0.05 percent each. The galvanizing of the pipes shall be as specified in IS 4736. The zinc coating shall be uniform adherent, reasonably smooth and free from imperfections. The pipes shall be galvanized before screwing. All screwed pipes and sockets shall have pipe threads conforming to the requirements of IS 554. Gauging in accordance with IS 8999 shall be considered as an adequate test for conformity of threads of IS 554. Screwed tubes shall have taper threads while the sockets shall have parallel threads. The specifications for G.I. pipes shall be generally in accordance with Clause 15.4 of standard specifications. The tolerances on the length of pipes shall follow clause 11.0 of IS 1239 (Part I). The fittings for G.I. pipes shall be of mild steel tubular or wrought steel fittings conforming to I.S. 1239 (Part II). The laying of G.I. pipes and fittings shall follow the relevant I S code of practice. These pipes shall be used for drinking water supply for the office and laboratory buildings. The pipes shall be painted with two coats of anticorrosive bitumen paint.

Testing of G.I. Pipes:

Hydrostatic test shall be carried out at works at a pressure of 5 M Pa, maintained for at least 3 sec and shall not show any leakage in the pipe. The tensile strength of length or strip cut from selected tubes, when tested in accordance with IS 1894 shall be at least 320 N / mm2. The elongation percentage shall be as per clause 14.1.1 of IS 1239 (Part I). The bend test shall also be carried out as per clause 14.2 of IS 1239. The G.I. pipes and fittings shall be tested at site, after they are laid and jointed as per clause 15.4.11 of standard specifications.

25.1.6 Ductile Iron (DI) Pipes:

The DI pipes shall be centrifugally cast (spun) for Water and Sewage and confirming to IS 8329-2000. The pipes used shall be both gasket joints and flanged joints. The minimum class of pipe to be used shall be class K-9 conforming to IS 8329. In general, pipes inside the buildings and below the structures shall be jointed as double-flanged pipes and those outside the building can be either EPDM gasket in accordance with IS 5382 and manufactured by the pipe manufacturer only. The pipes shall be supplied in standard lengths of 5.5m and 6.00m length with suitably rounded chamfered ends. Any change in the stipulated lengths will be approved by the Engineer's representative. The flanged joints shall confirm to the Clause 6.2 of IS 8329. The pipe supply will also include one rubber gasket for each flange.

Inspection and Testing:

The pipes shall be subjected to following tests for acceptance:

- Visual and dimensional check as per **Clause 13 and 15 of IS: 8329**.
- Mechanical tests as per Clause 10 of IS 8329.
- Hydrostatic test as per Clause 11 of IS 8329.
- The test reports for the rubber gaskets shall be as per acceptance tests of the IS 5382 and in accordance to Clause 3.8.
- The sampling shall be as per the provisions of the IS 8329.

Markings:

All pipes shall be marked as per clause 18 of IS 8329 and shown as below:

- Manufacturer name / stamp
- Nominal diameter
- Class reference
- A white ring line showing length of insertion at spigot end.

Packing and Transport:

The pipes should be preferably transported by road from the factory and stored as per the manufacturer's specifications to protect them from damage.

Specials for DI Pipes

The DI specials shall be manufactured and tested in accordance with IS 9523 or BS 4772. The mechanical test and hydrostatic test shall confirm to clause 9 and clause 10 respectively of IS 9523. The tolerances on dimensions shall be as per IS 9523. The manufacturer of the pipes shall supply the fittings.

All the DI fittings shall be supplied with rubber rings for each socket. The rubber ring shall conform to IS 12820 and IS 5382. Flanged fittings shall be supplied with one rubber gasket per flange and the required number of nuts and bolts.

25.2 Valves

Valves shall be as per internationally recognized standards. Flanges shall be machined on faces and edges to ISO 7005, IS 6392. Valves shall be flanged type. For sluice / gate calves, back seat arrangement shall be provided. Valves buried or installed in underground chambers, where access to a hand wheel would be impracticable, shall be operated by means of an extension spindle and / or keys. Valves shall be suitable for frequent operation as well as operation after long periods of idleness in either the open or closed position. The valve stem, thrust washers, screws, nuts and all other components exposed to the water shall be of a corrosion resistant grade of stainless steel. All valves parts shall be in general of the material of construction best suited for the proposed application. The inspection category is detailed in subsection VII.

25.2.1 Valves: Guideline

S. No.	Service	Type	MOC
A	**Sewage / Sludge / Substrate:**		

1	Gravity / Pressurized	Knife Gate	CI Body & SS 304 Gate & SS 410 Spindle
2	Suction & Delivery of Pump	Knife Gate	CI Body & SS 304 Gate & SS 410 Spindle
B	**Water:**		
1	Gravity / Pressurized	Ball	CS Body & SS 304 Internals
2	Suction & Delivery of Pump	Butterfly	CI Body & SS 304 Internals
C	**Air:**		
1	Pressurized	Ball / Butterfly	CS Body & SS 304 Internals
2	Suction & Delivery of Blower	Butterfly	CI Body & SS 304 Internals
C	**Biogas:**		
1	Pressurized	Ball / Butterfly	CS Body & SS 304 Internals
2	Suction & Delivery of Blower	Ball / Butterfly	CI Body & SS 304 Internals
D	**Chemical**		
	Gravity / Pressurized	Ball / Diaphragm / Plug	As per Chemical Compatibility Chart

25.2.2 Types of Valves

25.2.3 Sluice Valves

The gate face rings shall be securely pegged over their full circumference. Valves of 450 mm and above shall be provided with a thrust bearing arrangement for ease of operation. They shall also have renewable channel and shoe linings. The gap between the shoe and channel shall be limited to 1.5mm. Alternatively, valve of diameter 450mm and above may be provided with a gear arrangement for ease of operation. The operation gear of all valves shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum specified rating. Valve and gearing shall be such as to permit manual operation in a reasonable time and not to exceed a required rim pull of 80 N. All hand wheels shall be arranged to turn in a clockwise direction for opening and counter clockwise for closing. These directions shall be indicated on the hand wheels. All valves shall be rated for not less than PN 1.0.

All valve doors when fully closed will ensure door faces are riding on body seat ring by at least 50% of width of seat ring providing sufficient allowance for wear. Valves of diameter 450 mm and above shall be provided with a drain and air plug.

Material of Construction:

Body, Bonnet, Wedge	CI conforming to IS 210 Gr FG 260 Spindle
Drain and Air Plug	IS 318 Gr LTBZ
Seat Ring, Wedge Ring	SS 304
Back seat Bush	Bronze IS: 318 Gr LTB 2
Gland Packing	Graphite Asbestos

Parameters:

Type	Rising spindle
Nominal pressure	2 times working pressure in pipeline
Nature of operation	Horizontal / vertical
Applicable code	IS 14846
Test	Acceptance tests as per IS14846

25.2.4 Knife Gate Valves

Knife gate valves shall be suitable for use at suction and delivery side of pumps in a sewage pumping station. The valve should be provided with gate made of stainless steel and the gate should have bevelled knife edge at the bottom to cut through and easily enter in the solids settled in the bottom and ensure positive shut-off / closure in sewage environment. The valve should be bonnet-less and suitable for face-to-face flange connections in between pipelines. It should be suitable for uni-directional application.

The valve body should be of Cast Iron Gr. FG 260.The body shall be designed to withstand 6 bar pressure.

The valve shall be provided with replaceable type flexible sealing seals to offer drop tight shut off. The seals should be made of EPDM rubber and should be held in place by an easily removable type seal retainer ring. The seal retainer ring should be designed in a manner so that the flow of the fluid should be away from the sealing perimeter and towards the center of the valve.

The valve housing should have integral as cast tapered lugs provided for pushing the gate towards the flexible rubber seal only at the verge of closure with a view to avoid seal wear and achieve drop tight shut off. The surface of the gate coming in contact with the seal should be polished & buffed.

The valve shall be provided with sufficient ply of stuffing seals in the in-built stuffing box to seal the rear opening. The stuffing box should have internal tappers for pushing the seals on to the gate. The seals should be of non-asbestos PTFE to reduce the friction and offer higher life. Provision shall be made to enable tighten the stuffing seals by means of a pusher arrangement to minimize the leakage through the back of the valve. Replacement of stuffing seals should be done in installed condition of the valve.

The spindle should be double start threaded and non-rising type for compact & safe operation. The gate movement area should be covered by protection shields. Gate opening indicating arrangement should be provided to find out the extent of gate opening /closing.

Flange drilling suitable to mount between flanges as per IS 1538 -1993.

- Body: Cast Iron FG 260 as per IS 210
- Knife gate: AISI304 Gr. ASTM A240
- Retainer ring: SS304 ASTM A351 Gr. CF:8
- Inlet Seal: EPDM
- Spindle: AISI410 Gr. ASTM A276
- Spindle Nut: Cast Iron Gr. FG 200 as per IS 210
- Stuffing plate: Cast Steel ASTM A216 Gr. WCB
- Stuffing seal: Synthetic yarn with PTFE

25.2.5 Check Valves:

Check valve shall possess high speed closing characteristics and be designed for minimum slam conditions while closing. External counterweights are not acceptable. Check valves shall conform to API 594 and API 598. They shall have metal to metal sealing. The pressure drop in the valve at design flow shall be limited to 0.4 mWC.

Material of Construction:

Body	CI conforming IS 210 Gr FG 220
Plate	SS AISI 316
Spring	SS AISI 316
Seal	SS AISI 304

Parameters:

Nominal pressure	Twice the pressure in pipeline
Nature of operation	Automatic
Closure characteristic	Non slamming
Applicable code	API 594
Tests	Acceptance tests as per API 598

26 SERVICE WATER TANK

26.1 Introduction

This section outlines the scope, design, construction, and functional requirements of the service water tank. The tank is intended to supply water to the Feed mix tank, Firefighting system, and other water needs within the plant.

26.2 Design Requirement

26.2.1 The tank shall be designed and constructed in accordance with API 650 and BIS 803 standards, ensuring suitability for construction within the CBG plant.

26.2.2 The tank shell must be designed on the assumption that it shall be filled with water or design liquid, whichever has a higher specific gravity.

26.2.3 The minimum thickness of all bottom plates shall comply with BIS 803, excluding corrosion allowance. The tank bottom shall be graded downwards towards the drain sumps located around the tank periphery. The design of the tank bottom shall incorporate a slope of 1 to 120.

26.2.4 Each tank shall be equipped with draw-off sumps, complete with valves and locking devices. Shell manholes and roof manholes, with a minimum size of 600mm, shall be provided on the tank shell. These manholes must include a davit arrangement, cover plate, bolts, and nuts. The number of manholes shall comply with API 650 standards.

26.2.5 An external spiral staircase with a handrail, intermediate platforms, and a gauger's platform shall be provided. Hand railings shall be provided all around the tank roof to enclose the platform and stairways from the sides. The height of the hand railings shall be a minimum of 1 meter.

26.2.6 A complete earthing arrangement, including an earthing boss, shall be provided for the tanks. The roof drains shall be designed in accordance with API 650, Section C3.8.

26.2.7 The stairs shall have a width of 800mm and a slope not exceeding 50 degrees to the horizontal. The treads shall be 250mm deep with a uniform rise of 180mm. The steps shall be made of grating. The stairways shall be designed in accordance with the relevant design code.

26.2.8 Vents shall be provided on the roofs of all tanks in accordance with the design code.

26.2.9 The bidder shall provide the forces and moments for all tank nozzles, along with calculations based on the relevant code. All nozzles, except for the manhole, shall be fitted with forged flanges.

26.2.10 Cage ladder shall be provided, and it should be easily accessible form ground level.

26.2.11 All nozzle flanges shall conform to ANSI B16.5.

26.2.12 All removable internals shall pass through manhole(s).

Section-IX Detailed Technical Specifications

- Civil, Structural & Architectural Works

TABLE OF CONTENTS

1 Scope 450
1.1.1 General 450

2 General Requirements 453
2.1.1 Architectural Concepts and Design 453
2.1.2 Architectural and Finishing Works 454
2.1.3 Electrical & Control Room 459
2.1.4 Approximate Sizes of Structures 460
2.1.5 Water Retaining Structures and Underground Tanks / Pits 460
2.1.6 Pipe / Cable Rack 460

3 Loads 461
3.1.1 General 461
3.1.2 Dead Loads 461
3.1.3 Equipment & Piping / Cabling Load 461
3.1.4 Imposed Loads 462
3.1.5 Crane & Monorail Loads 463
3.1.6 Temperature Load 464
3.1.7 Wind Load 464
3.1.8 Seismic Load 465
3.1.9 Earth Pressure Load 465
3.1.10 Hydrostatic Pressure Load 466
3.1.11 Other Loads 466
3.1.12 Load Combinations 467

4 Reinforced Concrete Structures and Foundations 469
4.1.1 General 469
4.1.2 Design Methodology 469
4.1.3 Minimum Thickness of Structural Elements 472
4.1.4 Minimum Heights for Pedestals of Steel Columns 473
4.1.5 Concrete Mix 473
4.1.6 Reinforcements 475
4.1.7 Grouting 475
4.1.8 Minimum Cover to Foundation Bolts 476
4.1.9 Miscellaneous Requirement 477

5 Steel Structures 481
5.1.1 General Steel Structures 481
5.1.2 Design Methodology 482
5.1.3 Permissible Deflections 483
5.1.4 Minimum Thickness and Sizes of Steel Elements 484

5.1.5 Joints/Connections in Steel Structures 485
5.1.6 Fabrication and Erection 488
5.1.7 Inspection of Welding 488
5.1.8 Painting 490

6 Outdoor Civil Works 492
6.1.1 Drainage and Sewerage 492
6.1.2 Roads 494
6.1.3 Fencing 495
6.1.4 Paving & Grade Slabs 495

7 Codes & Standards 496
7.1.1 General 496

8 Standard Technical Specifications for Construction 503
8.1.1 Earthwork in Site Grading & Embankment 503
8.1.2 Earthwork in Excavation & Backfilling 505
8.1.3 Plain and Reinforced Concrete Work 510
8.1.4 Structural Steelwork 532
8.1.5 Brickwork & Plastering 543
8.1.6 Sheeting Work in Roof and Siding 548
8.1.7 Floor And Floor Finishes 549
8.1.8 Doors, Windows, Louvres, Rolling Shutters & Glazing 554
8.1.9 Painting, colour washing etc., ... 560
8.1.10 Waterproofing 564
8.1.11 Water Supply, Drainage and Sanitary Works 567
8.1.12 Fencing & Gate 574
8.1.13 Road Works 576

1 Scope

1.1.1 General

This section sets out the scope of design, supply, construction, installation & testing including necessary components and services not specifically mentioned but required. The scope shall include other related works although they may not be specifically mentioned in the subsequent clauses and all such incidental items not mentioned but are necessary for completion of the work as a whole. The Contractor shall supply all construction materials including cement and steel. All costs, royalties, GST, transportation etc. towards building materials shall be paid by the Contractor and record to be maintained and jointly verified with Engineer in Charge (EIC).

Contractor shall consider changes based on site requirements & material availability upon approval from Owner.

The scope also includes supply of all labour, technical personnel, materials and equipment for execution of work and getting all materials tested at site laboratory or approved laboratory outside, submitting test reports, arranging supervision of manufacturer for specialised items. Following is the minimum list of types of structures, which will have to be considered in the civil scope of work. Construction of any other building / structure if required for completion of plant / system shall also be in Contractor's scope.

The list of buildings and structures are specified in Annexure - 1: List of Buildings & Civil works.

Non familiarity with the site conditions will not be considered a reason either for extra claims or for not carrying out work in strict conformity with time schedule, drawings, specifications and safety guidelines.

Scope of work will also cover, but not limited to the major items mentioned in the Annexure-1: List of Buildings & Civil works.

Topographical and Geotechnical survey shall be revalidated by contractor and in no manner will be construed to release the contractor from any liability or responsibility for proper design, construction, or compliance with the contract documents.

All Civil works including Liquid Retaining Structures, Sheds, Buildings, Roads, Pathways, Parking etc. **as per latest CPWD Works Manual and Standard Operating Procedures (SOPs).**

Design and Engineering

Detailed design calculations / design drawings shall be commenced by Contractor only after approval is obtained from the Owner to the basic design criteria submitted by the Contractor. No deviation from the approved design criteria will be permitted unless specifically approved by the Owner in

writing, prior to its adoption. All design calculation as listed in this specification shall be furnished by Contractor for approval / information within a period of 2 months from the receipt of LOA.

Preparation and submission of design calculations and construction drawings and getting the same approved by the Owner /Owner's Engineer, for the following.

- Topographical and Geotechnical survey shall be revalidated by contractor and in no manner will be construed to release the contractor from any liability or responsibility for proper design, construction, or compliance with the contract documents.
- Interpretation of geo-technical investigation report and selection of design parameters & foundation type & details in consultation and with approval of the Owner.
- Design criteria for foundations and super structure as per Indian standard and site requirements.
- Calculations for road and drains.
- Structural calculations for structures and foundations.
- General arrangement drawings and fabrication drawings for structural steel
- Hydraulic calculations for drains.
- Dynamic analysis for machine foundations
- General Arrangement and Reinforcement drawings for concrete works
- Architectural and joinery details for buildings
- Layout and details for outdoor facilities
- General Arrangement and fabrication drawings for steel structures
- Preparation and submission of design and drawings for statutory approvals from local Municipal/Panchayat authorities.

Construction

The architectural and structural design shall be maintained as per standard norms and codal requirements to ensure building aesthetics is maintained.

Providing grid pillars for the project area.

Clearing of the site and Site grading of the Plant area to the finished ground level. The finished grade level shall be to suit drainage & other system requirement.

Construction of buildings and structures for Contractor's use in the area allocated, such as Site Office, Cement Godowns, Storage yards, Canteen, Construction Material Testing Laboratory and other facilities as required. All building & structures for Contractor's use shall be created with due approval of owner.

Construction of roads, drainage, sewerage, culverts, bridges, duct banks etc., within the Plant area.

Construction of gate, fencing and signage board if any as per requirement.

Earthwork in excavation including hard rock quarrying/blasting and backfilling including disposal of excavated soil to the areas identified by the Owner within plant boundary.

Architectural and finishing works for all buildings.

Sanitary, septic tank and soak pit for the plant

Plumbing works

Construction of all foundations and structures in RCC and steel work for all the buildings and facilities of the CBG Plant.

Construction of all equipment and machine foundations.

Construction of pipe/cable racks, trenches, sleepers etc.

Any other Civil works within the CBG plant Boundary that may be required for commissioning and smooth operation of the plant.

The roof of each building shall be provided with water discharge through rain water down take pipes network to be connected to plant storm water drain.

Bill of Quantities

Contractor shall submit major items for cement, reinforcement and structural steel quantity as per the list of buildings & civil works mentioned in annexure:1 and all other Civil BOQ items related to scope of work.

2 General Requirements

2.1.1 Architectural Concepts and Design

Architectural Concepts

a) Layout of the plant area shall have definite hierarchy of road network depending upon its usage, aesthetic, visual sensibilities for creating road vistas, focal points, building back drops, building frames. General layout shall be evolved taking over the basis of landform and local climate and due consideration shall be given to orientation and wind direction. The building design should create a clear and recognizable image with distinctive features including landmarks, focal marks and visually appealing building profile.

b) Electrical & Control building shall be architecturally treated in such a way that it retains a monumental scale, yet presents a pleasing composition of mass and void with suitable and functionally designed projections and recesses. The overall impact of the building shall be one of aesthetically unified architectural composition having a comprehendible scale, blending tonal values with the surroundings and taking full consideration of the climatic conditions, the building orientation and the existing structures nearby.

c) Admin building shall be architecturally treated in such a way so as to be in complete harmony with the other plant building, surrounding structures and environment. Local architectural characters and materials may be judiciously imbibed. The building shall be designed initiating an architectural control common to all buildings. The architectural control shall be clearly spelt out in terms of scale, man and form.

d) Overall colour scheme of the buildings shall be designed judiciously and in a comprehensive manner taking into a account the mass and void of buildings, its facade, equipment, exposed structural elements, piping, trestles, bus ducts and other service elements. Minimum two numbers of colour schemes shall be proposed for approval of the owner.

e) Overall emphasis shall be on developing an eco-friendly architecture, merging with the nature.

The scheme shall be conceptually finalised in totality including that of equipment so that the proper coordination with other agencies can be taken up at appropriate time.

Architectural Design

a) Natural light shall be used to the maximum extent, especially in the form of north light/sky light. For adequate light and ventilation, National Building code recommendations shall be followed.

b) Entrance canopies chajjas (projections, recesses) over openable windows and door openings on exterior facades shall be provided.

c) All the buildings shall be architecturally designed to meet the National Building Code (SP: 7) norms and U.P state building bye laws, wherever applicable.

d) Architectural design and detailing aspects of all the buildings shall be rendered through services of an professional Architect. Statutory requirements may be required to be met with, wherever essential. The Architect shall be of National/International repute having experience in similar kind of works. The Architect shall evolve the design philosophy based on Owner/Engineer guidelines and shall present it in the form of presentation drawings, Prospective views and detail drawings.

e) Architectural components shall be designed for the conditions at the site for a minimum design life of 30 years.

2.1.2 Architectural and Finishing Works

Reference shall be made to relevant section for specification / thickness of the various Architectural works Finishing schedule for various buildings are indicated below

Finishing schedule of various buildings

S. No.	Area	Flooring	Internal Walls (Plastered Surface)	Ceiling
1.0	Electrical & Control room	Vitrified tiles	Emulsion paint	False ceiling
2.0	Admin building	Vitrified tiles	Emulsion paint	False ceiling
3.0	Workshop & Warehouse	Concrete floor with trowel finish	Colour wash	
4.0	Plant water & fire water pump room	Concrete floor with trowel finish	Colour wah	White wash
5.0	Toilets(All)	Anti skid mat finish ceramic tile Dado in ceramic tiles up to 2.1 m height.	Oil bound distemper	White wash on plastered surface

Doors / Windows schedule of various buildings

S. No.	Area	Doors	Windows
1.0	Electrical & control room	Aluminium / Glass / As per EIC	Aluminium windows
2.0	Admin building	Aluminium / Glass / As per EIC	Aluminium windows
3.0	Plant water & fire water pump room	Steel door. For fire exit, Fireproof door will be provided	Aluminium windows
4	Workshop & Warehouse	Aluminium / Steel / As per EIC	Aluminium windows

Roof finishing schedule

Plant & Non plant buildings: Elastomeric water proofing (100% acrylic or polyurethane based elastomeric coating).
Rainwater down take pipe shall be UPVC pipe of minimum 100 / 150 mm dia.

Painting:

Structural steel	- As per painting schedule
Windows, Grills, Hand railing	- Primer & Synthetic enamel paint
Metal and Timber Joinery	- Synthetic enamel paint
External faces of walls paint of	- Cement based or other type waterproof exterior approved make
Walls of battery room and Other acid/alkali spillage areas	- Chlorinated rubber paint

Hand railing for admin building shall be of SS 316.

A standard colour scheme for the different buildings/structures shall be prepared by the Contractor and the approval of the owner obtained, before commencement of work.

Roof Access

All RCC and Structural steel roof shall be provided with access through a staircase / cage ladder. Minimum 1200 mm wide access path shall be provided to approach on roof. Suitable lifeline arrangement shall be provided for fall protection on the structural steel roof.

Stairs & Ladders

Steel Stairs

For all steel staircases,

Minimum clear width (back to back of stringer)	-	1200 mm
Maximum inclination with horizontal	-	35.75 Deg
Maximum height between successive landings	-	1.8 m (max 12 steps between landings)
Minimum size of stair stringers engineering of treads.	-	Shall be decided during detailed considering loads, span and width
Minimum width of tread	-	250 mm
Maximum height of riser-Plant Buildings	-	180 mm
Maximum height of riser-Non Plant Buildings	-	150 mm

Treads shall be made of chequered plate / grating, with suitable nosing, and spaced equally.

Minimum thickness of chequered plate shall be 6 mm and grating shall be 30 mm.

Incase of space restriction,

Minimum clear width (back to back of stringer)	-	750 mm
Maximum inclination with horizontal	-	45 Deg

Steel Ladders

Ladders shall be provided to platforms, walkways and equipments which do not require frequent access. Normally, ladders shall be vertical or its angle with vertical shall not exceed 50 Deg.

Ladders shall have minimum clear width of 450 mm with 20 mm diameter MS rungs at a maximum spacing of 300 mm.

Ladders shall be provided with safety cage of minimum 750 mm diameter clear when the top of ladder is more than 4.5 m above the starting level. However, safety cages shall start at 2.5 m above the lower landing level.

RCC Stairs

For all staircases,

Minimum clear width of stairs	-	1000 mm

Minimum width of tread	-	250 mm for all buildings
Maximum height of riser	-	180 mm for all buildings
Maximum no. of risers in one flight	-	12
Edge protection	-	MS angle nosing with minimum 50x25x3 angle with lugs.

Handrails

Handrails shall be provided at appropriate places to ensure safety e.g. around all floors / roof openings, projections / balconies, walkways, platforms, steel & concrete stairs etc. on both side.

All handrails Post & Top rail shall be of 40 mm nominal bore MS pipes (medium class) with thickness 3 mm as per IS: 1161 and middle & bottom rail shall be of 32 mm. and shall be MS with epoxy paint. Paint colour should be decided in consultation with Owner.

Handrail post spacing shall be limited to 1500 mm as far as possible but can be proportioned to the length of the protected horizontal opening and shall not exceed 1850 mm in such a case.

All handrails shall be shop/site fabricated and field welded or bolted to the erected structural steel.

For platforms top rail shall be at 1000 mm and the intermediate rails at 500 mm shall be adopted.

Edge Protection

RCC kerb of 100 mm wide and 150 mm high shall be provided around floor openings as far as possible.

Edge protection angle of size 50x50x6 with lugs shall be provided for all concrete edges where breakage of edge is expected. Eg: All round the cut-outs/openings in floor slab, edges of drains supporting grating covers, edges of RCC cable/pipe trenches/manholes supporting covers and supporting edges of pre-cast covers etc.

Anchor Bolts and Insert Plates

Anchor bolts shall be designed for working stresses, in tension and shear, for embedded length of the anchor bolts and pipe sleeves. Anchor bolts shall generally not be considered to transfer the shear to pedestal. Shear keys/bars shall be generally considered for transfer of shear. Shear and crushing strength of concrete shall also be checked.

Insert plates shall be designed / checked for shear and bending moment. All lugs shall be checked for tension & concrete cone failure. Bond strength of concrete shall also be checked. Lugs using steel bars shall preferably be fillet welded to the plate to transfer full strength of the lug.

Vertical Head Room

All accessible areas shall be provided with minimum clear headroom as follows, unless otherwise specified:

Finished floors to bottom of beams (buildings)	-	3000 mm
Control Room	-	3200 mm (Min)
Cable vaults	-	2300 mm
Doors, Walkways, Platforms, Stairs etc.	-	2100 mm
False ceiling of office areas	-	2700 mm
Safety cage for ladders	-	2500 mm
Access for forklift trucks	-	2800 mm
Main roads/railway crossings & crane access	-	8000 mm
Roads and truck access , in case of trestles	-	6000 mm
Pipe Rack	-	3000 mm except at road crossing, and 6000 mm at road crossing.

Expansion/Construction Joints

Expansion and construction joints shall be provided wherever required. Maximum spacing between Expansion joints in Concrete buildings shall be 45m, compound wall & paving shall be 30m.

Two part polysulphide sealant conforming to IS: 12118 shall be used for sealing of joints in contact with water. For other cases, bitumen sealing compound conforming to IS: 1834 can be used. Preformed Duraboard HD 100 or equivalent shall be used as joint filler as per required thickness.

All expansion and construction joints of the water retaining structures in RCC shall be made watertight using PVC ribbed water stops with central bulb. However, kicker type (externally placed) PVC water stops may be used for the base slabs and in other areas where it is required to facilitate concreting. The minimum thickness and width of PVC water stops shall be 6 mm and 225 mm respectively. At other joints these shall be 150 mm wide.

Brick/Stone Masonry and Parapet Wall

All masonry works shall be designed in accordance with IS: 1905, IS: 2212, IS: 4326, IS: 2185 and other relevant IS codes as applicable. Structural design of load bearing and non-load bearing walls constructed with solid or perforated burnt clay bricks or solid concrete block, AAC brick shall be in

accordance with criteria specified in National Building Code of India Part VI and codal provisions. Fly ash bricks may also be used.

All Masonry walls for buildings shall be raised on plinth beams.

All walls shall be non-load bearing walls. All external and internal walls shall be of at least one brick thick except for internal partition walls for non plant buildings and toilets which may be half brick thick. Half brick & one brick thick walls shall be provided with RCC bands (transoms and mullions) wherever necessary to curtail the unsupported length/width/height of the wall.

Salient points to be considered for masonry work:

Compressive strength of brick for all external walls shall be at least 75 kg/sq.cm and for all internal walls shall be at least 75 kg/sq.cm, for non-load bearing brick work.

Cement sand mortar 1:6 for one brick thick wall and 1:4 for half brick thick wall shall be used. For half brick walls, RCC transoms and mullions shall be provided.

In case of brick work is not starting from plinth beam level then DPC (1:1.5:3) of 50 mm thick shall be provided at plinth level before starting masonry work.

Transoms shall be provided at lintel/door height. The spacing of mullions shall not exceed 2000 mm center to center.

Type, thickness and height of external wall, facing the transformer yard to take care of fire accidents in transformer yard shall be according to the codal requirements. Even where metal cladding is specified, for initial 3 m height from the ground level, 230mm minimum thick masonry wall shall be provided.

All upstands and parapet walls on roof shall be of RCC / brick masonry. Minimum height of parapet walls should be 1000 mm and thickness 230 mm for brick work and 125 mm for RCC, with aesthetics of architectural design as approved by the Owner.

2.1.3 Electrical & Control Room

The Contractor shall decide the dimensions of the buildings from Equipment Layout considerations

Local Electrical/Control rooms shall be of Reinforced concrete construction with plastered brick cladding/cement concrete block. Windows and doors and finishes shall be as per schedule given in this section. Electrical rooms and control rooms in upper floors shall have provision for lifting of panels and the equipment rolling shutter shall be suitably sized to accommodate the largest transportation module of panels or equipment. Electrical / Control room shall be constructed with cable cellar for routing of cables Pipe sleeves shall be provided in the wall for cable entry. The annular space between the pipe sleeve and the cables shall be sealed after erection of cables. All bus ducts should have access platform for maintenance.

Panel cutouts in slab to be made full length of room / hall. The non-panel area cutout to be covered with structural steel frame and Chequered plate.

2.1.4 Approximate Sizes of Structures

The Contractor to note that these dimensions are minimum sizes (For size of the structure, refer Annexure 1: List of buildings & Civil works. However, Contractor shall verify these sizes and note that they may change during the course of detailed engineering. The Contractor to consider all eventualities while evaluating the Civil BOQ.

2.1.5 Water Retaining Structures and Underground Tanks / Pits

For water retaining structure and tanks / pits below ground level, coarse aggregate used shall be 20 mm and downgraded. All tanks below ground level should have box type waterproofing. Water proofing admixtures of approved brand conforming to IS:2645 shall also be used as per manufacturer's recommendation. 230 wide PVC water stops of approved quality shall be provided at all elevations for construction joints water cement ratio shall be maintained as 0.45. Admixtures for increasing the workability of concrete for water retaining structures shall be used. All water retaining structures and underground tanks/pits should be made fully leak proof.

2.1.6 Pipe / Cable Rack

Structural steel pipe rack with pedestal is proposed. Multi-tier rack is proposed to accommodate the pipes. The cable trays shall be supported on steel members. Requirement of pipe & cable racks shall be as per system requirement.

3 Loads

3.1.1 General

All structures shall be designed for the most critical combinations of dead loads, imposed loads, equipment loads, crane loads, steam piping (static & dynamic) and other piping loads, wind loads, seismic loads, temperature loads, loads and forces developed due to differential settlement and any other loading conditions which can occur during the design life of the facility.

Foundation system shall be decided as per the Detailed Geotechnical Investigation recommendations.

The applicable loads for the design shall be as listed below :

3.1.2 Dead Loads

Dead loads consist of the weights of the structure complete with finishes, fixtures, partitions, wall panels and all equipment of semi-permanent nature including tanks, partitions, roofing, piping, cable trays, bus ducts etc. The content of tanks shall be measured at full capacity for this purpose.

The piping loads, cable tray loads and the contents of the tanks shall be listed separately so that they can be excluded from dead load when dead loads are acting as stabilizing load for uplift.

The following unit weight of material shall be considered for computation of loads. Loads given in IS: 875 (Part-I) shall be made use of for material not listed below.

Materials		Unit Weight
Plain Cement Concrete	-	24 kN/m^3
Reinforced Cement Concrete	-	25 kN/m^3
Structural Steel	-	78.5 kN/m^3
Brick work	-	20 kN/m^3
Cement Plaster	-	21 kN/m^3
Roof Treatment (7 course bituminous)	-	0.3 kN/m^2
Floor finish	-	22 kN/m^3

3.1.3 Equipment & Piping / Cabling Load

Static and dynamic loads of major equipments shall be based on the manufacturer's data of the specified equipments. Equipment loads shall be considered as given by equipment supplier.

Equipment loads which are of permanent nature shall be treated as dead loads.

However, where the uniform floor live load adequately accounts for the equipment moving weight, the weight of such equipment as a dead load shall not be considered e.g. control room floors are usually designed for a live load that includes the equipment weight.

All equipment, tank and piping design loading shall include hydraulic testing loading. Weight of equipments, ducts, tanks, pipes, conduits, etc., supported by structure shall include maximum possible loading conditions i.e. flooded material contents and associated impacts, test loading, anchorage and constraint effects.

3.1.4 Imposed Loads

General

Imposed loads in different areas shall include live loads, minor equipment loads, cable trays, small pipe racks/ hangers, erection loads, operation / maintenance loads etc. The loads considered shall not be less than that specified in IS: 875 (Part II).

The loads listed here under are minimum live loads for the areas involved. Special use areas shall be investigated and loads revised upward as necessary. Floors and supporting members which may be subjected to heavy equipment live loads shall be designed on the basis of the weight of equipment or specifically defined live loads, whichever is greater.

The specific minimum floor live loads are listed below:

Roofs

	-	1.5 kN/sqm plus hung loads for accessible roofs
Flat Roof	-	0.75 kN/sqm plus hung loads for non-accessible roofs.
	-	5.0 kN/sqm for accessible roofs with HVAC equipment etc
Sloped Roof	-	As per IS:875
Dust Loads on Roof, floors and platforms open to atmosphere	-	1.0 kN/sqm

Control Building and other electrical building

a.	Control Room Floor & switchgear room	-	10 kN/sqm
b.	Cable Vault Floor	-	5 kN/sqm in addition to actual cable loads
c.	Cable tray loads	-	1.0 kN/m or as specified in Electrical Drawings
d.	Minimum live load	-	5 kN/sqm
e.	Roof	-	1.5 kN/sqm

Other Areas

RCC Floors	-	5 kN/sqm for offices
Stairs and balconies	-	5 kN/sqm
Chequered Plate / gratings	-	The gratings/chequered plates shall be designed for minimum live load of 5 kN/sq.m
Walkways	-	3 kN/sqm
Toilet rooms	-	2 kN/sqm

Culverts and allied structures including buried RCC Pipes shall be designed for Class "AA" loading (wheeled and tracked) and checked for Class"A" loading as per IRC standards.

Covers for trenches & channels which are not exposed to vehicular traffic shall be designed for Live Load of adjoining area or 4 kN/sqm whichever is higher. Where channels are likely to be exposed to vehicular traffic, the requirements of Code of Practice for road bridges shall be adhered to.

Piping Loads

Piping load shall be as per load plan drawings unless otherwise mentioned.

For design pipe friction load shall also be considered. Pipe friction load shall be considered as 30% of pipe operating load. Friction load being temporary, shall not be combined with wind and seismic load.

A load of 1 kN/sqm shall be considered as Hung Loads for piping unless otherwise mentioned.

Ponding effects due to framing deflections for roofs, if any, shall be considered.

In addition to live loads, a minimum of 0.5 kN/sqm shall be considered as Hung loads for electrical, ventilation & air conditioning unless otherwise mentioned.

Live Loads reduction shall be in accordance with the provisions of IS: 875 & IS: 1893 in case of seismic analysis.

3.1.5 Crane & Monorail Loads

Crane girders and supporting columns shall be designed for vertical (including impact forces) and horizontal forces as per crane vendor's data. All lifting beams and monorails shall have their design loads increased for impact factor as mentioned hereinafter.

Impact Factor

Loads for cranes, hoists and elevators shall be taken as per IS: 875. The minimum impact factors to be used in design shall be as follows :

Crane Loads

The building frames shall be analyzed for the maximum wheel load when the lifted load is near each rows of column.

a. For vertical force, an impact factor of 25% of the maximum crane wheel load.

b. A lateral crane surge of 10% of the weight of the trolley plus lifted load applied at the top of each rail.

c. A horizontal surge of 5% of the maximum static wheel loads of the crane applied at the top of the rail in the direction along the rail.

Monorail Loads

a. Impact factor of 10% of lifted load of hoist for monorail and support design

b. Impact factor of 25% of lifted load for electrical pulley and support design

3.1.6 Temperature Load

Suitable expansion joints shall be provided in the longitudinal direction of the structure wherever necessary with provision of twin columns to account for the expansion and contraction due to changes in temperature of materials of the structure.

The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456 for steel and concrete structures respectively.

Analysis shall be carried out for ambient temperature variation. The temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum temperature during the coldest month of the year and mean of daily maximum temperature during the hottest month of the year. The structure shall be designed to withstand thermal stresses due to 50% of the temperature variation.

Co-efficient of thermal expansion for steel shall be taken as per IS: 800. Co-efficient of thermal expansion for concrete shall be taken as per IS: 456.

3.1.7 Wind Load

Site specific parameters for wind loading shall be as per the criteria specified in Project Information attached in this specification.

Wind loads on structures shall be calculated as per provisions of IS: 875-2015 (Part 3). The wind shall be assumed to blow in any direction and most unfavorable condition shall be considered.

The various design parameters for the project site as defined in IS: 875-2015 (Part 3)

Basic Wind Speed	-	50 m/s
Category of terrain	-	As per IS:875-2015 (part 3)
K2 varies with height	-	As per IS:875-2015 (part 3)
Topography factor K3	-	As per IS:875-2015 (part 3)

The wind analysis shall consider the wind direction relative to the structure and both external and internal pressures as applied to the windward and leeward sides of the structure.

In design of structures, wind force on equipment's supported on frame including all fixtures, piping, staircases, ladders, handrails, etc., shall also be considered.

3.1.8 Seismic Load

All plant equipment and structures shall be designed for Seismic loads as per the latest edition of IS: 1893 (Part 1 & 4), the site falls in Zone V.

Response spectrum method shall be used for the seismic analysis using at least five modes of vibration.

The structures shall be classified into four categories as per Table 5 of IS: 1893 (Part 4).

The damping factors shall be as per Table 4 of IS: 1893 (Part 4).

RCC Structures	-	5%
Steel Structures	-	2%

The importance factor for each structure shall be as per Table 2 of IS: 1893 (Part 4).

Response Reduction factor shall be as per Table 3 of IS: 1893 (Part 4).

Method of analysis for each structure shall be decided as per clause 10.3 of IS 1893 (Part 4), which depends on the seismic zone & category of the structure.

3.1.9 Earth Pressure Load

Earth pressure for all underground structures shall be calculated using coefficients of earth pressure at rest, coefficient of active or passive earth pressure (whichever is applicable).

However, for design of under ground liquid storage tanks earth pressure at rest shall be considered.

In addition to earth pressure and ground water pressure etc., a minimum surcharge load of 20kN/sqm shall also be considered for the design of all underground structures including channels, sumps, cable & pipe trenches etc., to take into account the vehicular traffic in the vicinity of the structure.

Dynamic effect of earth pressure due to seismic conditions shall be considered along with hydrodynamic effect water / liquid storage structures.

3.1.10 Hydrostatic Pressure Load

Ground water level for calculation shall be considered at finished grade level.

3.1.11 Other Loads

Test loads of pipes, tanks, vessels, etc., wherever applicable shall be considered.

Stresses imparted to structures due to differential settlements, variation of water table, erection and maintenance loads, creep and shrinkage shall also be considered in design of all structures.

Equipment loads shall not be considered as a part of DL for checking the stability of the structure.

For large structure design, construction loading depending on methodology of construction shall be considered. Temporary loadings likely to be imposed are due to handling of concrete, formwork, hoist fixing, storage of materials, temporary access etc. Loads due to foundation settlement shall also be considered.

Basic Load Cases

The following basic load cases shall be considered for the analysis:

a.	Dead Load	DL1
b.	Equipment & Piping / Cabling Load	DL2
c.	Live load on floor	LL
e.	Crane load	CRL
f.	Wind load	WL
g.	Seismic load	SL
h.	Load due to soil pressure	SP
i.	Load due to surcharge	SCL
j.	Load due to hydrostatic pressure	HP
k.	Load due to temperature	TL
l.	Pipe friction	PFL
m.	Pipe anchor loads	PAL

3.1.12 Load Combinations

Building / Structures

The individual members of the frame shall be designed for worst combination of forces such as bending moment, axial force, shear force and torsion. Permissible stresses for different load combinations shall be taken as per IS: 875 (Part-V) and other relevant IS codes. Wind and seismic forces shall not be considered to act simultaneously.

Criticality of erection / maintenance loads shall also be checked separately in combination with other simultaneously occurring loads for possible design loading.

Crane Lifted Load shall be considered during wind condition.

The following are the general load combinations to be considered for analysis of buildings / structures.

Combinations for Serviceability/Working Stress Method:

DL1 + DL2 ± TL
DL1 + DL2 + LL ± TL
DL1 + DL2 + CRL ± TL
DL1 + DL2 + LL + CRL ± TL

DL ± WL ± TL
DL1 + DL2 + LL + CRL ±WL ± TL

DL ± SL ± TL
DL1 + DL2 + % LL + CRL1 ± SL ± TL

For stability check
0.9DL1 ± SL
0.9DL1 ± WL

Combinations for design of RCC members (Limit State Method):

1.5DL1 + 1.5DL2 ± 1.5TL
1.5DL1 + 1.5DL2 + 1.5LL ± 1.5TL
1.5DL1 + 1.5DL2 + 1.5CRL ± 1.5TL
1.5DL1 + 1.5DL2 +1.5 LL + 1.5CRL ± 1.5TL
1.5DL ± 1.5WL ± 1.5TL
1.2DL1 + 1.2DL2 + 1.2LL + 1.2CRL ± 1.2WL ± 1.2TL
1.5DL ± 1.5SL ± 1.5TL
1.2DL1 + 1.2DL2 + 1.2LL + 1.2CRL1 ± 1.2SL ± 1.2TL

However, the above load combinations given here are indicative only and load combinations shall be referred as per IS:875 part-V and IS:1893-2002 during detailed engineering design.

While considering seismic nodal masses live load reduction factors shall be as per the IS 1893:2002 Cl 7.3 Table 8. For imposed loads,

Up to 3 kN/Sq.m - 25%,

Above 3 kN/Sq.m - 50%,

For Roofs - 0%.

Note:

1. For overall structural analysis the equipment load (DL2) shall be the operating loads of equipment. For local design of members / supports the hydraulic test load or operating loads whichever is higher shall be used.

2. Based on the above broad load combinations, the full set of load combinations shall be generated and the same shall be covered in the detailed design calculation.

3. Temperature loading shall be considered.

Wind and Seismic loads acting in the transverse and longitudinal direction shall be considered independently as separate load cases.

Underground Structures

Water retaining structures shall be designed as per provisions of IS 3370.

Following loading conditions shall be considered in addition to the loading from super structure for the design of underground structures.

a. Only liquid pressure from inside and no earth pressure & ground water pressure and surcharge pressure from outside (applicable only to structures which are liable to be filled up with water or any other liquid).

b. Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.

c. Base slab of the sump tank shall be designed for the condition of different combinations of sumps being empty during maintenance stages with maximum ground water table. Intermediate dividing piers of p sumps and partition walls in channel shall be designed considering water on one side only and the other side being empty for maintenance.

d. Design shall also be checked against buoyancy due to ground water during construction and operation stage. Minimum factor of safety as per IS: 3370 against buoyancy shall be ensured considering empty condition ignoring superimposed loads.

4 Reinforced Concrete Structures and Foundations

4.1.1 General

All structures, building foundations, machines / equipment foundations, water retaining structures, trenches, pits, etc., shall be designed as per IS relevant Codes in general. Construction in general shall follow provisions of IS: 456 and IS: 3370 for normal and water retaining structures respectively.

4.1.2 Design Methodology

General RC Structures

All designs of RCC structures shall be carried out by limit state method as per IS: 456 unless use of working stress method is specifically mentioned. Design strength of materials and design loads shall be calculated using appropriate partial safety factors over characteristic strength and characteristic loads as per IS: 456.

For reinforcement detailing IS: 5525 and SP: 34 and ductile detailing as per IS:13920 shall be followed.

Walls shall be provided with reinforcement on both faces for sections 150 mm or more, even if not required from design consideration.

Foundations and Underground Structures

The footings/foundations/piling arrangements shall rest on firm strata. The safe bearing capacities at different depths of foundations shall be as per Geotechnical Investigation Report. Foundation system adopted shall ensure that settlement / relative settlement is as per provision of IS: 1904 and settlement criteria for the equipment to be verified as per OEM requirement. Maximum settlement for, (as per Table 1 of IS: 1904) a) Isolated footings: 50 mm b) Rafts : 75 mm. However, the settlement shall be restricted to a lower value, if necessary, as per the system requirement.

Highest Flood Water Level (HFL) for the proposed site shall be that applicable for Sambalpur as per Water Resources Department, Government of Odisha.

All foundations including machine/equipment foundations shall be of RCC construction. All foundations shall be designed in accordance with relevant parts of IS: 2974 and IS: 456 as per working stress / limit state method of design. Raft foundation shall be designed as per IS: 2950. Pile foundation shall be designed as per IS: 2911.

The presence of hazardous materials in the randomly dumped waste poses a risk to the integrity of the pile concrete, potentially causing it to degrade and leading to reinforcement corrosion. Therefore, to safeguard against such deterioration, it is advisable to provide a permanent liner for the pile along the full depth of the waste, plus an additional 1.0 meter into the stable soil beneath.

The foundation system shall be designed to ensure structural stability and durability, with a minimum design service life of structures erected on Pile foundations shall be 30 years.

The foundation design shall suit to the local soil conditions and the materials used (cement, reinforcement steel etc.) shall confirm to relevant standards. Bidder shall submit the GA and construction drawings and concrete mix design of all the foundations to Owner/PMC. Contractor shall provide a certification from IIT/NIT/SERC (Structural Engineering Research Centre of CSIR) about the stability of the civil structure and foundation designs with factors of safety

All underground pits, tunnels, basements, cable and pipe trenches, etc., shall be leak proof RCC structure where specified design depth of ground water table so warrants. Effects of uplift and reduction in bearing capacity due to underground water table shall also be considered.

In case of isolated foundations, partial contact between foundation and soil strata shall be considered wherever applicable and footings shall be checked for minimum contact area (90%) and maximum bearing pressure. Foundations shall be checked for safety against sliding and overturning.

Major foundation shall not rest on filled up soil. Minimum depth of foundation shall be at least 1.5m below virgin soil. CNS (cohesive non swelling) soil shall be used for foundations on shallow depth. However minor foundation like sleeper foundation, minor equipment foundation etc. shall be rested on compacted soil as per Codal standard.

Liquid Retaining Structures

All underground structures shall be designed as per IS:456 but limiting the crack width to 0.1mm for the external surfaces. Check for crack width shall be in accordance with BS: 8007. In case of leakage in the above structures injection grouting method shall be applied to repair the structure according to the requirement of IS: 6494.

All liquid retaining structures shall be designed as per IS: 3370 – 2009

- As un-cracked section by working stress method.

All water retaining / storage structures shall be designed assuming liquid up to the full height of wall irrespective of provision of any overflow arrangement.

Approved water proofing compound shall be used for addition in concrete to all liquid retaining structures.

In all liquid retaining structures, PVC water bar shall be provided at each construction / expansion joint. The sequence of construction shall also be specified on drawings showing construction joints.

Design shall also be checked against buoyancy due to ground water during construction and operation stage. Minimum factor of safety as per IS: 3370 against buoyancy shall be ensured empty condition ignoring super imposed loads.

Machine Foundations

The design of machine / equipment foundation shall be as per IS: 456 and IS: 2974. The provisions of DIN 4024 shall also be followed for machine foundations.

All machine / equipment foundations and structures subject to vibrations shall be suitably proportioned so that amplitude and frequency of the foundation / structures are within permissible limits.

Dynamic analysis shall be carried out for all major vibratory equipment foundations where manufacturer supplies the complete dynamic loading data along with limitation on design criteria. All block foundations resting on soil shall be designed using the elastic half space theory or Barken's theory. Block foundation resting on piles shall be designed using Novak's or Barken's theory.

The mass ratio for centrifugal machine shall be 3 and for reciprocating machine ratio shall be 5. The CG of the combined mass of foundation and equipment should pass through the CG of the base area with tolerance not more than 5%.

Dynamic analysis shall be carried out to calculate natural frequencies in all the modes including coupled modes and to calculate vibration amplitudes. Frequency and amplitude criteria as laid down by the relevant codes and / or machine manufacturers shall be satisfied.

Minimum reinforcement shall be governed by IS: 2974 and IS: 456.

For the foundations supporting minor equipments weighing less than one ton or if the mass of the rotating parts is less than one-hundredth of the mass of the foundation, no dynamic analysis is necessary.

All such foundations shall be separated from adjoining part of building and other foundations. Joints at floor / slab shall be suitably sealed. All appendages to such foundations shall be reinforced suitably to ensure integral action.

Increase in Stresses

The increase in stress is applicable only when wind (or seismic) and temperature are combined with those due to dead, live and impact in case of working stress method for concrete. For steel structures the increase in stresses by 33.33% is allowed when effect of wind or seismic is taken into account, provided wind load is not the main load acting on the structure.

Allowable bearing capacity of soil / pile capacity shall be allowed to increase by 25% under seismic / wind load condition.

Stability of Structures

Design shall be checked against buoyancy due to the ground water during construction and maintenance stages for structures like underground tanks, pits trenches, basements, etc. Minimum

factor of safety of 1.2 against buoyancy shall be ensured considering empty condition inside and ignoring the superimposed loading. For purpose of calculating downward load due to any overburden, only the mass located vertically above the projected area shall be taken into consideration.

All building sub-structures shall be checked for sliding and overturning stability during both construction and operating conditions for various combination of loads. Factor of safety for these cases shall be taken as mentioned in IS: 456 and other relevant IS codes. However, following minimum factor of safety shall be followed.

a. Factor of safety against overturning shall be 1.5 minimum.

b. Factor of safety against sliding shall be 1.5 minimum.

c. Factor of safety against uplift due to hydrostatic forces shall be 1.2 and due to any other loads shall be 1.5.

Stability of the structure shall also be investigated for loading conditions during construction, repair or other temporary measures. Lower factor of safety may be used for such loading conditions as per relevant IS codes.

In case where dead load provides the restoring force, only 0.90 times characteristic dead load shall be considered. Imposed loads shall not be considered as restoring force.

4.1.3 Minimum Thickness of Structural Elements

The following minimum thickness requirement of structural elements are as follows :

a.	Suspended floor slab / roof slab / walkways / canopy slabs etc.	-	150 mm
b.	Ground floor slab (non - suspended)		
	Plant buildings	-	150 mm
	Non - Plant buildings	-	150 mm
c.	Water Retaining Slab / Walls	-	200 mm
d.	Cable / Pipe Trenches / Underground pit / Launder walls and base slab	-	150 mm
e.	All footings (including raft foundations)	-	300 mm
f.	Tapered footings	-	150 mm (Min. at edges)
g.	Parapets / Chajjas	-	125 mm

h.	Sunshades	-	75 mm at edge
i.	Precast louvers / fins	-	50 mm
j.	Precast trench cover slabs / floor slabs/ louvers	-	75 mm
k.	Paving	-	100 mm
l.	Pile cap	-	500 mm
m.	Basement walls and base slab	-	200 mm
n.	Underground reservoir		
Below ground water table		-	200 mm
Above ground water table		-	150 mm

From fire resistance point of view minimum thickness of reinforced concrete members shall be as per fig 1 of IS 456. Minimum fire rating of 4 hours shall be considered where fire hazard is expected.

4.1.4 Minimum Heights for Pedestals of Steel Columns

Pedestals to Steel columns for building structures

Top of RCC pedestals for structural steel columns shall normally be kept at a lower level so that the column base plates together with gussets and stiffeners remain below finished floor level (FFL) unless specified otherwise. Foundation levels of some columns shall be changed suitable to accommodate underground services, pits trenches, etc.

Stair and ladder pedestal shall be kept 200 mm above the finished floor level.

Pedestals to Steel Columns for Equipment structure and Pipe Racks:

a.	Equipment in open area	-	as required (300 mm min.) above FFL
b.	Equipment in covered area	-	as required (150 mm min.) above FFL
c.	Structures / equipment supplied by Vendor	-	as per vendor's data subject to vendor's minimum as specified above

Anchor bolts shall be provided in pedestals for fixing of structures subject to uplift forces. Such pedestals shall be checked for uplift with 50% soil overburden and 0.9 times dead loads.

4.1.5 Concrete Mix

The following minimum grades of concrete as per IS: 456 shall generally be used for the type of structures noted against each grade. 53-grade Ordinary Portland Cement (OPC) conforming to IS: 12269, fly ash based Portland Pozzolona cement as per IS: 1489(Part-I) or 43-grade ordinary Portland

Cement as per IS: 8112 shall be used. For aggressive/saline soil approved cement shall be used. Sulphate resistant cement shall conform to IS: 12330.

Unless specified 20mm and downgraded aggregates shall be used for all structural concrete works. However, 40mm and downgraded aggregates may also be used under special conditions for foundation.

Sound and durable crushed stone aggregates shall be used. All aggregates shall be tested for alkali aggregate reaction. Materials, which contain high percentage of reactive silica, shall not be used. In exceptional cases of high percentage of reactive silica content, aggregate may be allowed where low alkali cement shall be used.

Plinth level shall be cutoff level for underground structures

Mix (1 : 4 : 8)	-	Fill concrete PCC
Mix (1 : 3 : 6)	-	Foundation below brick wall Blinding layer below foundations Trenches and underground structures (Minimum thickness of the layer shall be 75 mm)
Mix (1 : 2 : 4)	-	PCC for plinth protection work
Grade M20		Base plate encasement, Grade slab and Pavement around building
Grade M25	-	All RCC members including Foundations Superstructure Grade beams Pedestals Roof slabs
Grade M30	-	Water retaining structures

Intermixing of different grades of concrete in the same structure shall not be allowed in a particular structural element.

Minimum cement content shall be governed by the requirement of IS: 456 for normal concrete structures and IS: 2911 for piles.

The Minimum Cement content and water cement ratios shall be as per the concrete mix design report subject to a minimum cement and maximum water cement ratio (as per IS: 456) for Concrete grades as follows:-

M15	:	240 kg/m3 & 0.6
M20	:	300 kg/m3 & 0.55
M25	:	300 kg/m3 & 0.50
M30	:	320 kg/m3 & 0.45
M35	:	340 kg/m3 & 0.45

For Piles : 400 kg/m3 & 0.45

For water retaining structures the minimum w/c ration shall be 0.45.

Bituminous paint shall be applied to concrete underground structure to prevent chemical attacks and corrosion.

4.1.6 Reinforcements

High strength deformed steel shall be used for all RCC structures. The grade of reinforcing steel shall be Fe500.

All reinforcement shall be of TMT bars conforming to the requirements of IS 1786 and shall be used for all RC structures unless specified elsewhere.

Reinforcement bars shall be as per the following codes:

High Yield Strength Deformed bars	-	IS: 1786
Mild steel bars	-	IS: 432 Grade 1
Welded wire fabric	-	IS: 1566

Intermixing of different grade of reinforcing bars in the same structure shall not be done.

Reinforcement detailing shall be as per IS: 5525 and SP 34.

Two layers of reinforcement (on both inner and outer faces) shall be provided for RCC wall sections having thickness 150 mm or more.

Projecting reinforcement or dowel bars for future connection of the structural works shall be protected by cement paint, if they are to be left exposed for a long time

4.1.7 Grouting

Non-shrink flowable grout shall be used for under pinning work below base plate of columns. Non-shrink cum plasticiser admixture shall be added in the grout.

For grouting of base of machine foundation high strength flowable ready mixed non-shrink grout shall be used.

Nominal thickness of grouting shall be at least 50 mm for building columns and pedestals of major equipment.

For pipe rack pedestals, secondary posts, stair and ladder base etc. grouting shall not be less than 25 mm thick. All grouting for equipment foundation shall have 45° chamfer at the edges.

4.1.8 Minimum Cover to Foundation Bolts

Minimum distance from the centre line of foundation / anchor bolt to edge of pedestal shall be the maximum of the following :

a. Clear distance from the edge of the base plate / base frame to the outer edge of the pedestal shall be minimum 50 mm.

b. Clear distance from the face of pocket to the outer edge of the pedestal shall be 75 mm.

c. Clear distance from the edge of the sleeve or anchor plate to the edge of pedestal shall be 75 mm.

Minimum Cover to Reinforcement

The clear cover to reinforcement shall be for 2 hours fire rating as per table 16A of IS: 456 and also meet the requirement of durability requirements based on exposure conditions as per table 16, whichever is stringent.

The minimum cover to the main reinforcement for all the structures, unless otherwise specified, shall be as follows :

Slabs (roof and floors, canopies, chajjas, waist slab in stair etc.):		25 mm or dia of bar whichever is more 30mm in use of seawater exposure
Beams	:	30 mm or dia of bar whichever is more 40mm in use of seawater exposure
Grade Slab	:	30 mm
Lintel Beams (Sizes less than 300x300)	:	25 mm
Columns	:	40 mm
Pedestals	:	50 mm
Dry pits / retaining walls		
i. Face in contact with earth	:	50 mm
ii. Free face	:	40 mm
Water / Liquid retaining structures		
i. Face in contact with liquid	:	40 mm

ii.	Away from liquid but in contact with earth	:	50 mm
iii.	Base raft	:	75 mm

Footing

i.	Sides and top	:	50 mm
ii.	Bottom	:	75 mm

4.1.9 Miscellaneous Requirement

Formwork Requirements

Plywood formwork shall be used for all water retaining / conveying structures and for all over ground concrete works. For other areas steel / plywood formwork shall be used.

No metal part of any device for maintaining formwork in the correct location shall remain permanently within the specified concrete cover to the reinforcement.

In watertight construction, methods of fixing formwork, which result in holes through the concrete section when the formwork is removed, shall not be used. All wall ties shall have water baffles and wall kickers shall be cast monolithically with the base slab.

Approval for the size, type and position of any holes, insert or fixing required by CONTRACTOR shall be obtained before work proceeds. Unless otherwise specified or approved all holes shall be formed and all inserts cast in at the time of pouring No part of the concrete works shall be drilled or cut away without approval.

Formwork panels shall be stiff enough to prevent damage to the concrete surface caused by excessive movements of the panel during vibration of the concrete.

Damaged and used formwork shall not be re used without repairing.

All joints in form work and joints between the form works shall be sufficiently tight to prevent loss of liquid from the concrete through these joints.

The part of the ties shall be capable of being removed, so that no part remaining embedded in the concrete shall be nearer the surface of the concrete than the specified thickness of cover to the reinforcement. Holes left after the removal of ties shall be filled with concrete or mortar of approved composition.

Formwork props shall be positioned between permanent supports so that all members are supported at not more than 3 meters centre in both directions.

The props shall be in the form of space frames; composite or single members with sufficient stiffness or bracing so that props shall neither sway nor buckle under loads which they are designed to carry.

The formwork or the false work shall not be removed from a structural component until CONTRACTOR ensures that the concrete has attained sufficient strength.

The concrete is to be regarded as sufficiently hardened when the component has attained such strength that it can resist all loads acting at the time of removal of the formwork.

Particular care shall be taken with components which have to carry virtually the full design load directly upon removal of the false work (e.g. in the case of roofs, or floor slabs which have to support loading from floors above them which have not yet hardened).

Props shall remain in position for as long a period a possible, particularly for structural components, which are subjected to a major proportion of their design loading as soon as the formwork has been removed.

No superimposed load shall be allowed on any part of the concrete work prior to the removal of the forms and props.

Tolerance for formed and concrete dimension shall be as per IS:456.

Bamboo or wooden scaffolding shall not be used anywhere in the construction work.

Placing of concrete

Before each concreting CONTRACTOR shall give sufficient notice to the Owner as directed such that an inspection shall be made before the concreting.

The concrete shall be mixed in the mixer of adequate capacity having a power elevated loading hopper. The mixer shall be equipped with an automatic water-measuring tank filled with a device for locking the discharge setting. The Mixing shall continue until there is a uniform distribution of the materials and the mass is uniform in colour and consistency.

Any concrete surplus to immediate requirements shall be thrown away. In no case circumstances may the surplus be used later.

The volume of mixed materials in each batch shall comply with the mixer manufacturer's written recommendations.

Concrete shall be transported as quickly as possible from the mixer to its final position without segregation or loss of any of the ingredients.

All equipment to be used for transporting material shall be kept clean; all containers used for transporting concrete shall be thoroughly washed out whenever mixing ceases.

Concrete shall be placed continuously up to construction joints while it is still sufficiently plastic for adequate compaction.

At all times when reinforced concrete is being placed a competent steel fitter shall be in continuous attendance. CONTRACTOR shall adjust and correct the position of any reinforcement, which may be displaced.

CONTRACTOR shall keep on site a complete record of the works showing the time and date when concrete is placed in each part of the work.

Concrete shall be thoroughly compacted by suitable mechanical vibrators during placing and shall be carefully worked around all reinforcement and embedded fixtures and in to the side and corners of the formwork.

For top surfaces of slab and other surfaces for which formwork is not provided a smooth finish shall be provided with a wooden float after compaction.

Whenever, concrete is being vibrated at least one spare vibrator of each type in use shall be available in case of breakdown.

Compaction shall start as soon as there is sufficient concrete within the formwork to immerse the vibrator and vibration shall continue during the placing operation so that at no time shall there be a large volume of un compacted concrete in the form work.

The concrete shall not be placed directly against a vertical form face but shall be placed to flow to this surface during the compaction process. Care shall be taken to avoid the form face being splashed with mortar during the placing operation.

Exposed surfaces, immediately after final set, shall be protected from the sun. All concrete shall be well watered after it has been set and shall be kept continuously damp until thoroughly cured. Provision shall be made for adequate water distribution to all parts of the work so that if required this treatment can be continued sufficiently throughout the whole period of construction. In order to keep the concrete continuously damp, all exposed surface shall be covered with continuously damped gunny bags or shall have water compounded on them, for full period of curing.

On exposed concrete surfaces in high sun temperatures and /or strong drying wind conditions CONTRACTOR shall use curing method, which also shields the concrete, and this shall be placed in position not later than half an hour after final tamping.

Scheme for Concreting

Weigh batching plants shall be mobilized for the project site. Concrete pump and boom placer for elevated casting shall also be mobilized. For the entire duration of construction. Arrangements for stand-by Plant and Equipment shall also be made.

Other Requirements

Fillets at the junction of roof and vertical walls shall be provided with cast in situ cement concrete 1:2:4 (nominal mix) followed by 12 mm thick 1:4 cement mortar.

A screed layer not less than 100 mm thick of cast in situ concrete of nominal mix 1:3:6 shall be provided below all water retaining structures. A sliding layer of craft paper or bitumen paper shall be provided over the screed layer to destroy the bond between screed and base slab.

5 Steel Structures

5.1.1 General Steel Structures

Design of structural steel work shall include, generally but not be limited to the following steel structures

a. Steel building structure and open structures.
   This shall include beams, columns, bracings, supporting structure for floors, roof slabs, cladding etc.
a. Crane gantry girders, monorails, etc.
b. Platforms and walkways
c. Ladders, staircases, handrails etc
d. Pipe racks and cable racks.

Materials

Structural steel shall conform to Grade A of IS: 2062 for rolled steel members or plates up to 20 mm thickness. For plates above 20 mm thickness or welded construction, steel conforming to Grade B (Killed) of IS: 2062 shall be used except for crane girders where Grade C (IS: 2062) steel shall be used.

All sections for structural steel shall be rolled sections only.

Chequered plates shall conform to IS: 3502.

All gratings shall be pressure locked type (preferably Electro-forged) manufactured in accordance with applicable Indian Standard.

All handrails Post & Top rail shall be of 40 mm nominal bore MS pipes (medium class) with thickness 3 mm as per IS: 1161 and middle & bottom rail shall be of 32 mm. and shall be with MS epoxy paint.

Handrails for Non plant building (Admin building) shall be of 40 mm dia pipe (SS 316) for top rail and mid rails shall be of 20 mm dia pipe (SS 316) and vertical post shall be of 32 mm dia pipe (SS 316).

Foundation bolt material shall be of mild steel (property class 4.6) and shall conform to IS: 1367 – Part 3 (2002) and IS: 5624 (1993), material grade shall conform to IS: 2062 grade A unless noted otherwise in the drawing.

Framing

All steel framed structures shall be either “rigid frame“ or “simple space frames“ or a combination of two. Column base shall be considered fixed or hinged.

Lateral forces shall be resisted by stiff jointed moment connections in rigid frame design. The column bases shall generally be fixed to concrete foundation pedestal by providing moment resistant base detail.

Simple space frame design utilises single-span beam systems, vertical diagonal bracing at main column lines and horizontal bracing at the roof and major floor levels. The most of plant steel buildings shall be designed as simple space frame structures.

Pipe rack shall consist of rigid main frame in transverse direction spaced longitudinally as required. In longitudinal direction, pipe rack shall be divided into sections of suitable length with an anchor bay. The main transverse frames shall be connected with longitudinal beams which shall transmit horizontal forces to braced anchor bays. The pipe and cable rack bridge structure shall be adequately rigid to carry the forces from pipelines at anchor points without undue deflection so that pipelines are really anchored at the anchor points.

Concrete floors (with shear connectors from top flange of steel beams) shall be considered to provide continuous lateral support to the top (compression) flange of the support beams. However, wherever large cut outs are provided in the floor slabs horizontal floor bracing shall be provided. Grating/chequered plate floor shall neither be considered to provide lateral support to the top flange of supporting beams nor to provide a shear diaphragm. Adequate lateral support and horizontal bracing shall be provided as required.

Columns shall be designed to support the load combination that produces the maximum interaction ratio. Exterior columns shall be designed to resist wind moments between braced elevations as appropriate. Columns shall also be designed to resist moments caused by discontinuous vertical bracing or non-concentric bracing work points.

5.1.2 Design Methodology

The design of steel structures shall be done by Limit State Design in accordance with the provisions of IS: 800 and other relevant latest IS codes as applicable to specific structures.

All buildings/structures shall be framed structure. Basic consideration for structural framing shall be stability, rigidity, building uses, ease of fabrication / erection and overall economy. Additional bracings/moment connections shall be used to assure stability of structures. Structure shall be designed such that the surfaces of all parts shall be accessible for inspection, cleaning, painting and maintenance.

Crane gantry girders shall be single web plate girder or welded construction with bearing and intermediate stiffeners. Crane girder shall be designed as simply supported and of single span length. Chequered plate shall be used for gantry girder walkway flooring. For lifting / monorail beams ISMB sections shall be preferred and the bottom flange of all beams shall be checked separately for distortion and reinforced suitably if required.

Permissible stresses for different members shall be allowed to exceed up to 33.33% only under normal loads along with wind and seismic conditions. The members which are designed primarily to resist wind load such as bracing members, no increase in permissible stress shall be permitted. However,

permissible stresses in bolts and welds shall be allowed to exceed up to 25% only under wind and seismic conditions.

For design which requires the use of the minimum column load (such as, uplift on anchor bolts, column axial tension, etc.) the following criteria shall be used in determining minimum load.

Use 90% of the column dead load, no live load is used, Uplift forces from vertical bracing are included where applicable and Wind uplift on the roof is included where applicable.

Base plates shall be placed on foundation pedestal with grouting. For large base plates necessary grout holes shall be provided. All anchor bolts for fastening steel columns on foundation shall be embedded in foundation during concreting itself. No anchor pockets in foundation shall be allowed. Design of base plates shall be based on design pressure on foundation, which shall not exceed the following:

a. **Pedestal in concrete grade M25 6.25 N/sq.mm**

The total horizontal shear force at the base of column is transferred to the column pedestals through friction between the base plate and the grout. A coefficient of friction of 0.30 shall be used in conjunction with the minimum column load as defined above. If the horizontal shear force exceeds the frictional resistance force or if the column is subjected to a net uplift load, the total force shall then be transmitted through shear bars / shear keys welded to the base plate. Anchor bolts are not assumed to resist any horizontal shear force. Necessary recesses shall be kept in the foundation concrete for shear lugs.

The following criteria shall be followed for posting loads on the design drawings.

- For vertical beam reactions, the load shall be posted whenever the value exceeds the maximum allowable uniformly distributed load.
- For axial loads in floor beams, the actual horizontal load which the beam end connection must resist shall be posted for each end of the beam. Note that this value may be different for opposite end of the same beam. For truss members, only one member force shall be noted for each member.

Angle sections shall not be used as flexural members except for roof trusses, purlins, side girt and walkway runners only.

5.1.3 Permissible Deflections

The permissible deflection of various steel members under normal loading conditions shall be as specified below. For calculation of deflections in structures and individual members dynamic effects shall not be considered, unless specified otherwise. Also, no increase in deflection limits shall be allowed when wind or seismic loads are acting concurrent with normal loading conditions.

Vertical Deflection

a. For beams supporting dynamic equipment - Span / 500

b. For beams supporting floors / masonry - Span / 325

c. For beams supporting pipes (pipe rack) - Span / 400

d. For roofing and cladding components - Span / 250

e. For gratings and chequered plates - Span / 200 subject to a maximum of 6 mm

For crane gantries or any member subjected to working loads, the maximum deflection under dead load and live load excluding impact shall not exceed the following values

a. For manually operated cranes & monorails - Span / 500

b. For electric overhead cranes

i. Up to 50 t capacity - Span / 750

For vertical deflection limits, refer clause 5.6.1 Table:6 of IS 800

Horizontal deflections

The permissible horizontal deflections shall be as per following unless specified otherwise :

a. Single storey building (without crane load) - Height / 325
b. Multistoried building (without crane load) - Height / 500
c. Pipe rack columns - Height / 200
d. Open structures - Height / 200

For horizontal deflection limits, refer clause 6.6.1 Table:6 of IS 800

Provisions of IS: 800 and relevant IS codes shall be followed for limiting deflections of structural elements not listed above.

5.1.4 Minimum Thickness and Sizes of Steel Elements

Minimum Thickness

The minimum thickness requirement of various components of a structure and hot rolled sections are as follows. The minimum thickness of rolled shapes shall mean flange thickness regardless of web thickness. Structural steel members exposed to marked corrosive environment shall be increased suitably in thickness or suitably protected otherwise as per good practice and sound engineering judgment in each instance.

a. Trusses, purlins, girts and bracing : 6 mm

b.	Columns and beams	:	8 mm
c.	Gussets	:	8 mm
d.	Stiffeners	:	8 mm
e.	Base plates	:	10 mm & above
f.	Chequered plates	:	6 mm o/p & above
g.	Grating flats	:	5 mm

Minimum thickness of structural members, other than gratings and chequered plate, directly exposed to weather and inaccessible for painting and maintenance shall be 8 mm.

For axially loaded members in framework, minimum angle section to be used shall be ISA 50x50x6.

Minimum Sizes

The flange width of purlins supporting light weight concrete slab shall not be less than 65 mm, and for those supporting roof sheeting and wall cladding it shall not be less than 50 mm.

Width of steel rolled section connected to other member shall be at least 50 mm.

The depth of beams for platform of all structures shall not be less than 125 mm.

Slenderness and Depth Ratio

The slenderness ratio of main members in tension, compression or bending shall be in accordance with IS: 800.

The following limiting ratios of depth to span shall be considered as general guide.

a.	Truss	-	1/10
b.	Rolled beams and girders for ordinary floors and rafters	-	1/24
c.	Supporting floor beams for vibrating machinery / equipment	-	1/15
d.	Roof purlins and girts	-	1/45
e.	Gable columns	-	1/30

5.1.5 Joints/Connections in Steel Structures

Steel structures shall be detailed and connection and joints provided as per the provisions of IS:800, IS:816, IS:9595, IS:1367, and IS:9178 and as per following requirements.

a. Connection of vertical bracings with connection members and diagonals of truss members shall be designed for full tensile capacity of the bracings unless actual loads are indicated on the drawings.

b. Size of fillet weld for flange to web connection for built up section shall be as follows:

i) For box section weld size shall be designed for 60% of full shear capacity or actual shear whichever is more. Where fillet weld is not possible, full penetration butt weld shall be provided.

ii) For built up I-section, weld size shall be designed for 80% of full shear capacity or actual shear, (if indicated, in drawings) whichever is more. However, weld size shall not be less than 0.5 times the web thickness. Weld shall be double fillet.

iii) All welds shall be continuous unless otherwise specifically approved. The minimum size of the fillet weld shall be 6mm.

c. Shear connections shall be designed for 75% of section strength for rolled sections and 80% of section strength for built up section or rolled section with cover plates. However, if load is more than above, the connection shall be designed for actual load.

d. Moment connections between beam and column shall be designed for 100% of moment capacity of the beam section. This can be achieved either by direct butt welding of the top flange of beam with column flange or by providing top moment plate with suitable notch for additional weld length.

e. Welding shall be used for shop fabrication and joints. All butt welds shall be full penetration butt welds. IS: 816 and IS: 9595 shall be followed for welding of structures.

f. The connection between top flange and web of crane girder shall be full penetration butt weld. Bottom flange, connection with web can be fillet weld or butt weld as directed by Owner/Engineer.

g. Connection of base plate and associated stiffeners with the columns shall be designed considering the total load transferred through welds. However, minimum weld size (double fillet) shall not be less than 0.6 times the thickness of stiffeners

h. Splicing: All splicing work shall be of full strength. Field splicing shall be done with web and flange cover plates for full strength. Shop splicing for all sections other than rolled shall be carried out by full penetration butt welds with no cover plates. Splicing for all rolled sections shall be carried out using web and flange cover plate.

i. For site connections, high strength friction grip (HSFG) type bolts shall be used, except in few cases for shear connections of lighter members or removable beam connections where bolted joints using permanent mild steel bolts may be adopted e.g. purlins, side girts etc. For high strength friction grip bolt connections IS: 4000 shall be followed. High strength friction grip bolts shall be of property class 6.6 or 8.8 and shall conform to IS: 3757. High strength bolts shall be installed as bearing type joint except where loads are reversible.

j. A minimum of two bolts per connection shall be used.

k. All bolted connections shall have bolts of minimum 16 mm dia. The connections of stairs and handrailing shall be made with 20 mm diameter threaded fasteners conforming to IS: 1363. Erection bolts shall be black bolts of minimum 12 mm dia.

l. All bolts and nuts have property class compatible to each other. For bolts carrying dynamic or fluctuating loads and those in direct tension shall be provided with an additional double coil helical spring washer conforming to IS: 6755. The threaded portion of the bolt shall project through the nut at least by one thread.

m. Where a steel beam or member is to be connected on RCC structure, it shall be connected using an insert plate and preferably through shear connection.

n. For crane girders, welding between web and flange plates shall be carried out by submerged arc welding process. Full penetration of weld between web plate and top flange shall be ensured. Intermediate stiffeners shall be connected with top flange plate by full penetration butt weld. Welding across tension flange shall not be permitted. Bearing edges of crane girders shall be machined.

o. The work point of the bracing connection shall be the centre of column and girder to which it connects, where practical. The connections of gusset plates to column and girders shall be made to include provisions for eccentricity in connection. Double angle bracings (back to back or star) can be used. The double angle back-to-back with gusset plates in between shall not be used in dust-laden areas. Where double angles are not adequate, beam sections with web in the plane of bracing are used.

p. Horizontal bracings shall be angle / tee section connected to the bottom portion of the top flange of framing beams. Field welding of bracing at the underside of beam as required to meet slenderness requirement of bracing member shall be indicated on the drawings. Horizontal bracing shall be arranged to avoid framing into the beams at columns locations.

q. For Major columns of main building, column splices shall be designed to resist the greater of the design axial tension load and moments in either the major or minor axis, whichever produces the greatest number of bolts. For horizontal bracings to act as torsion bracing the bracing shall not be connected to the bottom flange. Splicing of columns shall be 1.05 times the capacity of the section.

r. Minimum size of fillet weld shall be 6 mm. Main structural elements shall be welded continuously. Intermittent weld shall be used only on secondary members, which are not exposed to weather or other corrosive influence. Overhead welding shall not be permitted. However if it is un-avoidable welding shall be carried with 4G with approved WPS.

s. Efficiency of site welds to be considered shall be as follows:

i) Fillet weld above 25 m from ground 50%

ii) Others 80%

5.1.6 Fabrication and Erection

Contractor shall prepare detailed fabrication drawings and erection scheme based on the design drawings approved by Owner. Fabrication drawings are not to be submitted to Owner for approval as the responsibility for correct detailing rests exclusively on the Contractor. However, these drawings shall be furnished to Owner for their reference to effect payment and information.

Fabrication shall in general follow the provisions of IS:800, 816, 9595, 1367, 9178 and good engineering practice where provisions of IS:800 are not clear.

Tolerance in fabricated steel work shall be as per IS:7215.

Erection of fabricated steel components shall be as per erection drawings prepared by Contractor and approved by his Consultant

Tolerance for erected steel structures shall be as per IS:12843.

5.1.7 Inspection of Welding

The extent of quality control in respect of welds for structural elements shall be as follows.

Visual Examination

All welds shall be 100% visually inspected to check the following:

(i) Presence of undercuts
(ii) Surface cracks in both welds and base metals.
(iii) Unfilled craters
(iv) Improper weld profile and size
(v) Excessive reinforcement in weld
(vi) Surface porosity

Before inspection, the surface of weld metal shall be cleaned of all slag, spatter matter, scales etc. by using wire brush or chisel.

Dye Penetration Test (DPT)

This shall be carried out for all important fillet welds and groove welds to check the following for at least 10 % of the total length.

(i) Surface cracks
(ii) Surface porosities

Dye Penetration Test shall be carried out in accordance with American National Standard ASTME165.

Ultrasonic testing

Ultrasonic test shall be conducted for all groove welds and heat affected zone in dynamically loaded structures and for other important load bearing butt welds in statically loaded structures as desired by OWNER to detect the following:

(i) Cracks
(ii) Lack of fusion
(iii) Slag inclusions
(iv) Gas porosity

Ultrasonic testing shall be carried out in accordance with American National Standard ANSI / AWS D1-92 Chapter 6 : Part C.

Before Ultrasonic test is carried out, any surface irregularity like undercuts, sharp ridges etc. shall be rectified. Material surface to be used for scanning by probes must allow free movement of probes. For this purpose, surface shall be prepared to make it suitable for carrying out ultrasonic examination.

Radiographic Testing (X – ray and Gamma – ray Examination)

This test shall be limited to 2% of length of welds for welds made by manual or semi-automatic welding and 1% of length of weld if made by automatic welding machines. The location and extent of weld to be tested by this method shall be decided by OWNER to detect the following defects:

(i) Gas porosity
(ii) Slag inclusions
(iii) Lack of penetration
(iv) Lack of fusion
(v) Cracks

Radiographic testing shall be conducted in accordance with American National Standard ANSI / AWSD1.1-92.

Any surface irregularity like undercuts, craters, pits etc shall be removed before conducting radiographic test. The length of weld to be tested shall not be more than 0.75 x focal distance. The width of the radiographic film shall be width of the welded joint plus 20 mm on either side of the weld.

CONTRACTOR shall provide testing equipment for conducting non-destructive tests for confirming the integrity of welding wherever necessary as directed by the OWNER / consultant.

Acceptable Limits of defects of weld

Limits of Acceptability of welding defects shall be as follows.

(i) Visual inspection & Dye Penetration Test

The limits of acceptability of defects detected during visual inspection and Dye Penetration Test shall be in accordance with clauses 8.15.1 & clauses 9.25.3 of American National Standard ANSI / AWS D1.1-92 respectively, for statically and dynamically loaded structures.

(ii) Ultrasonic Testing

The limits of acceptability of defects detected during ultrasonic testing shall be in accordance with clause 8.15.4 & clause9.25.3 of American National Standard ANSI / AWS D1,=.1-92 respectively, for statically and dynamically loaded structures.

(iii) Radiographic Testing

The limits of acceptability of defects detected during Radiographic testing shall be in accordance with clause 8.15.3 & 9.25.2 of American National Standard ANSI / AWS D1, 1-92 respectively for statically and dynamically loaded structures.

Welding electrode shall be as per ISO classification: E51.18 and having certification of ISO 2560.

Rectification of Defects in Welds

In case of detection of defects in welds, the rectification of the same shall be done as follows:

All craters in the weld and breaks in the weld run shall be thoroughly filled with weld.

Undercuts, beyond acceptable limits, shall be repaired with dressing so as to provide smooth transition of weld to parent metal.

Welds with cracks and also welds with incomplete penetration, porosity, slag inclusion etc. exceeding permissible limits shall be rectified by removing the length of weld at the location of such defects plus 10 mm from both ends of defective weld and shall be re-welded. Defective weld shall be removed by chipping hammer gouging torch or grinding wheel. Care shall be taken not to damage the adjacent material.

5.1.8 Painting

All steel structures shall receive two primer coats and two finish coats of painting.

First coat of primer shall be given in shop after fabrication, before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and final alignment of the erected structures. Two finish coats shall also be applied after erection.

Steel surface which is to painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be abrasive blasted to Sa-2½ finish as per SIS05-5900. Primer paint shall be zinc silicate of approved make.

Finish paint shall be 2 coats of High built epoxy finish of approved brand. Dry film thickness of each finish coat shall be 90 microns. The undercoat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 300 microns. All paints shall be of approved brand and shade as per the OWNER's requirement.

6 Outdoor Civil Works

6.1.1 Drainage and Sewerage

All drainage lines for storm water, sewage, and waste drainage etc. shall preferably be laid in service aisles close to the road. Separate network shall be provided for lines of storm water, sewage, and waste drainage.

Storm Water Drainage System

The plant storm water drainage system shall take in to account the topography of the plant area, area drainage patterns and intensity of rainfall etc.

All storm water drainage shall preferably be through open storm water drains on both sides of the roads for 7m road and need to be designed to drain the appropriate catchment area including road surface, open and covered area etc.

The drains shall be minimum 300 mm wide for garland drain and 450mm wide for storm water drain at the base.

All Storm water drains in the plant shall be of RCC drains connected with chambers. All drains in the plant area and around buildings shall be covered with precast cover slab.

All the paved and unpaved areas shall be adequately drained. The surface drainage system shall be designed for surface washings and / or rain / fire water. Unpaved open areas shall be connected to plant storm water drains.

Minimum slope for paved areas towards drains - 1 in 100

Uncontaminated area surface drainage shall be connected to nearest open storm water drains

Contaminated area surface drainage shall be collected through separate network.

Interconnecting pipes and rectangular drains shall be sized for carrying the design discharge when running full.

Minimum width of RCC rectangular drains - 450 mm

Minimum velocity for self cleansing - 0.6 m/sec

Maximum velocity for pipe drains - 2.4 m/sec

Maximum velocity for open drains - 1.8 m/sec

Minimum slope of surface drains - 1 in 1000

Minimum earth cover over drainpipes in paved areas- 450 mm

Minimum width of garland drains all-round the building- 300 mm

Minimum grade of concrete - M25

Minimum thickness of side walls and bottom slab - 150 mm or as per design requirements whichever is greater

Run-off co-efficient for paved and unpaved areas shall be 0.9 and 0.6 respectively.

Surface drains shall normally have a bed slope not milder than 1 in 1000 along longitudinal direction and pipes shall have such slopes so as to have effective discharge.

Manholes shall be provided to piped drainage lines at every 30 m intervals, at junctions and at change of gradient, alignment and diameter of pipe and shall be of RCC construction. Minimum size of catch pits shall be of 1.0 m x 1.0 m. All Manholes shall be designed considering maintenance, inspection and cleaning of pipes. Easy accessibility and safety shall also be given due consideration.

The cushion over the pipes for storm culverts shall be minimum 600 mm. Where less cushion is available, pipe shall be encased in RCC M-15. Suitable RCC or masonry structures shall be provided at drops / falls to prevent scouring or damage to surface.

Invert of drainage pipe / drain shall be decided in such a way that the water can easily be discharged above the high-water level in water course outside the plant boundary to which the storm water to be let.

Sewage System

The plant sewage water shall be collected in the soak pit at appropriate location and provision for transferring sewage to nearest disposal point shall be provided with lift station as per requirement.

Salient points to be considered for sewage system,

- UPVC pipes shall be used for above ground level sewage system.
- For below ground level sewage system HDPE pipes shall be used.
- Pipes connecting toilet facilities to manholes shall be minimum 100 mm.
- Pipes connecting various manholes shall be minimum 150 mm.

Sewers shall be designed for peak flow condition (3 times the average flow) and pipes flowing half full.

Minimum self cleansing velocity - 0.75 m/sec

Maximum velocity - 2.4 m/sec

Suitable manholes shall be provided to piped sewage lines at every 30 m intervals, at junctions and at change of gradient, alignment & diameter of pipe and shall be of masonry or RCC construction. Details of manholes shall be as per IS: 4111 (Part-I). Minimum size of manholes shall be 1.0m x 1.0 m. All manholes shall be designed considering maintenance, inspection and cleaning of pipes. Easy accessibility and safety shall also be given due consideration.

Inter Plant Trenches

All cable and pipe trenches shall be of RCC with minimum M25 grade. Trenches located outside buildings shall be projecting at least 100 mm minimum above finished formation level to avoid entry of storm water into the trenches. The bottom of trench shall be provided with suitable slope for draining out collected water into a sump pit.

Trenches shall be covered using precast RCC cover of minimum M25 grade, each not weighing more than 65 Kg and shall be provided with a lifting hook.

As far as possible in the open area trenches shall be provided for running cables.

6.1.2 Roads

Roads shall be designed in accordance with the provision of the relevant IRC Codes of Practice.

All culverts shall be designed for the Class – AA loading conditions.

Sub-base shall be of granular material i.e. laterites, murrum, natural sand, gravel, crushed stone (grading-1) or combination thereof laid over well compacted sub grade. Granular base shall be of water bound macadam course (WBM) construction. Shoulder provided on either side shall be in murrum construction of 150 mm compacted thickness.

The geometric design of roads shall be done in accordance with IRC-73. Road widths, curves and parking areas shall have adequate space for manoeuvring of vehicles. The ruling gradient for roads in longitudinal direction shall be 1 in 30. Normally the roads shall have much flatter gradient. Transverse camber of 1 in 60 shall be provided for the black topping of roads and a slope of 1 in 40 shall be provided on shoulders. Finished top (crest) of roads shall be 250 mm above the surrounding grade level.

Minimum radius of curvature along the inner side of the carriage way shall be generally 12m. However, for minor roads this shall be reduced suitably as per layout requirements and site conditions. Road width and turning radii shall also be checked for to take largest foreseeable vehicles and equipment which can reasonably be expected.

All service and utility lines crossing under roads shall be taken through concrete pipes / ducts and designed for imposed loadings. Number of such crossings shall however be kept to a minimum.

Kerbs of PCC or stone shall be provided to distinguish carriage way.

6.1.3 Fencing

Fencing shall comprise of 2.4 m high galvanized chain link fence of minimum 12 gauge with mesh size 75 mm and galvanised barbed wire on inclined member to a height of 600 mm above the chain link fencing. 3 lines of 12-gauge high tensile spring steel wire shall be provided for the entire length of fencing. Also 50 x 6 galvanised MS flats shall be provided at every fifth post sandwiching the fencing with post using GI nuts and bolts.

Top of toe wall shall be 200 mm above formation level. Toe wall shall be generally of RCC construction and shall extend 150 mm below the formation level and the fencing mesh shall be embedded inside toe wall by minimum 75 mm.

Fencing post shall be fabricated out of galvanised MS angle section and shall be spaced at a maximum spacing of 2.5 m with struts made up of galvanised MS angle at every fifth fencing post in addition to these at bends. Expansion joint shall be provided at every 30m.

Steel entry gates shall be provided for all fenced areas. Gates shall be formed out of tubular section conforming to IS: 1161. Removable type of fencing shall be provided at suitable location to permit entry and exit of equipment.

Gate shall be fabricated out of tubular sections conforming to IS: 1161 and shall be painted with high quality epoxy paint finish. Outer frame shall be 65 NB (medium) tube and diagonal 50 NB (medium) tube 50 mm sq. welded mesh with 4 mm Dia GI wire fabric shall be welded to 25 mm x 6 mm thick GI flat which in turn shall be welded to the outer tubular frame. The gate shall be provided with 20 mm wide x 80 mm Dia flat M.S. roller at the bottom. The gate frame shall be fixed to MS Tubular post or RCC post.

However, provided specification & drawing will be minimum criteria and shall be followed as per the design requirement.

6.1.4 Paving & Grade Slabs

RCC Paving

R.C.C paving of grade M25, minimum 150 mm thick laid to a slope of 1 in 100 towards the nearest drain, shall be provided in the plant area

The under bed shall consist of well compacted ground supporting dry rubble soling of compacted thickness 230 mm in (two layers) with interstices properly filled with grits and subbase of approved earth material and compacted up to 95% proctor dry density shall be provided below the paving. RCC Paving shall be laid over a layer of PCC 1:3:6, 75 mm thick.

PCC Paving

PCC paving of nominal mix 1:1.5:3 of grade M20, 100 mm thick laid over 150 mm thick compacted rubble soling shall be provided other than plant area.

7 Codes & Standards

7.1.1 General

All the Standards referred to shall be the latest revision including all amendments issued thereto at the time of execution.

Reference of only some of the codes in this document and various clauses of design criteria shall not limit or restrict the scope or applicability of other relevant codes. It shall be ensured that all other codes relevant to a specific job, in addition to those already mentioned, are followed wherever applicable.

Where British / American / DIN or other codes and standards are referred to in this document, equivalent Indian Standards may be substituted if available.

In case of any deviation / conflict between provisions of IS codes and the design criteria, the provisions that are more stringent shall be followed unless specifically directed otherwise.

The Codes and Standards listed below are applicable for the design and construction of structures and buildings in general. Codes and Standards applicable for specific design and construction are listed elsewhere in reference sections.

Specifications for materials supplied from India follow the Indian Standard Specifications.

Field and laboratory testing procedures for materials follow Indian Standard Specifications.

Working stress design can be used as alternative but the approval of owner is a prerequisite.

Earthwork

IS: 1498	Classification and identification of Soils for General Engineering Purposes
IS: 3764	Safety code for excavation work.
IS: 7293	Safety Code for working with construction machinery.

LOADS

IS: 875 (All parts)	Code of Practice for design loads (other than earthquake) for buildings and structures
IS: 1911	Schedule of Unit Weight of building materials
IS: 6922	Criteria for safety and design of structure subjected to underground blasting.
IS: 1893	Criteria for earthquake resistant design of structure (All parts)
IRC Code	Bridge Rules of Government of India, Ministry of Railways (Railway Board)

Foundations

IS: 1080 Code of Practice for design and construction of shallow foundations in soils (other than raft, ring and shell)

IS: 1904 Code of Practice for design and construction of foundations in soils (General requirements)

IS: 2911 Code of Practice for design and construction of pile foundations (All parts)

IS: 2950 Code of Practice for design and construction of raft foundations

IS: 2974 Code of Practice for design and construction of machine foundations (All parts)

IS: 4091 Code of Practice for design and construction of foundation for transmission line towers and poles

IS: 8009 Code of Practice for calculation of settlements of foundations (All parts)

IS: 9556 Code of Practice for design and construction of diaphragm walls

IS: 11089 Code of Practice for design and construction of ring foundation

IS: 13301 Guidelines for vibration isolation for machine foundations

Reinforced Cement Concrete

IS: 269 Specification for 33 grade Ordinary Portland Cement.

IS: 383 Specification for coarse and fine aggregate from natural sources for concrete

IS: 432 Specification for Mild steel and medium tensile steel bars

IS: 455 Specification for Portland Slag Cement

IS: 456 Code of Practice for plain and reinforced concrete

IS: 458 Specification for pre cast concrete pipes

IS: 1343 Code of Practice for prestressed concrete

IS: 1443 Code of practice for laying and finishing of cement concrete flooring tiles

IS: 1566 Specification for Hard drawn steel wire fabric for concrete reinforcement

IS: 1785 Specification for plain hard drawn steel wire for prestressed concrete

IS: 1786 Specification for high strength deformed steel bars and wires for concrete reinforcement

IS: 1834 Specification for Hot applied sealing compounds for joints in concrete

IS: 3370 Code of Practice for concrete structures for the storage of liquids: (All parts)

IS: 2502 Code of Practice for bending and fixing of bars for concrete reinforcement

IS: 3370 Code of Practice for concrete structures for storage of liquids (all parts)

IS: 3414 Code of Practice for design and installation of joints in buildings

IS: 3935 Code of Practice for composite construction

IS: 4326 Code of Practice for earthquake resistant design and construction of buildings

IS: 4948 Specification for welded steel wire fabric for general use

IS: 4995 Criteria for design of reinforced concrete bins for storage of granular (All parts) and powdery materials

IS: 5525 Recommendation for detailing of reinforcement in reinforced concrete works

IS: 8112 43 grade Ordinary Portland cement

IS: 11384 Code of Practice for composite construction in structural steel and concrete

IS: 11682 Criteria of design of RCC staging for Overhead water tanks

IS: 12269 Specification for 53 grade Ordinary Portland Cement.

IS: 13620 Specification for Fusion Bonded Epoxy Coated Reinforcing Bars

IS: 13920 Code of Practice for ductile detailing of reinforced concrete structures subjected to seismic forces

BS: 8007 British Standard Code of practice for design of concrete structures for retaining aqueous liquid

Structural Steel

IS: 800 Code of Practice for general construction in steel

IS: 802 Code of Practice for use of structural steel in overhead transmission line towers (All parts)

IS: 806 Code of Practice for use of steel tubes in general building construction

IS: 808 Dimensions for hot rolled steel beam, column channel and angle section

IS: 813 Scheme of symbols for welding

IS:816 Code of Practice for use of metal arc welding for general construction in mild steel

IS: 919 Recommendations for limits and fits for engineering

IS: 1024 Code of Practice for use of welding in bridges and structures subjected to Dynamic loading

IS: 1161 Steel tubes for structural purposes

IS: 1239 Mild steel tubes, tubular and other wrought steel fittings (all parts)

IS: 1363 Black hexagonal bolts, nuts and locknuts (dia 6 to 39 mm) and black hexagon screws (dia 6 to 24 mm) [All parts]

IS: 1364 Precision and semi-precision hexagon bolts, screws, nuts and locknuts (dia. range 6 to 39 mm). [all parts]

IS: 1365 Slotted counter sunk head screws (dia range 1.6 to 20 mm)

IS: 1730 Dimensions for steel plate, sheet and strip for structural and general engineering purpose

IS: 1731 Dimensions for steel flats for structural and general engineering purposes.

IS: 2016 Plain Washers

IS: 2062 Structural steel (fusion welding quality)

IS: 3502 Specification for steel chequered plates

IS: 3589 Seamless or electrically welded steel pipes for water, gas and sewage

IS: 3613 Acceptance tests for wire-flux combinations for submerged-arc welding of structural steels

IS: 4000 High strength bolts in steel structures – Code of Practice

IS: 4759 Hot dip zinc coatings on structural steel and other allied products

IS: 4923 Hollow Steel sections for structural use

IS: 7215 Tolerances for fabrication of steel structures

IS: 7280 Base-wire electrodes for sub-merged arc welding of structural steels

IS: 8500 Structural steel - micro alloyed (medium and high strength qualities)

IS: 8640 Recommendations for dimensional parameters for industrial building

IS: 9178 Criteria for design of steel bins for storage of bulk material (Al parts)

IS:9595 Recommendation for Metal arc welding of carbon and carbon manganese steel

IS: 12843 Tolerances for erection of steel structures

Masonry

IS: 1077 Common Burnt Clay Building Bricks

IS: 2212 Code of Practice for brickwork

IS: 2185 Concrete Masonry units (All parts - Hollow & Solid concrete blocks)

IS: 3414 Code of Practice for design and installation of joints in Buildings

IS: 4441 Code of Practice for use of Silicate type chemical resistant mortars

IS: 4860 Acid Resistant Bricks

Doors, Windows & Ventilators

IS: 883 Code of practice for design of structural timber in building

IS: 1003 Timber paneled and glazed shutters (all parts)

IS: 1038 Steel doors, windows and ventilators

IS: 1361 Steel windows for industrial buildings

IS: 2835 Transparent sheet glass for glazing and framing purposes

IS: 1948 Aluminium doors windows and ventilators

IS: 1949 Aluminium windows for industrial building

IS: 2191 Wooden flush door shutters (Cellular and hollow core type)

IS: 2202 Wooden flush door shutters (solid core type)

IS: 3103 Code of practice for Industrial ventilation

IS: 3548 Code of practice for glazing in buildings

IS: 3614 Fire check doors

IS: 4021 Timber door, windows and ventilator frames

IS: 4351 Steel door frames

IS: 6248	Metal rolling shutters and rolling grills

Roof and Flooring

IS: 809	Rubber flooring materials for general purposes
IS: 1195	Bitumen mastic for flooring
IS: 1237	Cement concrete flooring tiles
IS: 2210	Criteria for Design of R.C. shell structures and folded plates
IS: 3201	Criteria for the design and construction of precast concrete trusses

Waterproofing

IS: 1322	Bitumen felts for waterproofing and damp proofing
IS: 1346	Code of practice for waterproofing of roofs with bitumen felts
IS: 3067 proofing and	Code of practice for general design, details and preparatory work for damp water proofing of buildings
IS: 2645	Specification for Integral Cement Waterproofing Compounds

Water Supply, Drainage and Sewerage

IS: 1172	Code of basic requirements for water supply, drainage and sanitation
IS: 1742	Code of practice for building drainage
IS: 2064 appliances	Code of practice for selection, installation and maintenance of sanitary
IS: 2065	Code of practice for water supply in buildings
IS: 2527	Code of practice for fixing rainwater gutters and downpipes for drainage
IS: 2556	Specification for vitreous sanitary appliances (vitreous china)
IS: 5329	Code of practice for sanitary pipe work above ground for buildings
IS: 12251	Code of practice for Drainage of Building Basement

Miscellaneous

IS: 1905	Code of Practice for structural use of unreinforced masonry
IS: 1641 grading and	Code of practice for fire safety of buildings (general): General principles of fire classification

IS: 1642 Code of practice for fire safety of buildings (general): Details of construction

IS: 2210 Criteria for design of reinforced concrete shell structures and folded plates

IS: 2212 Code of Practice for Brickwork

IS: 2470 Code of Practice for installation of septic tank

Part 1 - Design criteria and construction

Part 2 - Secondary treatment and disposal of septic tank effluent

IS: 3067 Code of Practice for general design details and preparatory works for damp proofing and water proofing of buildings

IS: 6313 Code of practice for anti-termite measures in buildings

SP-6 Handbook for Structural Engineers (all parts)

SP-7 National Building Code of India

SP-16 Design Aids for reinforced concrete to IS: 456-1978

SP-20 Handbook on masonry design and construction

SP-22 Explanatory handbook on codes on earthquake engineering (IS 1893-1975 and IS: 4326-1976)

SP-24 Explanatory handbook on Indian Standard code of Practice for plain and reinforced concrete (IS: 456 -1978)

SP-25 Handbook on causes and prevention of cracks in buildings

SP-32 Handbook on functional requirements of industrial buildings

SP-34 Handbook of concrete reinforcement and detailing (SCIP)

IRC: 15 Code of Practice for construction of concrete roads

IRC: 37 Guidelines for deign of flexible pavements

IRC: 73 Geometric design Standards for rural (Non-Urban) Highways Bridge rules of Government of India, Ministry of Railways (Railway Board)

8 Standard Technical Specifications for Construction

8.1.1 Earthwork in Site Grading & Embankment

Scope

This specification covers the requirement in respect of materials, workmanship, and quality for clearing, grubbing, grading, forming embankments and compacting of the areas in all kinds of soil.

Codes and Standards

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Bureau of Indian Standards shall govern in respect of design, workmanship, quality and properties of materials and method of testing. Some of the relevant available codes are listed hereunder:

IS:2720 Method of test for soils - grain size (Part 4) analysis

IS:2720 Method of test for soils - Determination (Part 5) of limit & plastic limit

IS:2720 Method of test for soils - Determination (Part VII) of water content - dry density relation using light compaction.

IS:10379 Code of practice for field control of moisture and compaction of soils for embankment and sub grade.

Materials

Earth used for filling shall be selected earth as approved by the Engineer and free from organic and other objectionable matter. As far as possible excavated earth from excavation for foundations within the project area shall be used for filling. All clods of earth shall be broken or removed. Expansive soil shall not be used. The Contractor need indicate in his offer the location of borrow areas and type of soil that he proposes to use.

Soil having plasticity index less than 20 and maximum proctor laboratory dry density more than 1.5 gm/cc shall only be used.

Adequate dewatering facilities like dewatering pumps, pipes etc. shall also be provided by the Contractor for this work including for excavation in borrow areas at his own cost.

Initial Levels

The Contractor need carry out the survey of the site before starting any work by taking accurate cross-section of the areas perpendicular to established grid / reference lines at 10 m interval or other intervals chosen by the Engineer based on the ground profile. For embankments initial levels shall

be taken along the line of embankment and at right angles to the proposed alignment. These should be checked by the Engineer and thereafter properly recorded.

Clearing

The area to be graded shall be cleared of plants, logs, stumps, bush vegetation, rubbish slush etc. If any roots of stumps of trees are met, they shall also be removed. The material so removed shall be disposed of as directed by the Engineer including burning if necessary. Trees to be cut shall be marked and the Engineer's approval taken before felling them. After the tree is cut and roots taken out the potholes formed shall be filled with good earth in 250 mm layers and compacted. The tree shall be cut in suitable pieces as instructed by the Engineer, stacked and delivered to the Owner. After the area is cleared of plants, logs, vegetation etc., the filling area shall be compacted with power roller of 8 - 10 ton capacity to obtain 95% of maximum proctor laboratory dry density of top soil as per IS:2720 part VII, Initial level shall be taken again as described in the above clause. These initial levels shall be considered for calculation of compacted volume of fill subsequently.

Grading

The grading shall be carried out so as to obtain the levels indicated in the drawing after compaction. Generally, such grading includes cutting and filling. The Contractor may employ any suitable means, mechanical, manual or a combination of both. The filled-up area will normally be filled with selected earth in layers of 250 mm (in loose condition – uncompacted thickness) and compacted using rollers so as to obtain a density desired by the Engineer, normally minimum of 95 % of Proctor dry density for cohesive soils and 85% of Relative Density for non-cohesive soils.

When a layer of loose earth over an area has been removed during grading, the area shall be prepared by ploughing to loosen the earth before addition of soil to make up the lost earth. After the addition of soil over the ploughed area, it shall be compacted to the desired density.

Embankments

The finished formation width, side slopes and grade of the embankment shall be true to the line and level as shown on the drawings.

The embankment shall be made up in layers not exceeding 250 mm thickness (uncompacted thickness), over the whole width between the surface of the side slopes and shall be slightly concave in section so as to retain the water for water subsidence. All large clods shall be broken up.

When the embankments are on side-long ground the whole area of the embankment on slope shall be benched out or stepped to prevent the material from slipping.

In construction of embankment over the culverts or pipe drains care shall be taken to bring the embankment up, equally on both sides and over the top of the structure. Earth embankment shall be

compacted as specified under "Grading". In rock embankments, the rock filling shall be carefully packed to the depths as shown on the drawing.

If embankments are made from borrow pits, the Contractor need excavate the earth from borrow pits at the locations indicated on the drawings. They shall be regular in width and shape and shall be properly graded, drained and finished with neatly trimmed slopes.

Testing and Acceptance Criteria

The degree of compaction shall be as specified above or as decided by the Engineer as per site conditions. The actual method for measuring the compaction will be decided by the Engineer. The Contractor need carry out at his own cost the required tests to prove that the soil has been compacted to the desired dry density. These tests shall be carried out at different stages of filling and after entire height has been completed. Since the degree of compaction largely depends on moisture content of soil, a close watch shall be kept on it and corrections done to optimize the moisture content. Generally, the moisture content shall be brought to within plus or minus 2% of optimum moisture content prior to rolling. The quality control operations shall include but not limited to the following items of work.

i) **Lines, levels and grades**

a) Periodic surveys

b) Establishment of markers, boards etc.

ii) Grading

a) Checking the quality of fill material

b) Checking moisture content of fill material

c) Checking degree of compaction

If a layer fails to meet the required density, it shall be reworked, or the material shall be replaced and method of compaction/equipment altered as directed by the Engineer to obtain the desired density.

8.1.2 Earthwork in Excavation & Backfilling

Scope

This specification covers the requirement of site clearing, excavation & backfilling in all types of soil for foundations, basements, trenches, drains, culverts etc.

Codes and Standards

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Bureau of Indian Standards shall govern in respect of design, workmanship, quality

and properties of materials and method of testing. Some of the relevant available codes are listed hereunder:

IS:1498 Classification and identification of soils for general engineering purposes.

IS:3764 Safety code for excavation works

IS:4081 Safety code for blasting and related drilling operations

IS:9759 Guidelines for dewatering during construction

Setting Out

The work shall be set out to exact dimensions as shown on the drawings and shall be checked and approved by the Engineer before commencement of excavation.

In firm soil, the sides of excavation in foundations shall be kept vertically up to a depth of 1.5 m from the bottom and for greater depths the sides shall be widened by forming steps of 300 mm on either side after every 1.5m from the bottom. Where soil is soft, loose or slushy, the width of steps shall be suitably increased or the side sloped or shored up, as directed by the Engineer. Working space shall be approved by the Engineer

In case of excavation for pipes, the authorized width of excavation shall be 600 mm plus outer diameter of pipe, or the width of bedding as shown in the drawing whichever is higher, up to a depth of 1.5 m. For higher depths, the width shall be widened by forming steps of 300 mm on either side after every 1.5 m from the bottom.

Initial Levels

Initial levels either in a definite grid pattern or as directed by the Engineer shall be taken by the Contractor jointly with the Engineer over the original ground prior to starting actual excavation work and after setting out. These initial levels will be used for preparing cross-section for volume measurement or for cross-checking the depths obtained from tape measurements.

Clearing and grubbing etc.

The area to be excavated shall be cleared out of trees, logs, stumps, bush, vegetation, rubbish, slush etc. and levelled up. Trees up to 300 mm girth shall be uprooted. Trees above 300 mm girth shall be cut up to 600 mm below ground level. Useful materials, saleable timber shall be the property of the Owner and hence shall be handed over. All the spoils and unserviceable materials and rubbish shall be burnt or removed from site to approved disposal areas as may be specified.

Excavation and Cutting

The Contractor need excavate to remove materials of any nature or description which may be encountered and excavate to depths, widths and inclinations as shown on the drawings and/ or as

directed. The bed of the excavation shall be made level and firm by watering and ramming. The Contractor need not remove any tree without permission.

While carrying out excavation for drain work, the sides and bottom shall be cut to the exact shape, slope and gradient as shown on the drawings. The surface shall be properly dressed. Excavated material shall not be placed within 1.5 m from the edge of any excavation or half of trench depth whichever is more.

Excavation in Rock

Blasting where permitted shall be carried out as specified in IS:4081. Where blasting is prohibited, rock excavation shall be by chiseling, wedging or any other approved method. Depending on the exact location of rock excavation, the decision to excavate by blasting or not will be taken by the Engineer.

Variation in Excavation

Bad Soil

Should the bottom of any excavation at design depth appear to be soft, unsound or unstable, the Contractor need report the matter to the Engineer and if the Engineer so directs, shall excavate the same to indicated depths. The extra depth shall be filled up with concrete or such other materials as the Engineer shall direct. No extra compensation will be entertained in this account.

Excavation Too Deep

If the Contractor excavates to levels deeper than those shown on drawings for any reason other than those stated above, he shall fill it up at his own expense to the proper level with lean concrete 1:5:10 or sand filling as directed. No payment will be made for excavation taken down to depths more than those shown on the drawings or for the filling carried out as directed.

Slips and Falls

Every precaution shall be taken against slips and falls of earth, clay, sand or other materials in the excavations, but in the event of any such occurrence, the Contractor need at his own expense make good the space affected by slips or falls even if the affected area is outside the dimension of the work ordered.

The Engineer will determine in each case whether such affected area is to be filled up in whole or in part with concrete, brickwork or masonry of the quality used in the adjoining work or where only one part is to be so filled, the materials to be used for this remaining part.

If in the opinion of the Engineer there is a possibility of the newly constructed work having been damaged or disturbed by such collapse, the work shall be laid bare at the expense of the Contractor for inspection. Any damage caused shall be made good by the Contractor, at his own expense.

Soil/Sub-soil Water Condition

Boring and sub surface data regarding the nature of soil, sub-soil water furnished to the Contractor need be taken as guidance only and variation there from shall not affect the terms of Contract. The Contractor must satisfy himself regarding the character and volume of all work under this item and expected surface, and/or sub-soil water to be encountered.

Keeping Works Site Free from Water

The Contractor need provide and operate pumps and all other equipment necessary to drain the sub-soil water, rainwater etc. to the nearest drain through properly laid pipes or channels and keep excavation pits, trenches etc. free from water always during excavation, backfilling and the continuance of the contract. Adequate care shall be taken to prevent movement of water through freshly laid concrete or masonry work. Sumps made for dewatering shall be kept clear of the foundation. Method of dewatering shall be approved by the Engineer but in no case the pumping arrangement shall be such that there is any movement of sub-soil or blowing-in due to differential head of water during pumping. If the water table is high, well point dewatering must be adopted for excavation beyond 1 meter below the water table. The dewatering shall be continued for a sufficient period so as not to affect the strength and other properties of the concrete. Guideline given in IS:9759 shall also be followed.

Protection of Work

The Contractor need support and maintain adjoining and abutting property and structures to render work safe to persons and property.

The Contractor need provide necessary decking, guard, fencing, planking with red flags and red lights at night to maintain safe pedestrian and vehicular traffic near all open excavations.

Shoring and Strutting

Shoring and strutting shall be used as directed when excavation is to be carried out in soft or slushy soil which is likely to collapse during the excavation of the work. The shoring shall be either open or close boarded type depending on the nature of the soil and depth of excavation and the type adopted shall be as directed by the Engineer. While excavating in very unstable ground requiring support throughout the period of excavation, runners shall be used and shall be driven always in advance of the excavation. The size and spacing of different members to be used in shoring shall be as directed by the Engineer, depending on the site conditions. If, however, slips do occur, the same shall be removed by him and backfilled later by him at his own expense. The withdrawal of shoring & shoring material shall be done very carefully to prevent the collapse of pit or trench. No claim shall be entertained for any material which cannot be removed and is lost or buried.

Disposal

The excavated earth shall be disposed in the following manner or as directed by the Owner / Owner's Engineer

i) By keeping separately, the materials suitable for backfilling/area filling and material not suitable at areas to be designated by the Owner / Owner's Engineer.

ii) The excess material remaining after back-filling/area filling shall be spread evenly to allow natural flow of water in the area.

Backfilling and Filling in Plinth

Earth used for filling shall be free from organic and other objectionable matter. As far as possible, materials obtained from excavation in foundation shall be used. The earth shall be basically CNS soil (Cohesive Non-Swelling Soil). All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not bigger than 150 mm in size and mixed with fine materials consisting of decomposed rock, murrum or earth and the mixture shall be used for filling. Expansive soils shall not be used for filling.

Filling Around Foundation with Earth

Filling shall be carried out in layers not exceeding 200 mm (uncompacted thickness) in depth. Each layer shall be watered, rammed and properly compacted to 95% of proctor density or 85% of relative density depending on the soil type.

Sand filling in plinth

Sand used for filling shall be free from dust, organic and other objectionable matter and shall not contain more than 10 percent of clay.

When filling has reached the appropriate level, the area shall be flooded with water for a minimum period of 24 hours to allow the fill to settle. The filling shall be allowed to dry and then compacted and dressed to the required level.

Testing and Acceptance Criteria

Excavation

On completion of excavation, the dimensions of the pits will be checked as per drawings after the pits are completely dewatered, the work will be accepted after all under-cuts are set right, all over excavations are filled with lean concrete or compacted earth as directed and all necessary shoring & strutting done, all temporary approaches to the bottom of trenches provided, all to the satisfaction of the Engineer.

Backfilling /Plinth Filling

All filling shall be done to the compaction specified. The backfilling work will be accepted only after the Engineer is satisfied with the degree of compaction.

8.1.3 Plain and Reinforced Concrete Work

Scope

This specification covers the requirement in respect of materials, workmanship and quality for Plain Cement Concrete (PCC) and Reinforced Cement Concrete (RCC) for all types of structures in foundation and superstructure.

Codes and Standards

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Bureau of Indian Standards and all other such as may be published by them during the currency of the Contract, shall govern in respect of design, workmanship, quality and properties of materials and methods of testing. Some of the relevant available codes are listed hereunder:

Cement

IS:269	Ordinary and low heat portland cement
IS:4032	Method of chemical analysis of hydraulic cement
IS:6452	High alumina cement for structural use
IS:8041	Rapid hardening portland cement
IS:8112	High strength ordinary portland cement
IS:12330	Sulphate resisting portland cement
IS:12269	Ordinary Portland Cement grade 53

Aggregate

IS:383	Coarse and fine aggregates from natural sources for concrete
IS:2386	Methods of test for aggregates for concrete
IS:2430	Methods of sampling of aggregates for concrete

Plain and Reinforced Concrete

IS:456	Code of practice for plain and reinforced concrete
IS:460	Test sieves

IS:516 Methods of test for strength of concrete

IS:1199 Methods of sampling and analysis of concrete

IS:1607 Methods for test sieving

IS:1834 Hot applied sealing compounds for joints in concrete

IS:2645 Integral cement water proofing compounds

IS:2750 Steel scaffolding

IS:2974 Code of practice for design and construction of machine foundations

IS:3370 Code of practice for concrete structures for the storage of liquids

IS:9013 Method of making, curing and determining compressive strength of accelerated-cured concrete test specimens

IS:9103 Admixtures for concrete

IS:9893 Precast concrete lintels and sills

IS:10262 Recommended guidelines for concrete mix design

IS:10297 Code of practice for design and construction of floors/roofs using pre-cast reinforced/pre- stressed concrete ribbed or cored slab units

IS:10566 Methods of tests for preformed fillers for expansion joints in concrete paving and structural construction

IS:10790 Methods of sampling of steel for prestressed and reinforced concrete

Steel

IS:432 Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement

IS:1566 Hard-drawn steel wire fabric for concrete reinforcement

IS:1568 Wire cloth for general purposes

IS:1786 High strength deformed steel bars and wires for concrete reinforcement

IS:2502 Code of practice for bending and fixing of bars for concrete reinforcement

IS:2751 Code of practice for welding of mild steel plain and deformed bars used for reinforced concrete construction

Materials

All materials that shall be used for works covered under this specification shall conform to following standards / specification.

Aggregate	Machine crushed blue granite conforming to IS:383

Cement

IS:269	Ordinary Portland Cement
IS:8041	Rapid Hardening Portland Cement
IS:8112	High strength Ordinary Portland Cement
IS:12330	Sulphate Resisting Portland Cement
IS:12269	Ordinary Portland Cement grade 53

Reinforcement

IS:432/IS:1786/IS:1566

Embedded plates	IS:2062
Binding wire	16 SWG annealed iron wire
Joint filler	Approved non extruding, resilient fillers
Sand	River or pit sand conforming to IS:2116
Water stops	PVC/Rubber/Metallic - GI, Aluminium, copper
Admixtures	IS:9103
Water	Clean, potable as specified in IS:456.

Source of coarse & fine aggregate shall be approved by the Engineer.

Test certificates for each consignment of cement procured have to be submitted by the Contractor to ensure conformity with relevant standards. The Engineer may reject such cements supplied in the event of unsatisfactory tests or in the event of deterioration due to age or bad storage etc. Decision of the Engineer shall be final in this regard.

Admixtures shall be used only after getting permission from the Engineer and as per the instruction of the manufacturer.

Grades and Proportioning

Any grades of concrete designated in IS:456 as shown on the drawings or as specified shall be used. Design mix concrete shall be adopted for all RCC works. The mix shall be designed as per "Handbook on concrete mixers", SP:23. While designing the mix, the strength, durability, minimum cement content, maximum water ratio allowed and workability necessary for the job by most economical use of the various ingredients shall be considered by the Contractor. The mix design shall be verified by carrying out preliminary test.

The water cement ratio, coarse aggregates and grading for each mix shall be predetermined from the results of cube tests of trial mixes. The mix proportions determined thus shall be followed at site and shall be in no way relieve the Contractor of his responsibility as regards the prescribed strength mix. The mix proportions, however, shall be revised if the results of the cube tests during the construction show consistently lower than the prescribed one. No extra claim will be entertained due to such changes in mix designs, as the Contractor will be responsible to produce the concrete of required grade. The maximum size of aggregates used shall be as indicated in IS:456 or specified elsewhere.

Nominal mix concrete in accordance with IS:456 for grade M15 or lower may the used if shown on drawings or approved by the Engineer. In all cases the proportioning of ingredients and works control shall be in accordance with IS:456 and shall be adopted for use after the Engineer is satisfied regarding its adequacy and after obtaining his approval in writing.

Mixing

Mixing should be carried out in mechanical mixers. No hand mixed concrete is permitted for RCC works. Hand mixing if permitted for PCC works shall be carried out on a clean, hard and watertight platform and 10% extra cement shall be added to each batch at no extra cost to the Owner. Water cement ratio shall be rigidly controlled during mixing. Mixers shall be fitted with automatic devices to discharge measured quantity of water to the mixing pan. The water shall not be admitted to the drum until the cement and aggregate constituting the batch are thoroughly mixed. Mixing shall continue until the concrete is uniform in color and not less than 2 minutes and forty (40) revolutions after all the material and water are in the drum. Regular checks on mixer efficiency shall be carried out as directed by the Engineer. Only those mixers whose efficiencies are within the tolerances specified in IS:1791 will be allowed to be employed. Batching plant where used shall conform to IS:4925.

The entire content of the drum shall be discharged before the ingredients for next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used. Such concrete shall be immediately removed from site. Each time the work stops the mixer shall be thoroughly cleaned and when the next mixing commences, the first batch shall have 10% additional cement at no extra cost to the Owner to allow for loss in the drum.

Design mix to be done by contractor from NABL approved Lab with 2-3 type of makes of cement and 2-3 sources of course, fine aggregates and water samples.

Placing

Concrete shall be transported from the mixing plant to the forms, as rapidly as possible, by means, which will prevent segregation, consolidation or drying out in hot weather. Concrete shall be placed within thirty (30) minutes after commencement of mixing. At the time of placing concrete in very hot weather, care shall be taken to see that the temperature of wet concrete does not exceed 38 Deg 'C'.

Before placing concrete, all formwork, embedment and reinforcement shall be checked for completeness, location, dimension. It should also be square and plumb. All chips and saw dust or other foul matter shall be removed from within the forms. The base surface shall be well moistened, and puddles wiped up. Earth foundation on which direct placement of concrete is allowed will be rammed and consolidated as directed by the Engineer such that it does not crumble and get mixed up with the water during or after placement, before it has sufficiently set and hardened. Concrete may be placed against moist surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and pre-caution, as directed by the Engineer will have to be adopted. A layer of mortar of thickness between 12 mm to 25 mm as directed, of the same or less W/C ratio and the same proportion as that of concrete being placed and /or cement slurry will be spread thoroughly on the foundation or construction joint just prior to placement of concrete. Placing equipment and accessories shall be kept clean and free of partially set grout and concrete and maintained in proper working order. Walking on reinforcement layers is not permissible. Walkways of wooden planks or similar can be placed with removable supports and should be independent of reinforcement.

In general, placing shall be direct, by transporting buckets. Where it is necessary to deposit the concrete at level differences of more than 1.5 m, short chutes shall be used. Short chutes and hoppers shall be so designed and installed that segregation will not take place. In cases where chutes are impracticable due to excessive drop to placing level, hoppers and sectional tubes (elephant trunks) shall be used.

After the concrete has been placed, it shall be spread, if necessary and thoroughly worked around reinforcement or other embedded fixtures into concrete form and shape. Vibrators shall not be used for pushing the concrete into the adjoining areas. Care must be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced during or immediately after the placement and bring the concrete surface out of the alignment beyond tolerance limits, the Engineer may direct to remove the portion and reconstruct or repair the same at the Contractor's expense.

The rate of placement of concrete shall be such that no cold joint is formed, and fresh concrete is placed always against green concrete which is still plastic and workable. No concrete shall be placed in open, while it rains. During rainy season, no placement in open is to be attempted unless sufficient tarpaulins or other similar protective arrangement for complete covering the still green concrete from

rain is kept at the site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately.

Compaction

Concrete in general shall be consolidated by vibration using high frequency mechanically driven vibrators. Concrete shall be placed in layers at least 300 mm deep in walls and approximately 450 mm in mass pouring. Vibrators shall not penetrate more than 50 mm into the surface of previously placed layers but shall completely vibrate the working layer. Care shall be taken not to over-vibrate any concrete and especially those with higher slumps. Under no circumstances vibrators shall be attached to or allowed to touch reinforcement. Spare vibrators in good operating condition shall be on hand during placing operations.

Construction Joints

In general, construction joints shall be limited to those indicated on the drawings. In mass concrete, construction joints may not be indicated in the drawings but shall be made at breaks, offsets or other convenient levels as controlled by volume, plant capacity and time factors. Such construction joints shall be so located that they do not impair the strength of the structure. In walls and columns, height of each lift shall not generally exceed 1.5 m unless otherwise specified in the drawings or directed by the Engineer. Method of forming all construction joints shall conform to the provisions of IS:456.

All construction joints shall be cleaned with wire brush and water to remove all laitance and loose material to expose the aggregates. Immediately before placing fresh concrete, the surface of previously placed concrete shall be coated with a thin coat of cement mortar slurry of the same proportion as that of concrete.

Where locations of the joints are not specified, it will be in accordance with the following:

a. In a column, the joint shall be formed 75 mm below the soffit of the beam or the edge of the anchored bar of the beam framing into it whichever is lower. The Contractor need refer to the beam reinforcement drawing before deciding on the location of the joint at column-beam junction.

b. Concrete in a beam shall preferably be placed without a joint, but if the provision of a joint is unavoidable, the joint shall be vertical and at the middle one third of the span, clearing the cross beam location, if any.

c A joint in a suspended floor slabs shall be vertical and at the middle one third of the span and at right angles to the principal reinforcement.

d In general, construction joints shall be located preferably in a low shear stress zone and at right angles to the direction of the principal stress

Any deviation from the above shall be approved by the Engineer.

Curing and Protecting

As soon as the concrete has hardened sufficiently, it shall be covered either with hessian, canvas or similar materials and kept continuously wet for at least seven (7) days after final setting. Curing by continuous sprinkling of water will be allowed if the Engineer is satisfied with the adequacy of arrangements made by the Contractor.

Curing of concrete with water shall comply with IS:456. Curing compound shall be used subject to approval by the Engineer. Finished floors shall be protected carefully until completely set. Protection of concrete against extreme weather conditions shall comply with the code.

Finishing

No touching-up will be permitted to the concrete after removal of formwork. Where damages, honey-combing or other unsatisfactory finishes have occurred to the concrete surfaces, they shall be rectified in a manner as directed by the Engineer, at no extra cost. If in the opinion of the Engineer the concreting is unsatisfactory, demolition of the entire concrete work and reconstruction of the same shall be carried out by the Contractor, as directed by the Engineer at his own cost.

Formwork

Form work in general shall conform to IS:456.

For complicated work, the Contractor need submit his proposal of formwork before starting the work for approval of the Engineer. The number of props, their sizes and dispositions shall be such as to be able to safely carry the full dead load and constructional loads. However, approval of the Engineer to this effect shall not relieve the Contractor of his responsibility for proper work and safety.

All forms of beams, slabs and members shall be so designed and erected that the sides can be removed without disturbing the soffit shutter and supports there to.

Beam soffit shall be provided with an upward, camber of 6mm for each 3 m of horizontal span or as directed by the Engineer. Vertical props shall be supported on wedges or sole plates or other measures whereby the props can be gently lowered while commencing to remove the shuttering. Columns shuttering shall not be over 1.5 m in height a piece.

Before removal of the shuttering the concrete shall be examined and its removal order taken from the Engineer. In no circumstance shall forms be struck until the concrete reaches strength of at least twice the stress to which the concrete may be subjected at the time of striking.

Shuttering shall not be removed until the number of clear days specified in IS:456 have elapsed since the last day of placing concrete in the member concerned. All formworks shall be removed without such shock or vibration as would damage the reinforced concrete. Before the soffits and struts are removed, the concrete surface shall be exposed, where necessary, to ascertain that the concrete has

sufficiently hardened. The specified period may be extended if desired by the Engineer on account of delayed hardening caused by low atmospheric temperature.

Reinforcement

The reinforcement bending shall be carried out as per the approved bar bending schedule prepared based on design drawing.

Workmanship shall conform to IS:2502. All reinforcement shall be free from loose mill scale, rust, oil, grease and paint. Reinforcement shall not be bent or straightened in a manner that will injure the materials and all bars shall preferably be bent cold. Hot bending shall not be permitted for bars whose strength have been increased by cold working.

Reinforcement bars shall be placed and maintained accurately in positions as shown in the drawings. The correct cover to the reinforcement shall be maintained by use of precast concrete blocks.

All intersections of longitudinal and transverse bars or stirrups and all laps shall be securely tied together with approved binding wire. The binding wire shall be so placed that it touches all the four corners of the intersection, and the two ends shall be looped with pliers and the ends shall be turned into the body of the concrete.

Welded joints may be used but in all cases of important connections, tests shall be made to prove that the joints are of the full strength of bars connected. Welding shall be done in accordance with IS:2751 and IS:9417. Butt welding between the ends of a rod in line, whereby stress is transferred across the section may be adopted only for mild steel bars. In case of tack welding for fixing reinforcements in their position, no special precaution need be taken.

All quality reports will be prepared and jointly signed against the activities PCC, RCC and other Civil & Structural works.

Steel Embedments

All embedments shall be accurately set, rigidly fastened and suitably anchored by welding lugs. Anchor bolts shall be set to template and firmly secured in vertical and horizontal line and required positions.

Exposed surfaces of embedded materials are to be painted with one coat of red oxide zinc chrome and/ or bituminous paint. Correct location and alignment of all anchor bolts, anchor sleeves, inserts, hangers, conduit pipes and other embedded fixtures as per drawings/instruction shall be entirely the responsibility of the Contractor.

Expansion & Isolation Joints

General

Expansion and isolation joints in concrete structures shall be provided at specified places, as per details indicated on the drawings. The materials and types of joints shall be as specified hereinafter. In case of liquid retaining structures, additional precautions shall be taken to prevent leakage of liquids as may be specified on the drawings or as directed by the Engineer. All materials are to be procured from reliable manufacturers and must have the approval of the Engineer. Where it is the responsibility of the Contractor to supply the material, the Engineer may demand test certificates for the materials and/or instruct the Contractor to get them tested in an approved laboratory free of cost to the Owner. Approved samples of the material to be incorporated in the works shall be with the Engineer. Joints shall be formed true to line, level, shape, dimension and quality as per drawings and specifications. Prior approval of the method of forming the joints should be obtained from the Engineer before starting the work.

Joint Filler Board

Preformed Duraboard HD 100 or equivalent shall be used as joint filler The thickness may vary from 8 mm to 100 mm. The material will have to be procured from reliable manufacturers as approved by the Engineer. The method of installation will be like that recommended by the manufacturers for fixing on cold storage walls. A coat of bitumen paint may have to be applied on the board against which concrete will be placed.

Joint Filler

The concrete surface shall be made clean, smooth and free from dirt or loose particles. When the surface is completely dry, a coat of hot blow bitumen conforming to IS:702 of grade 85/25 shall be given with brush or spray. When the bitumen is still hot, the premoulded joint filler board shall be pressed against the surface and held in position till the time it takes to adhere. When more than one layer of filler is specified, each layer shall be made to adhere to the preceding layer with a few patches of bitumen between the two layers. After placing the filler in position, the surface of the filler against which further concreting is to be done is given a coat of bitumen.

Joint sealing compound

Two-part polysulphide sealant conforming to IS: 12118 shall be used for sealing of joints in contact with water. For other cases, bitumen sealing compound conforming to IS: 1834 can be used.

Before application of the sealing compound the sides of the joint are sprayed or brushed with bitumen primer. The primer is then allowed to dry out thoroughly for at least 24 hours and then filled with a mix of 30 % fine sand and 70 % sealing compound by weight.

Joint Sealing Strips/Water Stops

Joint sealing strips may be provided at the construction, expansion and isolation joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure. The sealing strips will be either metallic like G.I., Aluminium or non-metallic like P.V.C.

Sealing strips shall not have any longitudinal joint and shall be procured and installed in largest practicable lengths having a minimum number of transverse joints. The joint procedure shall be as per the manufacturer's recommendations, revised, if necessary, by the Engineer.

Metal Sealing Strips

Metal sealing strips shall be either G.I.,or Aluminium and formed straight, U shaped, Z shaped or any other shape and of thickness as indicated in the drawing and/ or as instructed by the Engineer.

The transverse joints will be gas welded using brass rods and approved flux and will be tested by an approved method to establish that it is leak proof. In case it is found that the joints cannot be made leak proof, longer lap length and different method of brazing which will render it leak proof, will be adopted by the Contractor. The edges shall be neatly crimped and bent to ensure proper bond with the concrete.

G.I. Strips: G.I Strips shall be minimum 1.5 mm thick and 150 mm in width unless specified otherwise. The standard of Galvanising shall be as per relevant Indian Standards for heavy duty work. The strips shall be strong, durable, without any rust or crease. At the joints, the over-lapping should be for a minimum length of 50 mm.

Aluminium Strips: Aluminium strips shall be minimum 18 swg. thick and 300 mm wide unless specified other wise and shall conform to IS:737 of 19000 grade or 31000 grade (Designation as per IS:6051). A minimum lap of 50 mm length is required at the joints.

It should be cleaned thoroughly before use to expose fresh surface, without any reduction in gauge. A minimum lap of 50 mm is length is required at the joints.

Water stops

This shall be of P.V.C. having any combination of the following features :

a. Plain

b. Central bulb

c. Dumb-bell or flattened ends

d. Ribbed and Corrugated Wings

e. V-shaped

Transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer. The method of forming these joints, laps etc. shall be specified by the Manufacturer and/or as approved by the Engineer, taking particular care to match the central bulbs and the edges accurately.

The minimum thickness of P.V.C water stops shall be 8 mm and the minimum width 150 mm. The actual size and shape will be as shown in drawings and/or as directed by the Engineer. The material should be of good quality Polyvinyl Chloride highly resistant to tearing, abrasion and corrosion as well as to chemicals likely to come in contact with during use. The physical properties will generally be as follows. The actual requirements, which will be directed by the Engineer, may vary slightly. PVC water stops used in water retaining structures shall be able to withstand the water pressure to which it will be subjected to.

Bitumen Compound

When directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacturer and shall conform to the requirements of IS:1834.

Isolation Joints

Strong and tough alkathene sheet or equivalent, about 1 mm in thickness and as approved by the Engineer shall be used in Isolation Joints. It shall be fixed by an approved adhesive compound on the cleaned surface on the already set concrete, to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way.

Rubber Pad

Hard foundation quality rubber pads of required thickness and shapes shall be used below machine or other foundation for vibration isolation. The rubber shall have a unit weight of 930 Kg/m3, shore hardness - 65 A to 70 A and be of best quality of approved manufacturer, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any other deleterious material expected under normal conditions.

Waterproofing of Concrete Structures

General

Waterproofing of concrete structures shall be done by suitable extraneous treatments like applying paints, installing water bars at construction joints etc.

The design, material and workmanship shall conform to the relevant I.S. codes where applicable. The Engineer's approval of the materials shall be obtained by the Contractor before procurement. If

desired by the Engineer, test certificates for the materials and samples shall be submitted by the Contractor. The materials shall be best quality available indigenously, and suitable for the duties called upon.

Water Stop

Water bearing structures and underground structures shall have PVC water stops installed at the joints. Installation will be as described under "Expansion & Isolation Joints".

Waterproofing Admixtures

In Concrete

The admixture shall be procured from reliable and reputed manufacturers and approved by the Engineer. The method of application and other details shall conform to the manufacturer's specification and/or as instructed by the Engineer.

In Plaster

The concrete surface, to be plastered, shall be hacked to Engineer's satisfaction, cleaned thoroughly and kept wetted for 24 hours. The plaster shall be in cement sand mortar mixed is proportion varying from 1:1 to 1:4 by volume along with the approved waterproofing admixture and laid in appropriate thickness and in layer not exceeding 15 mm or as per manufacturer's specification. The additive shall be of quality and type approved by the Engineer. On completion, the plastered surface shall be cured continuously for a minimum period of fourteen (14) days like concrete.

Bituminous Coating

The surface to be waterproofed shall be rendered absolutely dry, clean and dust free. The surface shall be sand papered, cleaned and completely coated with hot coal tar pitch of approved manufacture and quality as per IS:216 (not heated above 375oF) using not less than 2 kg. per Sq.m. or with hot asphalt i.e. bitumen according to IS:73 (not heated above 400oF) using not less than 1.5 kg per Sq.m. When the first coat has completely dried up and approved by the Engineer, the second coat shall be applied in the same manner using not less than 1.25 Kg. per Sq.m. in case of coal tar and 1 kg per sq m in case of asphalt. Immediately after application of the second coat and before it is dried up, sand shall be spread on the surface to cover it completely. Sufficient time shall be allowed after spreading of sand before backfilling is done in order to allow the final coat to dry up completely.

Testing Concrete Structures for Leakage

Hydro-static test for water tightness shall be done at full storage level or soffit of cover slab, as may be directed by Engineer, as described below:

In case of structures whose external faces are exposed, such as elevated tanks, the requirements of the test shall be deemed to be satisfied if the external faces show no sign of leakage or sweating and

remain completely dry during the period of observation of seven days after allowing a seven day period for absorption after filling with water.

In the case of structures whose external faces are submerged and are not accessible for inspection, such as underground tanks, the structures shall be filled with water and after the expiry of seven days after the filling; the level of the surface of the water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hrs. Over a period of seven days. Backfilling shall be withheld till the tanks are tested. The total drop in surface level over a period for seven days shall be taken as an indication of the water tightness of the structure. The Engineer shall decide on the actual permissible nature of this drop in the surface level, taking into account whether the structures are open or closed and the corresponding effect it has on evaporation losses. Unless specified otherwise, a structure whose top is covered shall be deemed to be water tight if the total drop in the surface level over a period of seven days does not exceed 40 mm.

Each compartment/segment of the structure shall be tested individually and then all together.

For structures such as pipes, tunnels etc. the hydrostatic test shall be carried out by filling with water, after curing as specified, and subjecting to the specified test pressure for specified period. If during this period the loss of water does not exceed the equivalent of the specified rate, the structure shall be considered to have successfully passed the test.

Any leakage that may occur during the hydro-test or subsequently during the defects liability period or the period for which the structure is guaranteed shall be effectively stopped either by cement/epoxy pressure grouting, guniting or such other methods as may be approved by the Engineer. All such rectification shall be done by the Contractor to the entire satisfaction of the Owner/Engineer at no extra cost to the Owner.

Testing of Materials

Cement

The Contractor need submit to the Engineer the manufacturer's certificate for each consignment of cement procured by him. If required by the Engineer, representative samples shall be taken from each consignment and tests for fineness (by hand sieving), setting time and compressive strengths as per IS:269 shall be carried out, free of charge by the Contractor.

Aggregates

Coarse and fine aggregate and the grading shall be as per IS:383. It shall be free from organic or clay coatings and other impurities, flaky particles, and any other material liable to affect the strength, durability or appearance of concrete. Washing of aggregates by approved means shall be carried out, if desired by the Engineer.

The Contractor need carry out any or all the tests on aggregates as may be required by the Engineer in accordance with IS:2386. The acceptance criteria of samples tested shall be in accordance with the requirements of relevant Indian Standards and as per QAP & ITP.

Admixture

Air Entraining Agents

Initially, before starting to use Air Entraining Agents, relationship between percentage of air entrained and the cylinder cube crushing strength vis-a-vis quantity of Air Entraining Agents used for all types of concrete will be established by the Contractor free of charge by carrying out sufficiently large number of tests. After that, at regular intervals and whenever directed by the Engineer, the Contractor will check up free of charge, the actual percentage of air entrained and corresponding curing strengths to correlate with the earlier test results.

Other Admixture

Tests for establishing the various properties of any other admixtures which may be required to be added shall be carried out by the Contractor free of charge to the Owner.

Concrete

Sampling, curing and testing of specimen will comply with IS:1199 and IS:516. Sampling procedure, shall generally conform to IS:456. Sampling frequency for each grade of concrete M15 and above shall be six (6) cubes for each 15.2 m3 or part thereof, or per day concreting volume, whichever is less. Out of each set of six (6) cubes, three (3) cubes shall be tested at seven (7) days and the remaining three (3) cubes at twenty eight (28) days. If there is a change in batch of cement, a separate set of samples consisting of six (6) cubes shall be taken for each batch.

In case, the stripping time for shuttering needs to be reduced or early age strength is required to be known in specific cases, the Contractor need carry out at short notice testing of cubes at one (1) day and three (3) days after accelerated curing as per IS:9013. The required number of additional samples for the same shall also be taken.

To control the consistency of concrete from every mixing plant/machine, slump tests and/or compacting factor tests as per IS:1199 shall be carried out by the Contractor every two hours or as directed by the Engineer in addition to the slump measured when making test cubes.

In case, the stripping time for shuttering needs to be reduced or early age strength is required to be known in specific cases, the Contractor need carry out at short notice testing of cubes at one (1) day and three (3) days after accelerated curing as per IS:9013. The required number of additional samples for the same shall also be taken.

To control the consistency of concrete from every mixing plant/machine, slump tests and/or compacting factor tests as per IS:1199 shall be carried out by the Contractor every two hours or as directed by the Engineer in addition to the slump measured when making test cubes.

Acceptance Criteria

Structural Criteria

Acceptance criteria of concrete shall be generally in accordance with Clause 15 of IS:456. Immediately after stripping the formwork, all concrete shall be carefully inspected and any defective work or small defects either removed or made good before the concrete has thoroughly hardened.

The acceptance criteria of concrete shall be in accordance with IS:456. Concrete work found unsuitable for acceptance shall have to be dismantled and replacement is to be done as per specification by the Contractor. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good, free of charge by the Contractor, to the satisfaction of the Engineer.

Dimensional Criteria

The permissible variation from dimension, lines given in the drawing shall be within tolerances specified below. Wherever tolerances are not specified below the same shall be in accordance with the relevant IS codes/other applicable national/international standards or as indicated by the Engineer.

Tolerances for R.C. Buildings : (as per IS 2102 - part 2)

i) Variation from the plumb

- In the lines and surfaces of columns, : 5 mm per 2.5 m or 25 mm, whichever is less piers, walls and in arrises.

- For exposed corner columns and other conspicuous lines

  In any bay or 5 m max. : 5 mm

  In 10 m or more : 10 mm

ii) Variation from the level or from the grades indicated on the drawings

- In slab soffits, ceilings, beam soffit, and in arrises

  In 2.5 m : 5 mm

  In any bay or 5 m max. : 8 mm

  In 10 m or more : 15 mm

- For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines

In any bay or 5 m max.	:	5 mm
In 10 m or more	:	10 mm

iii) Variation of the linear building lines from established position in plan and related position of columns, walls and partitions.

In any bay or 5 m max.	:	10 mm
In 10 m or more	:	20 mm

iv) Variation in the size and locations of sleeves, - 5 mm except openings in walls and floors in the case of and for anchor bolts

v) Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls

Minus (-)	:	5 mm
Plus (+)	:	10 mm

vi) Footings

- Variation in dimension in plan

Minus (-)	:	5 mm
Plus (+)	:	50 mm

- Misplacement or eccentricity : 2% of footing width not more than of misplacement but 50 mm in the direction

- Variation in thickness

Minus(-)	:	5% of specified thickness subject to a max. of 50mm
Plus (+)	:	100 mm

vii) Variation in steps

- In a flight of stairs

Riser	:	3 mm
Tread	:	5 mm

- In consecutive steps

Riser : 1.5 mm

Tread : 3.5 mm

- Tolerances in other Concrete Structures

i) All structures other than those covered in ii) below.

- Variation of the constructed linear outline from established position in plan

In 5 m : 10 mm

In 10 m or more : 15 mm

- Variations of dimensions to individual structure features from established positions

In 20 m or more : 25 mm

In buried construction : 50 mm

- Variation from plumb, from specified batter or from curved surfaces of all structures

In 2.5 m : 10 mm

In 5 m : 15 mm

In 10 m or more : 25 mm

In buried-construction : Twice the above amounts

- Variation from level or grade indicated on drawings in slab, beams, soffits, horizontal grooves and visible arises

In 2.5 m : 5 mm

In 7.5 m or more : 10 mm

In buried construction : Twice the above amounts

- Variation in cross-sectional dimensions of columns beams, buttresses, piers and similar members

Minus (-) : 5 mm

Plus (+) : 10 mm

- Variation in thickness of slabs, walls, arch sections and similar members

Minus (-) : 5 mm

Plus (+) : 10 mm

ii) Footing for columns, piers, walls, buttresses and similar members

- Variation of dimension in plan

Minus (-) : 5 mm

Plus (+) : 10 mm

Misplacement or eccentricity

2% of footing width in the direction of misplacement but not more than 50 mm

- Reduction in thickness

5% of specified thickness subject to a max. of 50 mm

Tolerances in other types of structures not covered above shall generally conform to those given in Recommended Practice for Concrete Formwork (ACI 347)

Tolerances in fixing anchor bolts and embedded parts shall be as follows :

- Anchor bolts without sleeves : (±) 1.5 mm in plan
- Anchor bolts with sleeves : (±) 5.0 mm in elevation
- For bolts upto and including

28-mm dia : (±) 5 mm in all directions

- For bolts 32 mm dia and above : (±) 3 mm in all directions
- Embedded parts : (±) 5 mm in all directions
- Tolerances in precast members

i) Length

Upto 3 m : (±) 6 mm

3 m to 4.5 m : (±) 9 mm

4.5 mm to 6 m : (±) 12 mm

Additional for every

subsequent 6 m : (±) 6 mm

ii) Cross Section (Each direction)

Upto 50 cm	:	(±) 6 mm
50 cm to 75 cm	:	(±) 9 mm
Additional for every subsequent 25 cm	:	(±) 3 mm

iii) Straightness or bow (Deviation from intended line)

Upto 3 m	:	6 mm
3 m to 6 m	:	9 mm
6 m to 12 m	:	12 mm
Additional for every subsequent 6 m	:	6 mm

iv) Squareness

When considering the squareness of a corner, the longer of the two adjacent sides being checked should be taken as the base line. The shorter side should not vary in its distance from a perpendicular so that the difference between the greatest and shortest dimensions does not exceed the following limits.

Length of shorter sides up to and including 1.2 m.	:	6 mm
Over 1.2 m but less than 2 m	:	9 mm
2 m and over	:	12 mm

For the purpose of this requirement, any error due to lack of straightness should be ignored; squareness should be measured with respect to the straight lines which are most nearly parallel with the features being checked.

v) Flatness

The maximum deviations from a 1.5 m straight edge placed in any position on nominally plane surface should not exceed 6 mm.

Storage And Handling of Materials

Cement

Cement shall be stored in easily countable stacks with consignment identification mark above ground level in perfectly dry and watertight sheds. Bulk cement shall be stored in air tight containers. Cement shall be stored in a manner so as to facilitate removal of first-in first-out basis. Any cement considered

defective by the Engineer shall not be used by the Contractor and shall be removed from the site immediately. Cement that has been in store for three (3) months or more shall be tested for quality. Should at any time the Engineer has reasons to consider that any cement is defective, then irrespective of its origin, date of manufacture and manufacturer's test certificate, such cement shall be tested immediately at the Contractor's cost at an approved laboratory and until the test results are found satisfactory, the cement shall not be used on any work. The Contractor is not entitled to any claim of any nature on this account.

Codes and Standards

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Bureau of Indian Standards and all other such as may be published by them during the currency of the contract, shall govern in respect of design, workmanship, quality and properties of materials and methods of testing. Some of the relevant available codes are listed here under:

IS:4082Code of Practice for storage and handling of Cement.

Coarse and fine aggregate

Aggregates shall be stored in easily measureable stacks on brick soling or an equivalent platform so that they do not come in contact with dirt, clay, grass or any other injurious substances at any stage. Aggregate of different size shall be kept in different stacks. If so desired by the Engineer, aggregate from different sources shall be stacked separately with proper care to prevent intermixing.

Any aggregate delivered at site in a wet condition or becoming wet at site due to rain or any other means shall be kept in storage for at least twenty four (24) hours to obtain adequate drainage before it is used for concreting or the water content of the mix must be suitably adjusted as directed by the Engineer.

Reinforcement

Reinforcement bars shall be stored off the ground and under cover, if so desired by the Engineer. If necessary, a coat of cement wash shall be given to bars to guard against rusting. Reinforcing steel shall be stored consignment wise and diameter wise.

Codes and Standards

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Bureau of Indian Standards and all other such as may be published by them during the currency of the contract, shall govern in respect of design, workmanship, quality and properties of materials and methods of testing. Some of the relevant available codes are listed here under:

IS:800 Code of Practice for use of structural steel in general building construction.

Formwork

Design of Formwork

The design of Form work shall take into account all vertical and lateral loads that the forms will carry or be subjected to, during the construction process. Besides weight and pressure of reinforced concrete and weight of the forms themselves, the design shall consider loading due to unsymmetrical placement of concrete; impact from dumping of concrete; concentrated loads produced by storing materials on the freshly placed concrete; movement of men and construction equipment; wind action and any other imposed load during construction. Contractor need assess the magnitude of vertical live load to be taken for design of formwork duly considering his method, sequence and rate of pour of concrete. However, minimum design vertical live load to be considered shall be 750 Kg/m^2 excluding weight of concrete.

Side shuttering shall be designed to cater for concrete pressures, duly considering rate of pour, temperature of concrete, slump and rate of vibration. The column shuttering shall be designed for a rate of vertical pour not less than 4 metres per hour. For shuttering of deck slab of pedestal, the design rate shall not be less than 1.5 metres per hour. Concrete temperature for design purpose shall be taken to be 21°C (or 70°F) or less. Lateral pressures for design of forms shall be based on ACI Committee 622 Pressure Formula or CERA Research Report No.1 Pressure Design Chart. Following Table, based on ACI Committee 622 Pressure Formula, is given as guidance for assessing maximum lateral pressure for design of forms. Pressure in excess of 2400 Kg/m3 x height of fresh concrete in metres shall not be considered.

Rate of Concrete placement	Maximum lateral pressure in Kg/cm^2 in metre per hour for temperature indicated		
	21° C (70°F)	15°C (60°F)	10°C (50°F)
1.5	3870	4395	5125
1.8	4500	5125	6005
2.1	5130	5860	6885
2.4	5750	6590	7765
3.0	7010	8055	9520
3.6	8265	9520	11280
4.2	9520	10985	13035

Materials for Formwork

Scaffolding, props, struts and bracing for the shuttering shall be of structural steel. Plywood faced shuttering shall be used for achieving smooth exposed concrete finish.

Wall ties/through bolts

Through bolts, when used as wall ties, shall be in one single piece for the full length.

Through bolt diameter and spacing should be designed to cater for entire lateral concrete pressure on the shuttering. In addition, side stays shall be provided to take at least 50% of the specified design pressure.

Where use of through bolts is not feasible, the entire pressure shall be taken by side stays/props.

Welding of through bolts to reinforcement shall not be permitted.

Platforms/Windows

Adequate windows at maximum 2 m vertical spacing's shall be provided in column shuttering for concreting, inspection and introducing vibrators. Arrangements should be made for closing tightly the windows to prevent loss of water and fine material from concrete, as the pour level overtakes the window level.

Inserts/Embedments

Inserts/embedments shall not be supported on or tied to reinforcement, but independently on shuttering. Suitable arrangements shall be made to locate and fix them to shuttering. Stools shall be provided where required.

Main equipment foundation bolts, pipe sleeves and block-outs for pockets shall be placed and maintained in position at the top by means of an adequately braced steel template. While planning the template, care should be taken to ensure that it does not block the top of beam and that adequate free space is left to pour concrete from the top.

Placing of Concrete

Contractor need furnish to Engineer together with formwork design, his proposed scheme for concreting the digestor & hydrolysis tank. The scheme shall indicate types of equipment, mobilisation of men and materials, standby arrangements and method, sequence and rate of pouring concrete. Work shall proceed only after Engineer's approval.

8.1.4 Structural Steelwork

Scope

This specification covers the requirements in respect of materials, workmanship and quality for preparation of fabrication drawings, supply, fabrication, inspection, testing, painting and erection of structural steelwork including tubular steel work for buildings and structures.

Codes and Standards

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Bureau of Indian Standards and all other such as may be published by them during the currency of the contract, shall govern in respect of design, workmanship, quality and properties of materials and methods of testing. Some of the relevant available codes are listed here under:

IS:800 Code of Practice for use of structural steel in general building construction.

IS:801 Code of Practice for use of cold formed light gauge steel structural members in general building construction.

IS:806 Code of Practice for use of steel tubes in general building construction.

IS:808 Dimensions of hot rolled steel sections.

IS:813 Scheme of symbols for welding.

IS:814 Covered electrodes for metal are welding of structural steel.

IS:815 Classification and coding of covered electrodes for metal are welding of mild steel.

IS:816 Code of Practice for use of metal are welding for general construction in mild steel.

IS:817 Code of Practice for training and testing metal are welders.

IS:818 Code of Practice for Safety and Health requirements in electric and gas welding and cutting operations.

IS:822 Code of Practice for inspection of welds.

IS:919 Recommendations for limits and fits for engineering.

IS:961 Structural Steel (High Tensile).

IS:1148 Hot-rolled rivet bars for structural purposes.

IS:1149 High tensile rivet bars for structural purposes.

IS:1161 Steel tubes for structural purposes.

IS:1239 Mild steel tubes, tubular and other wrought steel fittings.

IS:1363 Hexagon head bolts, screws and nuts of product grade C.

IS:1364 Hexagon head bolts, screws and nuts of product grade A and B.

IS:136 Technical supply conditions for threaded steel fasteners.

IS:1608 Method for tensile testing of steel products.

IS:1730 Dimensions for steel plate, sheet and strip for structural and general engineering purposes.

IS:1731 Dimensions for steel flats for structural and general engineering purposes.

IS:1852 Rolling and cutting tolerances for hot-rolled steel products.

IS:1977 Structural steel (ordinary quality) St-42-0.

IS:2062 Weld able structural steel.

IS:2074 Ready mixed paint, air drying, red oxide zinc-chrome, priming.

IS:2633 Methods of testing uniformity of coating on zinc coated articles.

IS:3757 High strength structural bolts.

IS:4000 High strength bolts in steel structures - Code of Practice.

IS:9595 Recommendations of metal arc welding of carbon and carbon manganese steels.

IS:7205 Safety code for erection of structural steelwork.

IS:7215 Tolerances for fabrication of steel structures.

AISC American Institute of Steel Construction Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

SP6(4) Hand book for use of high strength friction grip bolts.

Materials

Structural steel

All structural steel shall be of tested quality and shall conform to IS:2062. High tensile steel, when supplied, shall conform to IS:961. Alternatively, RC may provide material which is equivalent or better than the relevant Indian steel specified in this document.

Bolts and nuts

Bearing bolts and nuts shall conform to IS:1363 and IS:1364 and unless shown or specified otherwise shall be hexagonal. All nuts shall fit tight. Mechanical properties shall conform to IS:1367. High strength friction bolts shall conform to IS:3757 and nuts to IS:6623.

Washers

Washers shall conform to IS:5369, IS:5372, IS:5374, IS:6610 and IS:6649 as applicable.

Spring washers shall be provided for those parts which carry dynamic loads and where black bolts for connection are permitted.

Electrodes

Mild steel electrodes shall conform to IS:814. The Contractor need furnish to the Engineer a certificate issued by the manufacturer to the effect that the electrodes supplied are in accordance with the above specifications. For welding in any particular position, the electrodes used shall be those recommended by the manufacturer for use in that position.

Paints

Paints to be used for shop coat of fabricated steel shall be compatible with the finish coat specified.

Other Materials

Other materials used in association with steel work shall comply with the appropriate Indian Standard specifications.

General requirements regarding supply of materials by Contractor

Before ordering bought out items, special accessories, equipment etc. and materials of any description, the Contractor need submit, for the approval of the Engineer, the names of the proposed manufacturers or suppliers together with the specification of the materials and shall, thereafter, send to the Engineer copies of the orders.

When a supplier or sub-Contractor orders materials for the execution of his sub-contract, he shall also comply with the aforesaid requirements, by the submission through the Contractor, for the approval of the Engineer, of the names of the manufacturers proposed and by sending to the Engineer of copies of the orders.

The Contractor need furnish to the Engineer the following certificates, if required, before commencement of fabrication:

i) A certificate stating the process of manufacture and chemical composition of the steel supplied.

ii) Test certificates by the manufacturer giving the results of each of the specified mechanical tests applied to the structural steel, bolts, nuts and washers and the chemical composition of the same.

Drawings and Lists

Unless otherwise stated, the Contractor need be responsible for the preparation of the detailed fabrication/working drawings, erection and marking plans and all necessary lists such as indents, rivet and bolt lists, material lists, Despatch Office Despatch lists and lists for all bought out items. The fabrication drawings shall indicate the size of each component and length and sequence of all welds & bolted connections.

Fabrication work shall not be taken in hand until the relevant shop drawings have been approved by the Engineer. Although these drawings receive the approval of the Engineer, the Contractor need be wholly responsible for their being correct and complete.

Welding

General

The welding and the welded work shall conform to IS:816 unless otherwise specified. The permissible stresses for welding shall be taken as 75 per cent of those specified in IS:816 where welds are not tested by either radiographic or ultrasonic methods. All butt welds in critical structures such as, crane girders, heavy columns, bunkers etc. shall be tested by either radiographic or ultrasonic methods. As much work as possible shall be welded in shops and the layout and sequence of the operations shall be so arranged as to eliminate distortion and shrinkage stresses to the satisfaction of the Engineer.

Plant and equipment

The plant used shall be of sufficient capacity to suit the welding procedure laid down and be capable of depositing the particular type or types of electrodes to be used under the conditions of current and voltage specified by the electrode manufacturer. The number of welding sets, both automatic and hand operated proposed to be used in the work shop for fabrication of the structural steel work for the contract shall be given by the tenderer along with his tender. Efficient means shall be provided for the accurate indication of the current and in addition, a pair of tong testers shall be supplied by the Contractor and be available to the Engineer.

All equipment, accessories and connections shall be maintained in proper working order.

Electrodes

All electrodes shall be kept under dry conditions. Any electrode damaged by moisture shall not be used unless it is stated by the manufacturer that when it is properly dried, there will be no detrimental effect. Any electrode which has part of its flux coating broken away or is otherwise damaged, shall be discarded. Any electrode older than 6 months from the date of manufacture shall not be used. Low

hydrogen electrodes shall be used for joints in material above 20 mm thick and all important connections.

Welding procedure

Before commencement of work the Contractor need submit to the Engineer for his approval, the procedure proposed to be adopted. The welding procedure shall be arranged to suit the details of the joints as indicated on the drawings and the position at which welding has to be carried out. Welding procedure shall cover the following:

i. Type and size of electrodes
ii. Current and (for automatic welding) arc voltage
iii. Length of run per electrodes, or (for automatic welding) speed of travel
iv. Number and arrangement of runs in multi-run welds
v.

When necessary the procedure shall also cover the following:

i. Position of welding
ii. Preparation and set up of parts
iii. Welding sequence
iv. Pre or post heating
v. Any other relevant information

- The welding procedure shall be so arranged that the distortion and shrinkage stresses are reduced to a minimum and that the welds meet the requirement of quality specified here under.

- The Contractor need record the approved welding procedure and shall provide each operator with all relevant details. Alternative approved procedure may be furnished in such cases when it is desirable to make the fullest use of available plant. The welding procedure then laid down shall be strictly followed and no variation shall be permitted without the approval of the Engineer.

- Peening of the welds involving deformation of the weld surface either during deslagging operation or thereafter, shall not be allowed.

- Fusion faces and surrounding surfaces:

- Fusion faces and the surrounding surfaces within 50 mm of welds shall be free from all mill scale and free from oil, paint, or any substance which might affect the quality of the weld or impede the progress of welding. They shall be free from irregularities such as would interfere with the deposition of the specified size of weld or the cause of defects.

- All mill scale within 50 mm of welds shall be removed prior to welding either by pickling at works followed by thorough power wire brushing or by other approved methods.

- If preparation or cutting of the fusion faces is necessary the same shall be carried out by shearing, chipping, gas-cutting or flame-gouging.
- Where hand gas cutting or hand-gouging is employed, the blow pipe or gouging blow pipe shall be properly guided.

Assembly for welding:

Parts to be welded shall be properly assembled and held firmly in position by means of jigs and clamps prior to and during welding.

Accuracy of fit up:

Parts to be fillet welded shall be brought into as close contact as practicable and the gap due to faulty workmanship or incorrect fit up shall not exceed 1.5 mm. If greater separation occurs at any position, the size of fillet weld shall be increased at such positions by the amount of the gap.

Jigs and manipulators:

Jigs and manipulators shall be used where practicable and shall be designed to facilitate welding and to ensure that all welds are easily accessible to the operators.

End of butt welded joints:

The ends of butt joints shall be welded so as to provide the full throat thickness. This may be done by the use of extension pieces, cross-runs or other means approved by the Engineer.

Weld face and reinforcement of butt welds:

The weld face shall at all places be deposited proud of the surface of the parent metal. Where a flush surface is required the surplus metal shall be dressed off.

Minimum leg length and throat thickness in fillet welds:

The minimum leg length of a fillet weld as deposited shall be not less than specified size. In no cases shall a concave weld be deposited without specific permission of the Engineer. Where permitted, the leg length shall be increased above that specified, so that the resultant throat thickness is as great as would have been obtained by the deposition of a flat-faced weld of the specified leg length.

De-slagging:

After making each run of welding all slag shall be thoroughly removed.

Quality of welds:

The weld metal, as deposited (including tack welds if to be incorporated) shall be free from cracks, slag inclusions, gross porosity, cavities and other deposition faults. The weld metal shall be properly

fused with the parent metal without serious undercutting or overlapping at the toes of the weld. The surface of the weld shall have a uniform consistent contour and regular appearance.

Working conditions:

Welding shall not be done under weather or other conditions which might adversely affect the efficiency of the welding and where necessary effective protection or other safeguard shall be provided.

Qualification and testing of welders:

The Contractor needs to satisfy the Engineer that the welding operators are suitable for the work upon which they will be employed and shall produce evidence to the effect that welders have satisfactorily completed appropriate tests as described in IS:817. The Engineer may at his discretion order periodic tests of the welders and/ or of the welds produced by them. Such tests shall be at the expense of the Contractor.

Supervision:

The Contractor needs to employ a competent welding supervisor or charge-hand to ensure that the standard of workmanship and the quality of the materials comply with the requirements laid down in this specification.

Machining of butts, caps and bases

Column splices and butt joints of struts and compression members depending on contact for stress transmission shall be accurately machined and close butted over the whole section with a clearance not exceeding 0.2 mm locally. In column caps and bases the ends of shafts together with the attached gussets, angles, channels etc. after riveting, bolting and/ or welding together as the case may be, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles or channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 2.0 mm.

Where sufficient gussets and bolts or welds are provided to transmit the entire loading or where connection is by full penetration butt welds, the column ends need not be machined.

Slab bases and caps, if applicable, shall be in one solid piece, and except when cut from material with surfaces, and shall be accurately machined over the bearing surfaces and shall be in effective contact over the whole area of the machined end of the stanchion. A bearing face need not be machined if it is to be grouted directly to a foundation provided it is true and parallel to the machined face. To facilitate grouting, holes shall be provided where necessary in stanchion bases for escape of air.

Shop painting

The whole of steel work with the exception of bolts and nuts and machined surfaces after being thoroughly cleaned to remove rust, loose scale, grease, dust etc. shall be given one shop coat of primer compatible with the finish paint. For epoxy based paints, surface preparation shall be by sand blasting. All rivets, bolts, nuts and washers etc. shall be thoroughly cleaned and dipped in boiled linseed oil. All machined surfaces shall be well coated with a mixture of white lead and tallow. Surfaces which are to be held in contact by bolting shall be painted before assembly, and the parts brought together while still wet. Unless specified otherwise, all surfaces inaccessible after bolting or intermittent welding shall be given two coats of approved paint before assembly. In the case of surfaces to be welded, the steel shall not be painted or metal coated within a suitable distance of any edges to be welded if the paint specified or the metal coating would be harmful to welders or impair the quality of the welds. Welds and adjacent parent metal shall not be painted prior to de slagging, inspection and approval. Parts which are to be encased in concrete shall not be painted or oiled.

Marking, packing and dispatching

Each piece shall be distinctly marked before delivery, in accordance with an approved marking diagram and shall bear such other marks as will facilitate erection. For easy identification at site, a small distinguishing mark for each building shall be painted on each end of every member before dispatch from fabrication shop. The fabricated steel work shall be dispatched in such portions as may be found convenient for erection or as ordered by the Engineer.

All projecting plates or bars and all ends of members at joints shall be stiffened, all straight bars and plates shall be bundled, all screwed ends and machined surfaces shall be suitably packed and all rivets, bolts, nuts, washers and small loose parts shall be packed separately in cases so as to prevent damage or distortion during transit.

General

The material shall be verified with marking on the marking plan or shipping lists which shall be supplied by the Contractor.

Any material found damaged or defective shall be stacked separately and the damaged or defective portions be painted in distinct colour. Such material is to be dealt with under the orders of the Engineer without delay.

The field assembling of the component parts of a structure shall involve the use of method and appliances not likely to produce injury by twisting, bending or otherwise deforming the metal. No member slightly bent or twisted shall be put in place until the defects are corrected and members seriously damaged in handling shall be rejected.

All small bends or twists received by members shall be rectified before such members are put in place; any serious bends or damage shall be reported at once to the Engineer by the Contractor for

instructions. The straightening of bent edges of plates, angles and other shapes shall be done by methods not likely to produce fracture or other injury.

Following the completion of the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of incipient or other fractures.

Setting Out

The Contractor need assume full responsibility for the correct setting out of all steel work and erecting it correctly as per alignment and levels shown on the drawings and plumbing of vertical members. Datum points will be fixed by the Engineer near the work site. Notwithstanding any assistance rendered to the Contractor by the Engineer, if at any time during the progress of the work any error should appear to arise therein, on being required to do so, the Contractor at his own cost shall remove and amend the work to the satisfaction of the Engineer.

Field connections

All field connections in the trusses, columns, girders, framework etc. shall be welded, unless otherwise specified. Connection of purlins, girts and other unimportant members only may be bolted with black bolts, except where welded connections are required.

Use of "high strength friction grip" bolts in place of welding may be permitted for field connections at the discretion of the Engineer.

Field welding

All field assembly and welding shall be executed in accordance with the requirements for shop fabrication, excepting such as manifestly apply to shop conditions only. Where the steel has been delivered painted, the paint shall be removed before field welding, for a distance of at least 50 mm on either side of the joints.

Bedding and grouting

Bedding shall be carried out with cement grout or mortar having a compressive strength of 250 kg per sq. cm at 28 days for main column bases and 200 kg per sq. cm at 28 days for secondary column bases. For the main column the Contractor need provide screed bars of mild steel flats and fix them in mortar. The Engineer will be the sole authority in deciding "main" and "secondary" columns and his decision in this matter will be binding on the Contractor within the terms of this contract.

The bedding shall not be carried out until a sufficient number of columns has been properly aligned, leveled and plumbed and sufficient girders, beams, trusses and bracings are in position to the satisfaction of the Engineer.

Immediately before grouting, the space under the base plate and around bolts shall be thoroughly cleaned and made free from excessive moisture.

The grout or mortar shall be mixed as thick as possible consistent with fluidity and shall be poured under pressure with pressure grouting machine, until the space has been filled with mortar. Admixtures, if directed to be added will be measured and paid separately. If desired, ready mix high strength non-shrink grout of specified strength shall be used.

Painting after erection

Before painting of steel which is delivered unpainted is commenced, all surfaces to be painted shall be dry and thoroughly cleaned of all loose scale, rust, dust, grease, etc.

The specified protective treatment shall be completed after erection. All rivet and bolt heads and the site welds after deslagging shall be cleaned. Damaged or deteriorated paint surfaces shall be made good first with the same type of paint as the shop coat. Where specified, surfaces which will be in contact after site assembly shall receive a coat of paint (in addition to any shop priming) and shall be brought together while the paint is still wet.

Surface which will be inaccessible after site assembly shall receive the full specified protective treatment before assembly.

Site painting should not be done in frosty or foggy weather or when humidity is such as to cause condensation on the surface to be painted.

Two or more final coats of approved paint as specified shall be applied to the steel work after erection.

Correction of misfits

Correction of minor misfits, a reasonable amount of reaming and cutting of excess-stock from rivets will be considered a legitimate part of the erection.

Any error in shop work which prevents the proper assembling and fitting up of parts by the moderate use of drift pins or a moderate use of reaming and slight chipping or cutting shall immediately be reported to the Engineer and his approval of the method of correction obtained.

Testing and Acceptance Criteria

General

The Engineer shall have free access at all reasonable times to those parts of the manufacturer's works which are concerned with fabrication of the steel work and shall be afforded all reasonable facilities for satisfying himself that the fabrication is being undertaken in accordance with the provisions of this specification.

Unless specified otherwise, inspection shall be made at the place of manufacture prior to dispatch and shall be conducted so as not to interfere unnecessarily with the operation of the work.

Should any structure or part of a structure be found not to comply with any of the provisions of this specifications, it shall be liable to rejection. No structure or part of the structure, once rejected shall be resubmitted for test, except in cases where the Engineer considers the defect as rectifiable.

Defects which may appear during fabrication shall be made good with the consent of and according to the procedure laid down by the Engineer.

All gauges and templates necessary to satisfy the Engineer shall be supplied by the manufacturer.

The Engineer may, at his discretion, check the test results obtained at the manufacturer's works by independent tests at the Government Test House or elsewhere.

When all tests to be performed in the Contractor's shop under the terms of this Contract have been successfully carried out, the steel work will be accepted forthwith and the Engineer will issue an acceptance certificate, upon receipt of which, the items will be shop painted, packed and dispatched. No item is to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work, should it, on further tests before or after erection, be found not in compliance with the Contract.

Acceptance

Should any structure or part of a structure be found not to comply with any of the provisions of this specification, the same shall be liable to rejection. No structure or part of the structure, once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check the test results obtained at the Contractor's works by independent tests at an approved laboratory.

Erection (as per IS 12843)

Columns

- Shifting of column axis at foundation with respect

to building both in longitudinal & lateral direction (±) 3 mm

- Out of plumb ness (verticality) of column axis from

  true vertical axis as measured at column top

- For column upto 10 m height (±) 5 mm

- For column exceeding 10 m (±)1/2000 of

10 m height column height but not more than 15 mm

- Deviation in the level of bearing surface of

columns at foundation top with respect to true level	(±) 3 mm
- Deviation in bearing levels for beams, trusses . etc. with respect to true level	(±) 3 mm
- Difference in bearing level between adjacent column both across and along the building	(±) 6 mm
- Difference in erected position at adjacent pairs of columns along the length or across the width of building prior to connecting trusses/beams with respect to true distance	(±) 10 mm

Trusses/Beams

- Deviation at Centre of span of upper chord

  1/250 of member from vertical plane running through depth of chord and perpendicular to plane truss or at truss/beams 20 mm whichever is less

- Lateral displacement of top chord at centre of span from vertical plane running through centre of supports	1/1500 of the span or 10 mm whichever is less
- Lateral shift in location from it true line of purlin / beam	(±) 5 mm

8.1.5 Brickwork & Plastering

Scope

This specification covers the requirements in respect of materials, workmanship and quality for brickwork and plastering.

Codes and Standards

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Indian Standards Institution and all other such as may be published by them during the currency of the Contract, shall govern in respect of design, workmanship, quality and properties of materials and method of testing. Some of the relevant available codes are listed hereunder:

Brick work

IS:1077 Common burnt clay building bricks

IS:1542 Sand for plaster

IS:1661 Code of practice for application of cement and cement-lime plaster finishes

IS:2116 Sand for masonry mortars

IS:2212 Code of practice for brickwork

IS:2250 Code of practice for preparation and use of masonry mortars

IS:2691 Burnt clay facing bricks

IS:3495 Methods of tests of burnt clay building bricks

IS:3696 Safety code for scaffolds and ladders

IS:5454 Methods of sampling of clay building bricks

Materials

Cement

Cement used shall conform to IS:269.

Sand

The sand shall be approved river or pit sand and it shall conform to IS:2116 for masonry mortar and to IS:1542 for plaster mortar.

Bricks

The bricks used shall be at least chamber burnt first class (class B) bricks conforming to IS:1077 having a minimum compressive strength of 35 kg/cm2. Bricks are to be whole, uniform texture, sound, well burnt, free from cracks, square and well-shaped, uniform in size, uniform red cherry or copper colour and shall emit a clear ringing sound when struck. Slight distortion or rounded edges are permitted provided no difficulty arises during laying of uniform course.

Water absorption after 24 hours immersion shall not exceed 20% by weight. Dimensional tolerance shall not exceed 8%. Representative samples shall be submitted and approved samples shall be retained by the Engineer for future comparison.

Storage and Handling

Bricks shall not be dumped at site. These shall be stacked in regular tiers on firm ground, even as these are unloaded, to minimise breakage and defacement of bricks. Bricks selected from different situation of use in the work shall be stacked separately.

Workmanship

Brick work

The whole of the brickwork shall be carried out by the Contractor in a uniform manner.

All the bricks shall be kept under water till they are completely soaked and used on the works on their becoming skin dry.

The Contractor need set out and build all brickwork to the dimension, thickness and heights shown on the drawings. The Contractor need build all brickwork in English bond and half brick walls and casing to pipe, chases etc. in stretcher bond. Brickbats shall not be used except where required for bond.

The Contractor need lay bricks in full mortar beds with shoved joints. The joints are not to exceed 10 mm in thickness and are to be full of mortar, close, well finished and neatly struck. The vertical joints in any course shall not be nearer than quarter of a brick length from those in the course below. All joints shall be of same width except for small variations to maintain bond. The brickwork shall be laid plumb and trim to line and level. No portion of brickwork shall be raised more than 1 meter above another at one time. If the mortar in any course has begun to set, the joints shall be raked out before another course is laid. The top course of brickwork in reinforced concrete framed structure shall be wedged against reinforced concrete surface and joint well filled with mortar.

The Contractor need flush up thoroughly with mortar all joints as the work proceeds. Where brickwork is to receive plaster, the joints shall be raked to a depth of 12 mm to provide proper bond.

The brickwork as it progresses shall be thoroughly watered on its faces and top. New work shall be properly bonded with the old work. The surface of unfinished work shall be cleaned and thoroughly wetted before joining new work to it.

Any work in which the mortar perishes shall be dismantled and rebuilt by the Contractor at his own expense.

The Contractor need carry out work in as clean a manner as possible and shall remove excess material and mortar droppings daily.

Where brick walls, are to receive plaster, excess materials and mortar droppings shall be removed and the surface shall be brushed clean.

During cleaning operations, adjacent work shall be protected and any damage resulting from improper protection shall be made good by the Contractor at his own cost.

Reinforcement if shown in the drawing shall be provided fully embedding in mortar after thoroughly cleaned. These shall be lapped with dowels if left in RC columns or welded to steel columns.

Encasing of structural steel shall be done by building masonry work round flanges, webs etc., and filling the gap between steel and masonry by minimum 12 mm thick mortar. Encased members shall be wrapped with chicken wire mesh when shown on drawings or instructed by the engineer. The minimum lap in chicken wire mesh shall be 50 mm. Other steel embedments shall be generally embedded in mortar and masonry unit shall be cut as required.

Plastering

Unless otherwise specified, all plaster work shall be carried out according to IS:1661. The thickness and proportion of cement plaster shall be as specified in the drawing.

The surface to be plastered shall be cleaned of all extraneous matter and rubbish. In brickwork the joints shall be raked and concrete surface roughened by chipping or hacking. Any shuttering material adhering to the concrete shall be removed. The Contractor need make plaster pads of the required thickness of plaster for correctness of plumb, line and level. The surface shall be thoroughly watered and soaked and aerated and all holes shall be closed before starting plastering operation.

Plaster, when more than 15 mm thick shall be applied in two coats - a base coat followed by the finishing coat. Thickness of under coat shall be of sufficient to fill up all unevenness in the surface, no single coat, however, shall exceed 15 mm in thickness.

For one coat plaster work, the plaster shall be laid slightly thicker than the specified thickness and the surface then leveled with flat wooden rule to the required thickness. The plaster shall be well pressed into the joints and the surface finished as specified.

For two coats of plaster work, the first coat shall be applied as described above except that the surface shall be left rough and keys formed for the application of second coat. The second coat shall be applied a day or two after the first coat has set, but the first coat shall not be allowed to dry. The second coat shall consist of mortar ground very fine and shall be laid on with a wooden rule to a specified thickness, rubbed smooth and leveled and the surface plastered completely the same day. The leveling shall be continued till the plaster is quite dry and all moisture which exudes from the plaster shall be wiped off with a fine cloth. The surface shall be kept dry until exudation of moisture ceases, during the process of rubbing.

Finish

Sand faced plaster

The plaster shall be applied in two coats. The first coat or the scratch coat should be approximately 14 mm and shall be continuously carried out without breaks to the full length of wall or up to doors, windows etc. The scratch coat shall be dashed on the prepared surface with heavy pressure, brought to true and even surface and then lightly roughened by cross scratch lines to provide bond for finish coat. The scratch coat shall be cured for at least 7 days and then allowed to dry.

The second coat shall be 6 mm thick and it shall not be applied until at least 10 days have elapsed after the application at second coat. Before application of the second coat, the scratch coat shall be evenly damped. This coat shall be applied from top to bottom in one operation and without joints; finish shall be straight, true and even. Only approved river sand shall be used for the second coat and for finishing work. Sand for finish shall be of even coarse size and shall be dashed on the surface and sponged.

Plaster-of-Paris Punning

Plastered surfaces, where specified, shall be finished with plaster-of-paris punning. The thickness of punning shall be 2 mm and shall be applied by skilled workman. The finish shall be smooth, even and free from undulation. Before bulk work is taken in hand, a sample of punning shall be done on roughly 1 sq.m area and approval of the Engineer-in-charge taken. The work shall be taken then in hand as per approved sample.

Curing

The brick shall be cured for a period of fourteen (14) days after laying and the plaster shall be cured for a period of seven (7) days.

Expansion & Separation Joints

Location and details of expansion joints shall be strictly as shown in the drawings. Expansion joint filler boards and sealing strips shall have minimum transverse joints. Transverse joints shall be approved by the Engineer.

Separation joints shall be with standard water proof paper or with alkathene sheets about 1 mm in thickness. Length and sealing of laps shall be to the satisfaction of the Engineer.

Damp Proof Course

The proportion of cement to aggregates shall be 1:2:4 using 6 mm down stone chips with a water proofing admixture. The percentage of waterproof admixture shall be as per manufacturer's specification but not less than 1% by weight of cement. The brick masonry surface shall be leveled, flushed up and prepared as directed to receive the damp-proof course. The thickness of damp proof course shall be 40 mm. In masonry walls of buildings it shall normally be placed above the external ground level. It shall be laid for the full width of the wall. The top surface shall be kept rough or ribbed for mortar for brickwork coming over it, for proper adhesion. All exposed surfaces of the

damp-proof course shall be finished fair and smooth. It shall be cured for atleast 7 days. After the surface has partially set, hot bitumen shall be applied in two coats at the rate of 1.7 kg per sq.m per coat and dry sand spread over it.

8.1.6 Sheeting Work in Roof and Siding

SCOPE

This specification covers the requirements in respect of materials, workmanship and quality for sheeting work in Roof and Siding of Buildings.

CODES AND STANDARDS

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Bureau of Indian Standards and all other such as may be published by them during the currency of the Contract, shall govern in respect of design, workmanship, quality and properties of materials and methods of testing. Some of the relevant available codes are listed hereunder:

IS : 277 Galvanised steel sheets.

IS : 730 Hook bolts for corrugated sheet roofing.

IS : 5119 Laying and finishing sloped roof coverings.

IS:1726 Sheet metal rain water pipes.

IS : 8869 Washers for corrugated sheet roofing.

Permanent colour coated metal sheets

Troughed zinc-aluminium alloy colour coated not less than 150 gm/sq.m M.S.sheets having 0.6 mm minimum base metal thickness (or High tensile steel sheet of 0.5 mm minimum base metal thickness) shall be used for the cladding system. The outer side (exposed face) shall be permanently colour (Blue) coated with PVF2 paint of minimum DFT 20 microns over primer and the inner side (internal face) shall be coated with same paint of minimum DFT 12 microns over primer. These shall be fixed directly to runners. The sheets shall meet the general requirement of IS: 14246 and shall conform to class 3 for the durability. For roof sheeting the specification remains same as that of side cladding except the thickness and galvanisation. The minimum thickness of roof sheeting shall be 0.8 mm with galvanisation rate of 275 gm/sq.m.

Flashings, caps, trim closures etc.,

All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain sheets having same material and coating specification as mentioned above for the outer face of the sandwiched metal cladding.

General

The Contractor need also supply all necessary, special fittings, fasteners, flashings, caulking etc. required for installation of the sheets in strict accordance with manufacturer's instructions.

Roof & siding sheets shall be capable of withstanding 200 kg/sq.m wind loads. Wind tie of 40 mm x 6 mm GI flat shall be fixed at the two caves end of the roof slopes. Fixing shall be done with the same bolts which secure sheets to the purlins. Slot holes shall be cut in the wind ties to allow for temperature variations.

Installation

Galvanised sheets shall be fixed with minimum 150 mm and 100 mm end laps for roof and side sheets respectively, unless higher laps are specified by the manufacturer or in the drawings. Side laps shall be as per manufacturer's recommendations. Unless otherwise specified, 10 mm and 8 mm dia J or L polymer coated Bolts shall be used for roof and side sheets respectively. 6 mm dia polymer bolt and nut with seal washer shall be used for stitching of roof sheets/fixtures and polymer round washer/diamond washer for side sheets. For fixing requirements not specified here, manufacturer's recommendations shall be adopted.

Acceptance Criteria

The installation shall present a neat appearance and shall be checked for water-tightness. The following shall be checked.

- Side and end laps.
- Absence of holes or damages in sheet.
- Spacing of bolts.
- Provision of double washers.
- Proper installation of flashings, wind ties etc.

8.1.7 Floor And Floor Finishes

SCOPE

This specification covers requirements in respect of material, workmanship and quality for soling, concrete floor and floor finishes work.

CODES AND STANDARDS

Unless specifically mentioned otherwise, all applicable codes and standards in their latest additions as published by Bureau of Indian Standards and all other such as may be directed published by them during currency of the contract, shall govern in respect of design, workmanship, quality and properties of materials and method of testing. Some of the relevant available codes are listed here under :

IS:777 Specification for glazed earthenware wall tiles.

IS:2114 Code of practice for laying in situ terrazo floor finish

IS:2571 Codes of Practice for laying in-situ concrete flooring

IS:3461 Specification for PVC Asbestos floor tiles.

IS:3462 Specification for unbacked flexible PVC flooring.

IS:4457 Ceramic unglazed vitreous acid-resistant tiles

IS:5318 Code of practice for laying PVC flooring.

IS:5491 Code of practice for laying in-situ granolithic concrete floor topping

Boulder Soling

The boulders for soling shall be granite, basalt or similar hard stone approved by the Engineer and generally shall be 230 mm thick. The sub grade shall be dressed to correct level and shall be rammed or rolled to proper consolidation before laying the soling. Stones shall be placed close to each other. The specified thickness shall be made up in two layers depending on thickness. The voids between the stones shall be hard packed first with smaller pieces and hammered into place so as to completely fill up the void along with moorum as binding material and the layer is watered and is compacted by roller/mechanical compactor. In case of building enclosing digester, hydrolysis tank etc., the compaction shall be by roller of 8/10 MT capacity.

Cement Concrete Flooring

Materials

Requirements given in relevant section.

Workmanship

The workmanship shall generally conform to the specification for Plain & Reinforced concrete and also to IS:2571. For ground floor slab or paving in open area, where the slab has to be laid over a consolidated ground, soling, a kraft paper shall be spread over the area and kept moist before concreting.

The floor shall be laid in alternate panels, of size not exceeding 4 m to reduce risk of cracking, intermediate panels being filled in after two or three days. For paving in open area, contraction joint and expansion joints shall be provided as per IS specification. The expansion joints shall be filled with bitumen impregnated boards 25 mm thick of approved manufacturer and top 25 mm shall be covered with approved mastic sealing compound.

Floor Finishes

Indian Patent Stone (IPS) with ironite topping

It shall consist of a under bed and a topping laid on an already laid and matured concrete base.

Thickness

The total thickness of finish shall be 40 mm of which the topping shall be 12 mm. While the topping shall be uniform thickness the under bed may vary in thickness to provide necessary slopes.

Mix

For under bed, it shall be 1:2:4 mix using 10 mm downgraded stone chips.

For toppings of heavy duty, the proportion of metallic hardener shall be strictly as specified by the manufacturer. In absence of such direction, one (1) part of metallic hardener shall be mixed dry with 4 parts of cement by volume. To this mixture, 6 mm nominal size stone chips shall be added in portion of 1:4 (mixture of hardener & cement: stone chips) by volume. Minimum quantity of water to be added to make it workable.

Laying

The topping including the under bed shall be laid in alternate bays or in chequered board pattern. No panel shall be cast in contact with another already laid till the contraction of latter has already been taken place.

The maximum area of each panel shall be 3 sq.m of which no side shall be more than 2 m long. Glass strips (4 mm thk.) or aluminum dividing strips shall be used for farming the panels.

A cement grout shall be applied and worked into the surface to receive the finish, the under bed then laid, compacted and leveled to proper grade with a screed or float. The topping shall be applied evenly on the under bed while it is not fully set, but firm enough and rolled and pressed to get full bond. The topping shall be troweled to a dense finish to the satisfaction of the Engineer. All trowel marks shall be mopped out with a cloth to give a clean smooth surface.

Curing

After the surface is sufficiently set, the finished floor shall be kept moist for 7 days for curing.

Indian Patent Stone (IPS) with non-metallic surface hardener finish

It shall consist of an underbed and a topping on which the hardener shall be laid.

Thickness

The total thickness of finish shall be 40 mm of which the topping shall be 12 mm including the hardener finish.

Mix

Mix for underbed and topping shall be same as for IPS flooring.

Hardener

Hardener shall be non-metallic abrasion resistant surface hardener NITOFLOR HARDTOP or equivalent.

Laying

The topping and underbed shall be laid as for IPS flooring. While the topping is still green, the hardener shall be applied by dry shake-on system. Cleaning of surface, surface preparation, curing and trowel finish shall be as per manufacturer's specifications and recommendation. The surface hardener application rate shall be as follows:

Heavy duty	:	7 kg/m^2
Medium duty	:	5 kg/m^2
Light duty	:	3 kg/m^2

Glass strips (4 mm thk.) or aluminum dividing strips shall be used for farming the panels.

Acid Resistant Tile Finish

This shall include all varieties of special tiles used for specific chemical/acid resistance function and an underbed over already laid concrete or masonry.

Thickness

The total thickness of finish shall be 50 mm of which the tile shall be 25 mm, acid proof mortar 6 mm, bitumen 3 mm and cement mortar underbed 15 mm.

Tiles

The tiles shall be of best approved manufacture, conforming to IS:4457 and resistant to the chemical likely to come in contact. The tiles shall have straight edges, uniform thickness, plain surface, uniform non-fading colour and textures. The water absorption after 24 hours of soaking shall not be more than 2% by weight. The compressive strength of tiles shall not be less than 700 kg/cm2. The surface shall be abrasion resistant and durable.

Underbed

The underbed shall be laid in three layers. The first layer shall be composed for 1 part cement and 3 parts river sand with just enough water to make the mix workable. This layer shall be troveled level and curved with water for atleast 3 days prior to application of the second layer. The second layer

consist of 3 mm thick hot blown bitumen conforming to IS:702 of grade 85/25 and shall be applied in three coats with brush or spray. The third layer of acid proof mortar as specified by manufacturer shall be applied . The acid proof mortar shall have chemical resistant properties equal to that of the floor tiles.

Laying

The tiles shall be embedded in the acid proof mortar and the gap between the tiles shall be grouted to the full depth of tile. The setting and fixing shall be strictly as per the manufacturer's specification and shall be approved by the Engineer.

Curing

The joints in the floor shall be cured with the solution of 25% proof hydrochloric acid or as specified by the manufacturer.

Ceramic Floor Tile/Glazed Wall Tile Finish

This finish shall be composed of glazed earthen ware tiles with an underbed laid over a concrete or masonry base.

Thickness

The total thickness shall be between 20 mm and 25 mm including the underbed.

The tile finish on vertical surface shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the finish, to accommodate the specified thickness shall be done.

Tiles

The glazed tiles shall be of earthenware, covered with glaze, white or coloured, plain or with designs, of 100 mm x 100 mm nominal sizes and 5 mm thick, unless otherwise specified. Ceramic floor tiles shall be of matt finish, white or coloured, plain or with designs of 150 mm x 150 mm nominal size and 6 mm thick, unless otherwise specified. The tolerance shall be ± 1.5 mm for length and breadth and ± 0.5 mm for thickness.

Specials like internal and external angles, beads, coves, cornices, corner pieces etc. shall match. The top surface of the tiles shall be glazed with a gloss or matt unfading stable finish as desired by the Engineer. The tiles shall be flat and true to shape. The colour shall be uniform and fractured section shall be fine grained in textures, dense homogenous. The tiles shall be strong and free from flaws like cracks, chips, craze, specks, crawlings etc. and other imperfections. The edges and the underside of the tiles shall be completely free from glaze and the underside shall have ribs or indentations for better anchorage with the fixing mortar. The coloured tiles, when supplied, shall preferably come from one batch to avoid difference in colour.

Underbed

The mix for the underbed shall consist of 1 part cement and 3 parts coarse sand by weight mixed with sufficient water or any other mix if specified.

Laying

Procedure for laying shall be same as that for precast terrazo tiles.

Finishing

The joints shall be cleaned and flush pointed with white cement and cured for seven (7) days by keeping it wet. The surface shall be cleaned with soap or suitable detergent, washed fully and wiped with soft cloth to prevent scratching before handing over.

8.1.8 Doors, Windows, Louvres, Rolling Shutters & Glazing

SCOPE

This specification covers the requirements in respect of materials, workmanship and quality for doors, windows, louvers, Rolling Shutters and glazing work.

CODES AND STANDARDS

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Bureau of Indian Standards and all other such as may be published by them during the currency of the Contract, shall govern in respect of design, workmanship, quality and properties of materials and method of testing. Some of the relevant available codes are listed hereunder:

Metal Doors & Windows

IS:733 Wrought aluminium and aluminium alloy bars, rods and sections (for general engineering purposes)

IS:1038 Steel doors, windows and ventilators

IS:1361 Steel windows for industrial buildings

IS:1948 Aluminium doors, windows and ventilators

IS:1949 Aluminium windows for industrial buildings.

IS:4351 Steel door frames

Timber Doors

IS:4021 Timber door, window and ventilator frames

IS:1003 Timber paneled and glazed shutters.

IS:2191 Wooden flush door shutter (cellular and hollow core type)

IS:2202 Wooden flush door shutters (solid core type)

Rolling Shutters

IS:6248 Metal rolling shutters and rolling grills

Glazing

IS:1081 Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators

IS:2835 Flat transparent sheet glass for glazing and framing purposes

IS:3548 Code of practice for glazing in buildings

Builder's Hardware

IS:204 Tower bolts

IS:205 Non-ferrous metal butt hinges

IS:208 Door handles

IS:281 Mild steel sliding door bolts for use with padlocks

IS:363 Hasps and staples

IS:723 Steel counter sunk head wire nails

IS:1823 Floor door stoppers

IS:2209 Mortice locks (vertical type)

IS:2681 Non-ferrous metal sliding door bolts for use with padlocks

IS:3564 Door closers (hydraulically regulated)

IS:3847 Mortice night latches

IS:4992 Door handles for mortice locks (vertical types)

IS:6607 Rebated mortice locks (vertical type)

Materials & Workmanship

Steel doors, Windows, Ventilators Etc.

Door Frames

Frames shall be rolled or pressed sections from 18 g sheet conforming to IS:4351. They shall be mortised, reinforced, drilled and tapped for hinges and lock and bolt strikes Where necessary, frames shall be reinforced for door closures. Welded construction with mitred corners shall be used. Rubber door silencers shall be furnished for the striking jamb. Loose 'T' masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be supplied. Frames shall be brought to site with floor ties/ weather bars installed in place.

Double Plate Flush Door Shutters

Door shutters shall be 45 mm thick, completely flush design and shall comprise of two outer sheets of 18 g steel sheets, rigidly connected and reinforced inside with continuous vertical 20 g stiffeners, spot welded in position at no more than 150 mm on centers. Both edges of doors shall be joined and reinforced full height by steel channels placed immediately inside and welded to the door faces. Top and bottom of doors shall be reinforced horizontally by steel channels running full width of door. Doors shall not have more than 2.5 mm clearance at jambs and head, shall have proper bevel on lock stiles and rails to operate without binding, and shall be reinforced at corners to prevent sagging or twisting. Pairs or double doors shall have meeting-stile edges beveled or rebated.

Doors shall be mortised, reinforced, drilled and tapped in shop for hinges, locks and bolts. They shall also be reinforced for closures, push-plates and other surface hardwares where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where necessary, provision shall be made for fixing glazing, vision panels, louvres etc. glazing mouldings shall be of 18 g steel and suitable for fixing 6 mm glass. Louvre blades shall be V or Z shaped and made out of 16 g sheets.

Sliding Doors

Sliding doors shall be double plate construction made out of 18 g steel sheets with adequate stiffness. The Contractor need specify the weight of the door in his shop drawing and submit the manufacturer's catalogue of the sliding gear he proposes to use. Where shown on drawings, the Contractor need make provisions for openings in the door for mono-rail beams. Doors shall close positively to exclude rain water from seeping in. Sliding doors shall withstand specified wind loads without buckling or jamming. The door shall slide freely under all ambient conditions.

Steel Windows, Sashes, Ventilators, etc.

These shall conform in all respects to IS:1038 and IS:1361. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, pivot arrangements for ventilators, etc.

All welds shall be dressed flush on all exposed and contact surfaces.

Where composite unit openings are provided the individual window units shall be joined together with requisite transoms and mullions. All windows shall be outside glazed, fixed with metal glazing beads.

All welds at the corner of casement shall be done by flash butt welding process and dressed flush on all exposed and contact surfaces.

Aluminum Doors, Windows and Frames

Aluminum sections for fabricating doors, windows, partitions etc., shall be extruded sections conforming to IS:1948 & IS:1949 or as manufactured by Indian Aluminium Company Ltd. or approved equivalent. The alloy used shall conform to IS designation HE 9-WP of IS:733.

Extruded sections shall have a 3.18 mm wall thickness and shutter shall have 2.0 mm thickness . All sections shall be approved by the Engineer before fabrication is taken up. Doors, frames, mullions, transoms etc. shall be anodized in a bath of sulphuric acid to provide a clear coating of minimum 0.06 mm thickness. The anodized materials shall then be sealed by immersing in boiling water for 15 minutes. A protective transparent coating shall be applied to the sections before shipment from the factory.

All work shall be fitted and shop assembled to a first class job, and ready for erection. Shop joints shall be made to hair lines and then welded or braced by such method as will produce a uniform colour throughout the work. Work on the above, other than described, shall be neatly finished with concealed fasteners. Glazing beads shall be snap fit type, without visible screws and shall be of sizes to accommodate 6 mm thick glazing.

PVC Doors & Windows

PVC doors and windows shall be obtained from reputed manufacturers and shall be SINTEX or approved equivalent quality. The material used shall be unplasticised PVC having superior impact resistance. Density of the material shall be 1.4 grams/cm3 and tensile stress and bending stress of 480 and 770 kilopascal/cm^2 . The outer section wall thickness shall be min. 2.8 mm.

The section shall be reinforced with steel sections concealed inside a cavity of PVC sections. Corners shall be welded, transome/mullions welded or mechanically joined. Weather sealing shall be by double sealing with elastomeric weather strip, the corners being glued.

Opening for PVC doors/windows shall be 10 mm more than the window/door size.

The doors shall be fixed to the wall by expandable fasteners or by brackets. Manufacturer's recommendation shall be followed for installation.

Rolling shutter (Hand operated, Mechanical gear operated and Electrically operated)

Rolling shutters shall be fabricated from 18 gauge steel and machine rolled with 75 mm rolling centres with effective bridge depth of 12 mm lath sections, interlocked with each other and ends locked with malleable cast iron clips to IS:2108 and shall be designed to withstand a wind load of 200 Kg/m2 without excessive deflection.

The guides shall be either rolled or pressed deep channel sections 75 mm and 25 mm wide fitted with necessary fitting and fixtures.

The suspension shaft shall be formed from heavy duty tubes conforming to IS:1161 and of sufficient diameter so as to resist deflection due to weight of the rolling shutter. The deflection shall not exceed 5 mm/ meter width. The shaft shall be provided with CI pulleys and helical springs for counter balancing the weight of the shutter adequately.

The springs shall be approved high tensile flat springs conforming to Grade 2 of IS:4454. These shall be fitted inside the fabricated housing of either ends which counter-balance the shutter curtain.

The ball bearings shall be double row self-aligning ball bearings fitted inside C.I. housing fixed on side brackets holding the suspension shaft at either end. The roller assembly shall be designed so as to be capable of producing sufficient torque to ensure easy operation of the rolling shutter in any position. The spring tension shall be adjustable by means of suitable adjustments holes drilled on the rims of the pulley.

The hood cover shall be made of 20 gauge galvanized sheets with necessary stiffeners and framework to prevent sag. The bottom lock plate shall be made of 5 mm thick M.S. plate and 95 mm wide reinforced with angle/T iron of suitable section with 6 mm dia M.S. rivets interlocked with last stride of curtain.

The locking arrangement shall consist of sliding bolts at both ends of the bottom plate fitted to engage with suitable receiving pockets at the bottom of guide channels.

Unless otherwise specified, for overall area of rolling, shutters up to 9 sq.m pull and push type hand-operated shutters shall be used; for area between 9 and 12 sq.m pull and push type shutters shall be provided with ball bearings; for area larger than 12 sq.m mechanical gear type or electrically operated shutters shall be supplied.

Glazing

Glass for glazing shall be of the following types:

4 mm thick transparent sheet glass conforming to IS:2835 generally used for openable shutters of windows.

5.5 mm thick wired glass conforming to IS:5437 generally used for fixed shutters of windows.

6.3 mm thick laminated safety glass conforming to IS:2553 generally used for fixed glazed partitions.

5.5 mm thick transparent sheet glass used for aluminium glazed doors.

All glass shall be cut according to the sizes required as per drawings. Glazing of metal doors, windows and ventilations shall conform to IS:1081 either with putty or metal clips. The Contractor need thoroughly clean all glass and replace all putty or glass damaged during the work.

Storage and Handling

All metal doors, windows etc. shall be packed and crated properly before despatch and shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminium products by rust or mortar etc. Glass shall be brought to site in manufacturer's original packing.

Assembly and Erection

The Contractor need assemble and install all doors, windows, louvers, etc. including transoms mullions for composite units in respective places keeping proper lines and levels, and in approved workman like manner, to give trouble free and leak proof installations. The installations shall be done according to the instructions of the manufacturer and/or as approved by the Engineer. If required by the Engineer, the installation shall have to be carried out under the supervision of the manufacturer's staff.

After installation of steel doors, windows etc. all abrasions to shop-coat of paint shall be retouched and made good with the same quality of paint in shop coat. All coupling mullions, transoms, frames etc. in contact with adjacent steel and other members shall be well bedded in mastic. Door shutters, partitions, hardware fixtures shall be fixed only after major equipments have been installed in rooms.

Hardware and Fixtures

Hardware and fixtures shall be best quality from the approved manufacturers and shall conform to the relevant IS specification and able to withstand repeated use. The Contractor has to provide the required number / size of fixtures for trouble free operation and adequate strength. Door closers shall be suitable for shutter weight and shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or the door closer replaced without extra cost to the Owner.

The Contractor need submit samples of each type of hardware to the Engineer and the approved samples shall be retained by the Engineer for comparison with bulk supply.

8.1.9 Painting, colour washing etc.,

Scope

This specification covers the requirements in respect of materials, workmanship and quality for finishing works, such as white washing, colour washing, distempering and painting to masonry, concrete, timber and metal surfaces of doors, windows, rolling shutters etc. Separate specifications shall be referred for painting of structural steel work.

Codes and Standards

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Indian Standards Institution and all other such as may be published by them during the currency of the Contract, shall govern in respect of design, workmanship, quality and properties of materials and method of testing. Some of the relevant available codes are listed hereunder:

Whitewashing, colour washing and distempering

IS:427	Distemper, dry colour as required
IS:428	Distemper, oil emulsion, colour as required
IS:6278	Code of practice for white washing and colour washing

Painting

IS:5	Colours for ready mixed paints and enamels
IS:102	Ready mixed paint, brushing, red lead, non-setting, priming
IS:123	Ready mixed paint, brushing, finishing, semigloss, for general purposes
IS:1477	Code of practice for painting of ferrous metals in buildings
IS:2074	Ready mixed paint, air drying, red oxide-zinc chrome, priming
IS:2338	Code of practice for finishing of wood and wood based materials.
IS:2339	Aluminium paint for general purposes in dual container
IS:2395	Code of practice for painting concrete, masonry and plaster surface
IS:2932	Enamel, synthetic, exterior, a) undercoating, b) finishing.
IS:2933	Enamel, exterior, a) under coating, b) finishing.
IS:5410	Specification for cement paint, colour as required
IS:5411	Specification for plastic emulsion paint

Materials

Distemper

Dry Distemper shall be made from suitable pigments, extenders lime proof tinters, water soluble binders confirming to IS:427. Oil bound washable distemper shall be of oil emulsion type containing suitable preservatives confirming to IS:428.

Gum and blue pigment

Gum and blue pigment for white wash shall be of best quality and of approved make.

Waterproof Cement Paint

Waterproof cement paint shall be made from best quality white cement and lime resistant colours with accelerators, water proofing agents and fungicides. The paint shall confirm to IS:5410.

Paint

The painting and finishing materials for use in the work shall conform to relevant Indian Standards specifications and shall be best brands of approved make produced for each kind of work. Aluminium paint shall be in two back containers and shall resist weathering.

The acrylic emulsion paint, after it is dried, shall be able to withstand washing with mild soap and water without any deterioration in colour or without showing flaking, blistering or peeling.

Primer coat

Unless otherwise specified, the primer coat for concrete, steel and iron work shall be as specified by the manufacturer.

Whitewashing, Colour Washing and Distempering

Mixing

The slaked lime shall be screened to pass through a sieve of 49 meshes per sq.cm. and dissolved in a tub with sufficient quantity of water and shall be well mixed to give a thin creamy consistency. It shall then be strained through a clean coarse cloth and clean gum dissolved in hot water added to it at the rate of 2 kg for each cubic meter of lime and ultramarine blue added to the mixture in small proportion just sufficient to give a very light bluish tint.

Colour wash shall be prepared in the same way as for white washing except that necessary amount of colouring matter shall be added to lime wash to obtain the colour specified. No blue shall be added

in this case. The entire quantity shall be mixed strictly in accordance with the manufacturer's instructions unless these are varied by the Engineer.

Distemper shall not be mixed in a larger quantity than is actually required for a day's work and hot water shall be used in preparing the mixture.

Preparation of Surface

Before whitewash is laid on new wall, the surface of wall shall be well cleaned and brushed and all patching must be scraped properly. After cleaning the surface, all holes, cracks and patches shall be made good with approved materials.

Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surface and finished with cement wash. For all internal painting the surface shall be made smooth by application of approved paste fillers before applying primer.

The distemper shall not be applied on damp walls and shall be applied in dry weather. The surface to be distempered shall be thoroughly cleaned of dust, dirt, grease, oil marks, cement marks, loose scales etc. and rubbed with sand paper to give a uniform smooth surface.

Workmanship

White wash shall be applied with brush, each coat consisting of vertical stroke from top downwards followed by opposite stroke upwards over the first stroke and horizontal stroke from left to right followed by stroke right to left. Each coat must be allowed to dry before the next coat is applied. On completion, the surface when it becomes dry, shall present a uniform white appearance. When dry, no coat of white wash shall show any patches, haircracks or streaks nor shall it come off when rubbed with hands. White washing shall be done in 3 coats unless otherwise specified. Doors, windows, floors etc. must be protected from white wash splashes. Any splashes and droppings shall be removed and cleaned.

Colour wash shall be applied in the same manner as specified for white wash. During application, the solution shall be stirred continuously and wash shall be applied with care to avoid any cut shade or brush marks on the walls when the work is complete. For all new work, the surface to be colour washed shall first be treated with a priming coat of lime wash. Unless otherwise specified, two coats of white wash shall first be applied before colour wash is applied. The colour wash, whether applied inside or outside of a building shall be of uniform tint and shade.

The workmanship for distempering shall conform to IS:427 and IS:428 unless specified otherwise. Distempering shall be done with proper distemper brushes of approved quality. The finished surface shall be of absolutely uniform shade throughout and free from brush marks. On drying, the distemper shall not come off on touch and shall not crack. Distemper shall be applied in two coats over one coat of priming. The priming coat shall be as specified and the primer shall be in accordance with the recommendation of the manufacturer. Before applying the primer, the plastered surface shall be

washed with a solution of 100 gm of zinc sulphate to one litre of water and then allowed to dry. Succeeding coats shall not be applied until the previous coat has been approved by the Engineer. The first coat shall always be of a lighter tint and shall be applied with care. In case the finish is not up to the standards, the entire surface shall be sand-papered and a fresh coat or coats of distemper shall be supplied without any extra cost.

All decorative moldings, cornices, bands etc. shall be finished according to detailed drawings. All splashes of distemper shall be removed by the Contractor at his own cost.

The surface to be coated with water proof cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After four to six hours, water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours), the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

Painting

Preparation of surface

The surfaces of iron and steel work to be painted shall be cleaned free of dirt, oil, rust, mill scale and be thoroughly dry before painting. Cleaning, degreasing, derusting and descaling wherever necessary shall be carried out as specified in IS:1477 (Part I). All galvanised iron surfaces shall be pre-treated with a compatible primer according to the manufacturer's direction.

The surfaces of wood shall be rubbed down smooth. All nails and screws shall be sunk below the surface and filled with mastic after applying an under coat. Small knots that do not justify cutting and sap streaks shall be covered with minimum two coats of pure shellac coating applied thinly and extended 25 mm beyond the area. All large, loose or resinous knots shall be removed and filled with sound wood. All work shall be done as per IS:2338.

Application

Painting of iron and steel work shall generally be carried out as per IS:1477.

The paint manufacturer's specification/instructions shall be followed as far as possible at all times. Particular attention shall be paid to the following:

a. Proper storage to avoid exposure, as well as extremes of temperature.

b. Surface preparation prior to painting

c. Mixing and thinning

d. Application of paints and the recommended time limit on time intervals between coats.

Painting operations shall not proceed until the Engineer has the opportunity to inspect the condition of prepared surface to be painted. Paint shall be thoroughly mixed and not more than 1/2 kg of recommended thinner per 4.5 kg litrers of paint shall be added if thinning is necessary. Exterior paint shall not be performed during the period of inclement weather. Interior painting may proceed during such periods only with the approval of the Engineer. Prior to application of subsequent coat, the Engineer shall be given the opportunity to inspect the prior coat. Should the work be judged by the Engineer be inferior, a supplementary coat shall be applied at no additional cost.

The number of coats including the primer coat shall be applied as specified. Each coat shall be allowed to dry sufficiently before the succeeding coat is applied.

The type of intermediate and finish coat and the number of coats to be applied shall be as specified. Intermediate and finish coats may be oil bound, bituminous, aluminium or other types of paints. The intermediate and finish coats for structural steel work, sheet metal work and cast iron work shall be applied as specified in IS:1477 (Part II).

Alternatively, RC shall provide painting/protective coating as per their standards. However, prior approval shall be sought from SEPC for the same.

Acceptance Criteria

a) All the painted surface shall be uniform and pleasing in appearance.

b) The colour, texture etc. shall match exactly with those of approved samples.

c) All stains, splashes and splatters of paints shall be removed from surrounding surface.

8.1.10 Waterproofing

Scope

This specification covers the requirements in respect of materials, workmanship and quality for water proofing of roofs and underground structures.

Codes and Standards

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Bureau of Indian Standards and all other such as may be published by them during the currency of the contract, shall govern in respect of design, workmanship, quality and properties of materials and method of testing. Some of the relevant available codes are listed hereunder:

IS:2645 Integrated cement water proofing compounds (1987)

IS:3067 and water- Code of practice for general design details and preparatory work for damp-proofing proofing of building.

Materials

Elastomeric water proofing treatment for roof water proofing.

A roof shall be provided with roof water proofing treatment using high solid content liquid applied elastomeric water proofing membrane with separate wearing course as per ASTM-C-836 & 898. Thickness of the membrane shall be 1.5mm (min). This treatment shall include application of polymerized mastic over the roof to achieve smooth surface and primer coat. Wearing course on the top of membrane shall consist of 25mm thick PCC (1:2:4) cast in panels of maximum 1.2x1.2m size and reinforced with 0.56mm dia galvanized chicken wire mesh and sealing joints using sealing compound / elastomeric water proofing membrane. However, Chequered concrete tile flooring 22mm (min) thick of approved colour and shade conforming to IS:13801 shall be provided for path way of 1m width for access of personnel and handling of equipment like A/C ventilation plant are provided in place of PCC wearing course. Equipment shall be installed on raised pedestal of minimum 30 cm height from the finished roof to facilitate maintenance of roof treatment in future.

Acrylic based polymer coating for underground water proofing.

For basement type of structures, internal/external surface shall be provided with acrylic based polymer modified cementitious coating system. For external application wherever the surface is in contact with the earth, fine silica/quartz and of 0.6 mm nominal size shall be added in the coating mix for better abrasion resistance and total nominal thickness of such coating shall be minimum 1.5mm.

Acceptance Criteria

The slopes and surface level shall be such as to allow quick draining of water without leaving any pool anywhere. The finishing course shall be fully secured and shall have an even density. There shall not be any bubble formation or crushed or squeezed insulation or underbed.

The Contractor need give a guarantee in writing for all works executed under this specification supplemented by a separate and unilateral guarantee from the specialised agency for the water proofing treatment work. The guarantee shall be for materials and workmanship for Ten (10) years.

False Flooring

The false floor system to be installed shall provide a maximum finished floor height of 750mm from the existing floor level. The system shall provide for suitable pedestal and under structure design to withstand various static loads and rolling loads. The entire access floor system shall provide for adequate fire resistance, acoustic barrier and air leakage resistance. The system shall be able to accept an independent floor covering i.e. antistatic PVC/ Laminate with PVC beading. The under structure should be able to withstand a UDL of 1080 Kg/m2 and a point load of 360kg. The under structure should be able to accept a pedestal axial load of 2200kg. Panels should be made from steel. The bottom of panel shall be embossed in hemispherical shape to give strength and flexural rigidity. The top sheet shall be plain and resistant welded at

various locations after the top and bottom sheets have been degreased and phosphated. The above hollow panel shall have an infill of light weight cementitious material. The entire panel shall be coated with epoxy coating on the exposed surface. The surface shall have factory laminated anti – static PVC/ Laminate with PVC beading on all sides for edge protection. Panel shall provide for impact resistance top surface minimal deflection, corrosion resistance properties and shall not be combustible or aid surface spread of flame. Panel shall be free standing on to the under structure with stringers. Pedestal installation to support the panel shall be suitable to achieve a minimum finished floor height of 750mm height of 750mm from the existing floor level. Pedestal shall support an axial load of 3500kg.

False Ceiling and Roof Insulation

All air conditioned areas shall be provided with the suspended false ceiling system. Under deck insulation system shall be provided on the underside of the roof/floor slab of the air conditioned areas based on the functional requirement. Ceiling of air washer room shall also be provided with under deck insulation.

Gypsum / Armstrong (to match with existing facility) false ceiling system shall comprise of 84mm wide 12.5mm 6deep closed type plain panels of approved colour, roll formed out of 0.5mm thick corrosion resistant aluminium alloy AA 5050 fixed on roll formed carriers. Additional hangers and height adjustment clips shall be provided for return air grills, supply air diffusers, light fixtures, Ac ducts etc.

Permanent colour coated square panelled suitable size for electrical fixing aluminium false ceiling system shall be provided. The suspension system shall consist of 6mm dia galvanised steel rods suspended from ceiling supporting aluminium grid of 38x25x1.5mm and cross tie of 25x25x1.5mm and aluminium angle of 25x25x1.5mm.

Suitable MS channel (minimum ISMC 100) grid shall be provided above false ceiling for movement of personnel to facilitate maintenance of lighting fixtures, AC ducts, etc.

Contractor need prepare a layout of the false ceiling system incorporating light fixtures, supply air diffuser, return air grills, fire protection sprinklers, etc. such that the ceiling looks aesthetically pleasing. Work shall commence only after the Owner approves the layout.

Under deck insulation shall comprise of 50 thick PUF material of density 36 kg/cubic meter. This mat shall be backed with 0.05mm thick aluminium foil and 24Gx25mm wire mesh netting. They shall be fixed to ceiling or wall as the case may be with 100x50x6 slotted mild steel plate welded to MS plate inserts embedded at the soffit of the slab at 600mm c/c and 14 G steel wire drawn through slots and fixed to wire netting.

Installation

The Contractor need prepare a layout for false ceiling showing the framing and the cut outs for AC/Electrical fixtures and other services and get the same approved before commencement of work.

Fixing of Ceiling and Floor Panels

The Contractor need submit sample panels and get the approval of the Engineer. Installation of ceiling and floor panels shall be strictly as per manufacturer's instruction. The hold down clips for ceiling panels shall be used at the rate of minimum one per 1.2 metre length of perimeter or as per manufacturer's specification. These shall however be omitted in access panels which shall be located as per the instruction of the Engineer.

Finished ceiling and floor shall be at the correct plane and present a pleasing and uniform appearance, free from sags, wraps, disfigured or damaged boards. Joints, exposed grids etc. shall be in true lines and symmetrically placed.

Acceptance Criteria

Finished ceiling and floor shall be at the correct plane and present a pleasing and uniform appearance, free from sags, warps, disfigured or damaged boards. Joints, exposed grids etc. shall be in true lines and symmetrically placed in manner shown on drawings. Cutouts for light fixtures, diffusers, cable ducts etc. shall be to the exact dimensions and in exact locations.

8.1.11 Water Supply, Drainage and Sanitary Works

Scope

This specification covers the requirements in respect of materials, installation and quality for water supply, drainage and sanitary works.

Codes and Standards

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Bureau of Indian Standards and all other such as may be published by them during the currency of the Contract, shall govern in respect of design, workmanship, quality and properties of materials and methods of testing. Some of the relevant available codes are listed hereunder:

Roof Drainage System

IS:1230 Cast iron rainwater pipes and fittings

IS:1626 Asbestos cement building pipes, gutters and fittings (spigot and socket type)

IS:1729 Specification for sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.

IS:1742 Code of practice for building drainage.

IS:2527 Code of practice for fixing rainwater gutters and down pipes for roof drainage

Pipes and fittings for sanitary plumbing and drainage

IS:404 Lead pipes

IS:405 Lead sheet and strip

IS:458 Concrete pipes (with and without reinforcements)

IS:651 Salt glazed stoneware pipes and fittings

IS:77 Glazed fire clay sanitary appliances

IS:774 Flushing cistern for water-closets and urinals (other than plastic cisterns)

IS:775 Cast iron brackets and supports for wash basins and sinks

IS:778 Copper alloy gate, globe and check valves for water works purposes.

IS:781 Cast copper alloy screw down bib taps and stop valves for water services

IS:782 Caulking lead

IS:783 Code of practice for laying of concrete pipes

IS:804 Rectangular pressed steel tanks

IS:1172 Code of basic requirement for water supply drainage and sanitation

IS:1239 Mild steel tubes and tubulars and other wrought steel fittings

IS:1536 Centrifugally cast(spun) iron pressure pipes for water, gas and sewage

IS:1537 Vertically cast iron pressure pipes for water, gas and sewage.

IS:1703 Ball valves (horizontal plunger type) including floats for water supply purposes

IS:1711 Self closing taps for water supply purposes

IS:1726 Cast iron manhole covers and frames

IS:1742 Code of practice for building drainage

IS:1795 Pillar taps for water supply purposes

IS:2065 Code of practice for water supply in buildings

IS:2104 Water meter boxes (domestic type)

IS:2326 Automatic flushing cisterns for urinals (other than plastic cisterns)

IS:2470 Code of practice for installation of septic tanks

IS:2548 Plastic seats and covers for water-closet

IS:2556Vitreous sanitary appliance (vitreous china)

IS:2963Copper alloy waste-fittings for wash basins and sinks

IS:3004Plug cocks for water supply purposes

IS:3006Chemically resistant glazed stoneware pipes and fittings

IS:3076Low density polyethylene pipes for potable water supplies

IS:3114Codes and practice for laying of cast iron pipes

IS:3311Waste plug and its accessories for sinks and wash basins

IS:3486Cast iron spigot and socket drain pipes

IS:3597Methods of test for concrete pipes

IS:4127Code of practice for laying of glazed stoneware pipes

IS:4346Washers for use with fittings for water services

IS:4984Specification for high density polyethylene (HDPE) pipes for potable water supplies, sewage and industrial effluents

IS:4985Unplasticized PVC pipes for potable water supplies

IS:5219Cast copper alloy traps (`P' & `S' (Part-I) traps)

IS:5329Code of practice for sanitary pipe work above ground for buildings

IS:5961Cast iron gratings for drainage purposes

IS:7634Code of practice for plastic pipe work for potable water supplies

IS:8008Injection moulded high density polyethylene (HDPE) fittings for potable water supplies

IS:10124 Fabricated PVC fittings for potable water supplies

Materials

Sanitary Fittings

All sanitary fittings shall be procured from approved vendors and shall conform to the requirements of the relevant IS Codes listed above. The sizes shall be as specified in the General Technical Specification, where not specified, the same shall be as per Engineer's approval.

Glazed earthernware fittings shall be of Hindustan Sanitary ware or approved equivalent make, white colour and one piece construction. All metallic fixtures like taps, stop cocks, soap holders etc. shall be of Chromium Plated (CP) brass, GEM or approved equivalent make. PVC fixtures shall be of CALIPLAST

or approved equivalent make. All wall fittings shall be fixed with wooden cleats and CP brass screws and washers.

Pipes and Fittings

Pipes and specials shall be of standard quality conforming to IS:3486.

Stoneware pipes shall conform to IS:651.

RCC pipes for underground sewer shall be P1 class conforming to IS:450.

Cast Iron rain water pipes shall conform to IS:1230.

Water supply lines of PVC, HDPE shall conform to IS:239, IS:4985 and IS:4984 respectively. PVC fittings for water supply lines shall conform to IS:10124.

The Contractor need submit to the Engineer samples of all materials, fittings and appliances for approval well in advance of starting the work. All materials, fittings and appliances used in the work shall conform to the approved samples.

General

All water supply, drainage and sanitary works shall be executed by a licensed or authorised plumbing supervisor or a license or authorised plumber and shall be in accordance with the requirements of IS:1742 and other relevant codes.

For items such as earthworks, excavation, concrete, brick work, stonework, painting etc. relevant specifications for these shall apply, unless other wise specified.

Unless otherwise specified, all exposed work such as cistens, brackets etc. shall be painted with one coat of red oxide paint and two coats of oil paint of approved colour.

The diameter of pipes and fittings wherever mentioned shall mean the internal diameter or nominal bore, unless otherwise specified.

The job shall include the cost of making necessary chases, holes etc., in walls, floors and in other places and also making good on completion of the works. Any damage caused to floors, walls etc. during execution of the sanitary and plumbing works shall be made good by the Contractor at his own cost to the satisfaction of the Engineer.

Installation

All execution will be done on the basis of drawings /instruction given by the Engineer. Fittings meant for operation shall be located and oriented to allow easy reach and operation, maintenance, repairs and replacements of pipes, fittings and fixtures must be conveniently possible.

High Density Polyethylene water supply pipes

All high density polyethylene pipes shall have screwed ends and shall be jointed with screwed fittings of the same materials of that of the pipes. Any burrs remaining on the pipe ends after cutting threads shall be removed. If necessary, an approved jointing compound with a few strands of fine yarn may be used for jointing pipes and fittings. All exposed high density polyethylene pipes shall be installed with PVC saddles screwed on 25 mm thick wooden blocks securely fixed on walls at suitable intervals, not exceeding 1 m. Pipe wherever installed in wall chasing shall be fixed as in the case of galvansised steel pipes.

PVC water supply pipes

All exposed pipes shall be installed with PVC saddles screwed on 25 mm thick wooden blocks securely fixed on walls at suitable intervals, not exceeding 1 m. Pipe wherever installed in wall chasing shall be fixed as in the case of galvanised steel pipes.

Septic tank and effluent disposal

Septic Tank

Septic tank shall consist of the masonry tank with inlet and outlets there from complete with all necessary earthwork and backfilling. The details of septic tank shall be as per IS:2470.

This item shall also include ventilating pipe of at least 100 mm dia whose top shall be provided with a suitable mosquito proof wire meshes and cowl. Ventilating pipe shall extend to a height of about 2 meter when the septic tank is at least 15 meter away from the nearest building and to a height of 2 meter above the top of building when it is located closer than 15 meter. Ventilating pipes can be connected to the normal soil ventilating system of the building where allowed.

After the Septic tank has been proved water tight and the sewage system is checked, the tank shall be filled with water to its outlet before the sewage is let into the tank. It shall be seeded with well digested sludge obtained from septic tank or sludge digestion tank. In the absence of digested sludge, small quantity of decaying organic matter such as digested cowdung may be introduced.

Effluent Disposal

The effluent from the septic tank shall be disposed by any of the following methods depending on the project requirements.

- Connecting to a treatment plant.
- Connecting to soak pit for absorption by soil.
- Allowing to be absorbed by soil through open jointed stoneware pipes laid in a trench filled with broken bricks.

Soak pit

It shall consist of a 900 mm dia pit 1000 mm in depth below the invert level of the inlet pipe. The pit shall be lined with stone, brick or concrete blocks set in cement mortal (1:6) and filled with brick bats. Inlet pipe shall be taken down to a depth of 900 mm from the top as an anti-mosquito measure.

Open jointed S.W. pipe/Dispersion trenches

Minimum dia of S.W. pipe shall be 150 mm nominal. The trench for laying pipe shall be minimum 600 mm depth. The joints of the pipes shall be left unsealed. The entire length of the pipe within the trench shall be buried in a 250 mm layer gravel or crushed stone of uniform size on top of the gravel/ crushed stone layer is a 150 mm bed of well graded coarse aggregate. Ordinary soil is used for filling the top of the trench.

Inspection pits and trap pits

Construction of pits shall commence only after the pipes have been laid in position to true line and levels as shown on the drawings and to the satisfaction of the Engineer.

Inspection pits

Unless otherwise specified, all inspection pits shall be constructed with rubble masonry in cement mortar (1:4). Half round channels of size suitable for the inlet and outlet pipe diameters shall be formed on the floor of the pit with PCC 1:3:6. The floor of the pit shall be haunched towards the channel as shown on the drawings. Inside of pits shall be finished with cement-sand plaster (1:4) and finished smooth with cement punning. Care shall be taken to avoid unevenness on the surface and sharp bends in the channel. The invert level after finishing shall be as shown in the drawings or as indicated by the Engineer.

Intercepting/master trap pits

The pits for the glazed stoneware master trap shall be constructed as indicated in the drawings. The construction and finishing of the pit shall be haunched towards the intercepting/master trap.

Gully trap pits

Gully trap pits shall be constructed as indicated in the drawings. The construction and finishing of the pit shall be as described above for inspection pits. The cast iron grating shall be set flush with the finished ground/floor level.

Sanitary appliances

All sanitary appliances shall be fixed in position rigidly on floor and walls as indicated in the drawings or as directed by the Engineer. All appliances shall be from the approved manufacturer and of approved colour.

Indian Water Closet - Squatting type (IWC)

Squatting type water closet shall be fitted on trap and shall be jointed with gasket yarn and cement mortar. Rim of the pan shall be leveled properly and set flush with the finished floor. The pan shall be connected to PVC low level push button/lever type cistern of 10 litre capacity. The flushing cistern shall be supported on a pair of CI cantilever brackets firmly embedded in the wall in cement mortar (1:4) or screwed to wall with suitable plugs. The flush pipe from the cistern shall be 32 mm dia tested quality Chromium Plated (CP) pipe and connected to the pan inlet by means of hemp and putty joint.

European Water Closet (EWC)- pedestal type

Pedestal type water closet shall be rigidly fixed on the finished floor by means of 75 mm long brass screws with suitable plugs. The flushing cistern shall be PVC low level push button/lever type cistern of 10 litres capacity. The cistern shall be supported on a pair of cast iron or rolled steel cantilever brackets firmly fixed on wall with brass screws and suitable plugs. The flush pipe from the cistern shall be 40 mm dia chromium plated brass end and fitted to the closet by means of rubber adopter. The closet shall be provided with double plastic seat cover conforming to IS:2548 and chromium plated hinges.

Urinals

Standing type urinals shall be firmly fitted on finished wall by means of 50 mm long brass screws and suitable plugs. Height of the lip from the standing point shall be as shown in the drawings. Urinals shall be fitted with automatic flushing cistern of 10/15 litres (2/3 urinals) capacity. Flushing pipes shall be of CP pipes of 25 mm dia and connected to the urinal with 15 mm dia PVC connector fitted with brass cap and lining at one end. The joint to the inlet of urinal shall be neatly finished with putty joints.

The arrangement of waste pipes and discharge to the floor trap shall be as shown on the drawings or as directed by Engineer. For single urinal the discharge may be direct to the floor trap through a 40 mm dia waste pipe. For a range of urinals, the discharge may be collected in a common waste pipe of 50 mm dia leading to the floor trap. Each urinal shall be connected to the common discharge pipe by 40 mm dia waste pipes. Alternatively, the discharge from each urinal through 40 mm dia pipe shall be lead to the 100 mm W.G half round channel laid on the floor leading to the floor trap.

Wash hand basin

Wash hand basin shall be fitted in position to true level on a pair of cast iron brackets plugs. The basin shall be fitted with 15 mm dia approved quality CP pillar tap and 32 mm dia waste fittings. The type of waste pipe and their connections shall be as shown in the drawings or as directed by the Engineer.

Sink

Stainless steel sink of shall be leveled properly and fitted in position on a pair of cast iron cantilever brackets firmly embedded in the wall in cement mortar (1:4). The sink shall be fitted with chromium

plated brass waste fittings of standard size. The type of waste pipes and their connections shall be as shown on the drawings or as directed by the Engineer.

Other miscellaneous fittings(e.g. mirror, towel rails, soap cases etc.)

All such fittings shall be of type and sizes specified in General Technical Specification and shall be fitted in position true to line, level and plane as shown on the drawings or as directed by the Engineer.

Water tanks

Water storage tanks shall be of SINTEX brand or approved equivalent make, unless otherwise specified.

In case large volume tank is to be constructed, the same shall be of GI, Masonry or RCC. They shall be fitted with a ball valve of the inlet pipe. A mosquito proof overflow pipe shall be fixed to the tank with the pipe invert about 25 mm above the top of water line. Approved type of stop valve shall be provided for every outlet pipe. All outlet and inlet pipes shall be fixed as shown in the drawings. Inside surface of galvanised steel tanks shall be painted with anti-corrosive drinking water paints.

All storage tanks, water supply fittings and pipes before being put into commission shall be disinfected with liquid chlorine by the Contractor at his own cost.

Testing and Acceptance Criteria

All sanitary appliances and fittings shall be inspected and tested as per the requirements of IS:1742. All defects and deficiencies detected shall be promptly rectified by the Contractor to the satisfaction of Engineer.

8.1.12 Fencing & Gate

SCOPE

This specification covers the requirements in respect of materials, workmanship and quality for chain link / barbed wire fencing fixed on M.S. angle posts or RCC precast posts.

Codes and Standards

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by the Bureau of Indian Standards and all other such as may be published by them during the currency of the Contract, shall govern in respect of design, workmanship, quality and properties of materials and methods of testing. Some of the relevant available codes are listed hereunder:

IS:278 Galvanised steel barbed wire for fencing

IS:1161 Steel tubes for structural purposes

IS:2062 Steel for general structural steel purposes

IS:2721Galvanised steel chain link fencing

Materials & Installation

Angle Iron Post

Angle Iron Post shall be rolled angle section conforming to IS:2062 and shall be double dip galvanized.

Precast Concrete Posts

Concrete mix shall be M:15 as per IS:456. Reinforcement shall be M.S. and/or torsteel bars.

Posts shall be cast in smooth steel forms made to correct dimensions as per drawing and concrete shall be compacted by table vibrators or needle vibrator to give smooth finish. Curing of concrete shall be done by submerging the posts in water tank for minimum 15 days.

Precast posts shall be installed in PCC 1:3:6 foundation, with a minimum embedment depth of at least 600 mm. Damage to the post shall be avoided during installation of the posts in position, aligning and leveling.

Diagonal post bolted to the vertical posts shall be provided at every eighth bay and on either side of the corner posts. Spacing of the posts shall be not greater than 3 m or as per drawing whichever is less.

All hardwares used shall be of hot-dip galvanised steel.

Chain link fence

Chain link shall conform to IS;2761. It shall be procured in rolls of appropriate length and width and shall consist of 10 G hot dip galvanised steel wires woven in the form of zigzag mesh giving an opening size of 50 mm square.

Chain link shall be secured to the posts with 6 mm dia GI hooks/rings.

Tension wire shall be provided passing through the mesh at top, centre and bottom of the erected chain link mesh and shall be of 3 mm dia hot dip galvanised wire and shall be stretched to keep the chain link in taut position. 25 mm x 6 mm GI flat stretcher bar shall be provided at the end posts to tie the tension wires.

Barbed wire fence

Barbed wire shall conform to IS:278

Barbed wire shall be made from hot dipped galvanised wire of 12 G, 2 ply with barbs of 16G spaced at 100 mm.

Barbed wire shall be procured in bundles of standard weights and shall be fully stretched across the posts and secured with G.I. hook bolts and washers.

Spacing of horizontal wires shall not be greater than 225 mm or as specified in the drawing. Diagonal wires shall be provided in each bay between two adjacent posts. No wire shall be left loose or sagging.

Transformer yard gate

Gate shall be fabricated out of tubular sections conforming to IS:1161 and shall be hot dipped galvanised. Outer frame shall be 65 NB (medium) tube and diagonal 50 NB (medium) tube. 50 mm sq. welded mesh with 4 mm dia GI wire fabric shall be welded to 25 mm x 6 mm thick GI flat which in turn shall be welded to the outer tubular frame. The gate shall be provided with 20 mm wide x 80 mm dia flat M.S. roller at the bottom. The gate frame shall be fixed to GI tubular post or RCC post.

Main gates

Workshop fabricated MS box section and square bar gate of approved design and specification. Contractor should take approval of Owner before procurement.

8.1.13 Road Works

Scope

This specification covers the requirement in respect of materials, workmanship and quality for road work like sub-grade preparation, sub-base layer, water bound macadam, bitumen macadam, premix carpet, concrete roads and pavements, drains, pipe culverts etc.,

Codes and Standards

Unless specifically mentioned otherwise, all applicable codes and standards in their latest editions as published by Indian Road Congress and Bureau of Indian Standards shall govern in respect of design, workmanship, quality and properties of materials and methods of testing.

Specification for road and bridge works of Ministry of Shipping & Transport (Roads wing) Published by IRC

Some of relevant available codes are listed here under.

IRC - 19 : Standard specification and code of practice for Water Bound Macadam.

IRC SP : 11 Hand Book of quality control for construction of roads and runways.

IRC - 47 : Standard specification and code of practice for bitumen road.

IRC - 48 : Standard specification for bitumen road's surface dressing using pre-coated aggregates.

IRC - SP - 11 : Hand book of quality control for construction for roads and runways.

IRC - 15 & 58 : Specification for Concrete Road.

IS : 458 : Specification fro Concrete Pipes.

IS : 783 : Code of Practice for Laying of Concrete Pipes.

IS : 2720 : Methods of Test of Soil (All parts).

IS : 73 : Specification for paving bitumen.

IS : 217 : Specification for cut back bitumen.

IS : 454 : Specification for digboi type cut back bitumen.

IS : 1200 : Method of measurement for road work including air field

(Part-17) : pavements.

IS : 456 : Code of Practice for Plain and Reinforced concrete.

IS : 1838 : Specification for Preformed fillers for expansion joints in concrete pavements and structures.

IS : 1834 : Specification for hot applied sealing compounds for joints in concrete.

IS : 6509 : Code of Practice for installation of joints in concrete pavements.

Roads

All roads shall be Bituminous roads. Shoulders shall be minimum 1 m wide. Minimum 150 mm thick subbase shall be approved earth material and compacted up to 95 % proctor dry density and 75 mm WBM shall be provided for shoulders and shall be followed as per construction drawing.

The main road (10 m wide at the entrance) to the plant originating from main approach road and 7m wide internal road with 1m shoulder on either side shall be constructed areas per layout. The crown of the road shall be minimum 250 mm above FGL. The final finished roads shall have a camber of 1 in 60. Camber on top of water bound macadam surface shall be 1 in 30. Construction of road shall be in accordance with **MORTH / IRC** specification.

The minimum recommended road section be as follows:

- Sub-base : Subbase shall consist of min 150 mm thk. Subbase shall be approved earth material and compacted up to 95 % proctor dry density with 150 mm thick Wet Mix Macadam (Compacted in two layers).
- Finish road : Thickness of bituminous will be decided based on CBR value and as per detailed design. Bitumen concrete (wearing course) 20 mm thick and premium seal coat 10 mm thick at top.

The thickness given above is the minimum requirement and it shall be checked and confirmed by the Contractor as per design requirements.

Main & internal roads shall be Bituminous Road.

Wherever drains or other underground facilities cross the roads, concrete pipe culverts class NP3 as required or RCC box culverts shall be provided. Culverts shall be designed for IRC class AA loading.

Kerb stone

400mm length x 150mm width X 350mm deep precast concrete blocks / kerb stone of grade M20 with 20 mm aggregate and of shape as per detailed drawing. Construction of kerb stone by fixing in 13mm thk. cement mortar 1:2 in joints, finishing of joints with neat cement paste.

Paving

All area shall be paved with RCC slab 100 mm thick in grade M20 power trowel finish & antiskid chequered of approved design) 230 mm thick rubble soling in two layers over subbase shall be approved earth material and compacted up to 95 % proctor dry density. shall be provided below the paving. Earth filling / cutting and proper compaction as per existing condition shall be done to required grade. Concrete pavement in alternative panel of size not exceeding 3 m x 3 m to be laid and finished by power trowel. Construction joints, expansion Joints shall be provided as per standard practice. Tree plantation pits to be provided in paving as per requirement. Paving levels & slopes shall be finalised during detailed engineering. In plant area RCC paving slab thickness shall be 150 mm.

Execution

Sub Grade Preparation

Excavation

After the earthwork in cutting, and the earthwork in embankments have been done properly upto the final road level with gradients and camber as per drawings and proper consolidation of the filling is completed, earthwork in box cutting shall be taken in hand. Before starting of Box cutting, the Contractor need obtain Engineer's approval of cutting and embankment work.

The surface of the formation for a width equal to that of the sub-base course shall be properly prepared before any further courses are laid. Surface shall be cut to a depth below the ground level equal to depth of sub-base course due allowance being made for compaction. Preparation of sub-grade also includes removal of any and all foreign substance accumulation and removing undulations upto 150 mm by filling and cutting as required. The sub-grade shall be dressed parallel to the finished profile.

The excavated spoils shall be transported and utilized in filling of low areas or as directed by the Engineer. The filling shall be done in layers or as directed by the Engineer. The filling shall be done in layers of 150 mm and clods and lumps shall be broken and consolidation done to the satisfaction of the Engineer.

In case of presence of weak soil-pockets below the formation, the Contractor need excavate and remove such soil to an extent as instructed by the Engineer. extra depth shall then be filled up with 38 mm down stone-metal and voids in metal shall be filled up with moorum. Then, the filling shall be rammed and rolled uniformly with a road-roller of 8 tonnes minimum weight. These operations of removing week soil pockets and filling with stone-metal shall be done by the Contractor and paid at the earthwork rates plus the cost of stone-metal only.

If, by mistake the depth of box cutting is made more than required, the Contractor need make up the extra depth by metal consolidation, as specified above, at his own cost.

After the top layer/WBM course is laid and compacted, the existing surface at the shoulders of the road must be scarified. Fresh quantity of approved earth must be extracted from the surplus earth obtained by box cutting spreading in layers for building up the berms. The layer of earth must be compacted by atleast three passes of 8 - 10 tonne rollers. The edges must be well compacted by suitable means to prevent edge slips and the work properly trimmed and dressed.

Rolling

After the box cutting is completed, the sub grade shall be compacted with powered road roller 8-12 tonnes. The roller shall run over the sub grade till the soil is evenly and densely compacted, to achieve a dry density of not less than 95% of maximum density as obtained from standard proctor compaction test. There shall be a minimum of five (5) roller passes. All the undulations on the surface which develop due to rolling shall be made good with earth and quarry spills as approved by Owner and the sub grade re-rolled. The top of the sub grade shall be dressed evenly to the required camber and necessary drainage arrangement at the time of rolling shall be provided. Care shall be taken to avoid excessive rolling of the formation. If, after rolling, the formation is higher than required, the excess earth shall be removed by carefully cutting and dressing and the formation shall be rolled as specified above. In case after rolling the formation is depressed below the required level, the Contractor need continue the process of filling and rolling as above till the correct level is attained upto a limit as decided by the Engineer at Contractor's cost.

Soling (Sub-base)

Description

This work shall consist of laying and compacting rubbles or boulders on prepared sub grade in accordance with the requirements of these specifications. The material shall be laid in one or more layers as shown on the drawings and according to lines, grades and cross sections shown on the drawings or as directed by the Engineer.

Materials

The materials to be used for the work shall be rubbles or boulders and gravel from approved quarries. The maximum size of stone shall be 150 mm. The length and breadth of stone shall not be more than twice of its depth. The stones shall be hard, tough and durable and free of earth, loam or vegetable matter. The flaky material shall not be used.

Spreading and Compacting

The soling shall be laid as per the cross section as shown on the drawing and the finished thickness after consolidation shall be as directed by the Engineer. The boulders shall be laid flat with their broad faces resting over the sub grade to have good seating. The stones shall be hand packed as close as possible and bedded firmly. The voids in the soling shall be filled with stone chips and small stones and hammered and wedged into position. Gauge pegs shall be driven in to indicate the thickness of the stones to be laid. Any hollows formed during rolling shall be filled in with spills during the process of consolidation so as to conform with the gradient, camber and cross section of the road and leave an even finished solid surface.

The soling shall be rolled by a 8 to 12 tons power roller after blinding with approved quality murrrum. The shoulder shall be rolled first to wedge the stones firmly at the edges and then rolling shall proceed towards the centre. The rolling shall be done longitudinally at the shoulder and worked towards the centre of the pavement overlapping on each successive trip by at least one-half of the width of the roller while starting and 300 mm width while finishing. In case of super elevated strips, the rolling shall commence from the inner edge and proceed towards the outer edge.

The roller shall be operated at the lowest speed possible. The speed in any case shall not be greater than 3 km per hour. Rolling shall be continued till a satisfactory surface is obtained. Wherever use of power roller is not feasible, suitable hand roller may be used as per instructions of the Engineer.

Bad Workmanship

The soling if not done as per the specification, if instructed by the Engineer, the whole soling over the defective portion shall be taken out, re-laid and compacted with a road roller as specified earlier, by the Contractor at his own cost.

Sand-Gravel Sub-base

Description

The work shall consist of laying and compacting of a mix of sand and gravel in specified proportion over a prepared sub-grade to the required lines, grades and cross-section in layers as per requirement of this specification.

Materials

Sand

Sand shall be medium hard, strong, free from organic and deleterious matter and shall be from a source approved by the Engineer. Sea sand shall not be approved.

Gravel

Gravel shall be clean, well graded and free from any vegetation organic clay or other materials and shall be from a source approved by the Engineer.

Mixing, Spreading and Compacting

The sand and gravel shall be mixed thoroughly in specified proportions by approved means. The moisture content shall be brought to within two (2) percent of the optimum moisture content for the mixed materials as per IS : 2720 part viii.

The sand gravel mix shall be spread over the prepared sub-grade in layer not exceeding 200 mm thick (un compacted thickness) and compacted by power rollers (8-10 tonnes) to achieve a field dry density of 90 percent of maximum proctor laboratory dry density. The layer shall be compacted to the required camber, slope and line. Further layer shall be placed only after the layer already laid has been compacted to the required density and approved by the Engineer based on the test results.

The finished surface shall be dressed to required camber and level and excess material removed and disposed off by the Contractor at his own cost as instructed by the Engineer.

Water Bound Macadam (Sub-base/Base Course)

Description

Water bound macadam shall consist of clean, crushed aggregates mechanically interlocked by rolling and bonded together with screenings, binding material, where necessary and water, laid on a prepared sub grade or sub-base, as the case may be, and finished in accordance with the requirements of these specifications and in conformity with the lines, grades and cross-sections shown on the drawings or otherwise directed by the Engineer.

Materials

Coarse Aggregate

Coarse aggregate and shall be of crushed blue granite. Aggregate shall be hard and durable and shall be free from excess of flat, elongated, soft and disintegrated particles, dirt and other objectionable matter and shall be from a source approved by the Engineer.

Crushed aggregate shall meet the following requirements :-

i) Flat or elongated pieces shall not be more than 15%.

ii) Los Angels Abrasion value shall not be more than 40% or Aggregate Index value shall not be more than 30%.

Coarse aggregate shall be graded as follows :

Size Range	IS Sieve designation	Percentage passing by weight
63 - 40 mm	80 mm	100
	63 mm	90 - 100
	50 mm	35 - 70
	40 mm	0 - 15
	20 mm	0 - 5

Following test shall be conducted on samples of aggregate :

i) Sieve analysis

ii) Impact tests

iii) Water absorption test - Maximum water absorption shall be 1%

iv) Wetting and drying test - The samples shall be subjected to alternate wetting and drying for 3 days and shall not show signs of disintegration.

Screenings

Screenings shall generally be of same material as the coarse aggregate and meet the following gradings :

Size of screenings	IS Sieve designation	percentage passing by weight
10 mm	10 mm	100
	4.75 mm	85 - 100
	150 microns	10 - 30

Where drawing/Schedule of Items specify non-plastic material like moorum, the liquid limit and plastic limit of such material shall be below 20 and 6 respectively and the fraction passing 75 microns sieve shall not exceed 10%.

Binding Materials

Gravel of suitable plasticity available from local quarries may be used as binding materials and the same shall be approved by the Engineer.

When sample of the binding material is wetted and squeezed in hand the following characteristics shall be noted

i) The material shall be extremely gritty.

ii) It can be formed into definite shapes that retain their form even when dried.

iii) When the wetted sample is patted in the palm of the hand it will compact into a dense cake that cannot be penetrated easily with a blunt stick.

Construction Operation

Preparation of Base

The sub grade /sub-base to receive the water bound macadam coarse shall be prepared to the specified grade and camber and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm. Where water bound macadam is to be laid until firm.

Inverted Choke

If the water bound macadam is to be laid directly over the sub grade, without any other intervening pavement course, a 25 mm course of screenings shall be spread on the prepared sub grade before application of the coarse aggregate is taken up.

Spreading Coarse Aggregate

The coarse aggregates shall be spread uniformly upon the prepared surface. The spreading shall be done from stockpiles along the side of the roadway or directly from vehicles. In no case shall the

aggregate be dumped in heaps directly on the surface prepared to receive the aggregate nor shall hauling over the un compacted or partially compacted base be permitted.

The surface of the aggregates spread shall be carefully checked with template and all high or low spots remedied by removing or adding aggregate as may be required. No segregation of large or fine particles shall be allowed and the coarse aggregate as spread shall be of uniform gradation with the pockets of fine material.

The coarse aggregate shall not normally be spread more than three (3) days in advance of the subsequent construction operations.

Rolling

Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of 8 to 10 tonne capacity or tandem roller or vibratory rollers of approved type. The weight of the roller depends upon the type of the aggregate and be indicated by the Engineer.

Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/ edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half width.

Rolling shall continue until the aggregates are thoroughly keyed and the creepage of aggregates ahead of the roller is no longer visible. During rolling slight sprinkling of water may be done, if necessary.

Rolling shall not be done when the sub grade is soft or yielding or when it causes as wave-like motion in the sub grade or sub-base course. Wherever use of power roller is not feasible, suitable hand roller may be used as per the instructions of the Engineer.

The rolled surface shall be checked transversely and longitudinally with templates. If irregularities noticed, which exceed 12.5 mm when tested with a 3m straight edge, the surface shall be loosened and aggregates added or removed as required and re-rolled until the entire surface conforms to desired camber and grade. In no case shall use of screenings be permitted to make up depressions.

Applications of Screenings

After the coarse aggregate has been rolled, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanical

spreaders, or directly from trucks. Trucks operating for spreading the screenings shall be so driven as not to disturb the coarse aggregate.

The screenings shall be applied at a slow and uniform rate (in three or more application) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregate.

The spreading, rolling and brooming of screenings shall be carried out in only such lengths of the road which would be completed within one day's operation.

Sprinkling and Grouting

After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued, with additional screening as necessary, until the coarse aggregate has been thoroughly keyed, well-bonded and firmly set in its full depth and a grout has been formed of screening. Care shall be taken to see that the base or sub grade does not get damaged due to the additional of excessive quantities of water during construction.

Application of Binding Material

After the application of screenings, the binding material where it is required to be used shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms, or mechanical brooms to fill the voids properly, and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller.

Setting and Drying

After the final compaction of water bound macadam course, the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding materials as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer shall have the discretion to stop hauling traffic from using the completed water bound macadam course if in his opinion it would cause excessive damage to the surface.

Second Layer of WBM

Before laying the second layer of WBM, the surface shall be scarified and reshaped to the required camber and profiles and all ruts, depressions, pot holes etc. made good. The second layer shall be laid after the surface preparation is approved by the Engineer.

The specification for second layer of WBM shall be similar to the first.

Concrete Roads and Pavements

Materials

Ordinary Portland cement

This should comply with the requirements of IS : 269, IS : 455 or IS : 1489.

Aggregates (General)

Aggregates should comply with the requirements of IS : 389 - Specification for coarse and fine aggregates from natural sources for the concrete work. In order to make good the concrete for roadwork it is important to avoid crushed aggregates of poor particle shape. Weather rock, and very angular, flaky or splintery aggregates should not be used.

Coarse aggregates

This should be furnished in at least two separate sizes with separation at 20 mm when combined material graded from 5 to 38 mm is specified and at 25 mm when combined material graded from 20 to 50 mm is specified. Gap graded single sized coarse aggregate as alternate to the continuously graded may be used particularly where grading of fine aggregate is fine to very fine.

Fine aggregate

Fine aggregate shall be natural sand and should comply with IS : 383. Bulking due to presence of moisture in the fine aggregate should be accounted for when the volumetric batching is employed.

Water

Water used in mixing or curing of concrete shall be clean and of potable quality.

Reinforcement

Bar mats

This shall conform to the requirements of IS : 432/IS : 1786/IS : 1139. The bars shall be of the size and spacing shown on the plans. All junctions of longitudinal and transverse bars shall be securely tied or welded together.

Load transfer devices

Dowel and tie bars shall be of plain round steel bars conforming to the requirements of IS:432.

Expansion joint filler

The material for filling the expansion joints shall be of premoulded, non-extruding and resilient type of approved quality. The premoulded joint filler shall be of thickness shown on the drawings or as stated in the bill of quantities. It shall be 25 mm less in depth than the thickness of the slab and of the full width between road forms. Holes to accommodate dowel bars shall be bored or punched out accurately. The joint filler shall comply with the requirements of IS:1838 - Specification for Preformed Fillers for Expansion Joints in concrete, non-extruding and resilient type

Joint sealing compound

The sealing compound shall comply with the requirements of IS:1834 - Specification for Hot Applied Sealing Compound for joints in concrete.

Waterproofing under layer

Waterproofing paper used as under layer be of a brand of approved quality. The paper shall be unrolled with an order lap of not less than 10 cm.

Forms

All side forms shall be of mild steel unless use of wooden sections are specifically permitted. The steel forms shall be of M.S. channel sections and their depth equal to the thickness of the pavements.

The sections shall have a length of at least 3 m except on curves where shorter sections may be used. Side shuttering shall be provided at curves as per the drawings or as directed. When set to grade and staked in place, the maximum deviation of the top surface of any section from a straight line shall not exceed 3 mm in vertical plane and 5 mm in horizontal plane. The method of connection between sections shall be such that the joint formed shall be free from movement in any direction. The use of bent, twisted or worn out forms will not be permitted. At least 3 stake pockets for bracing pins or stakes shall be provided for each 3 m of form and the bracing and support must be ample to prevent the springing of the forms under pressure of the concrete, or the weight of machinery operating on the forms. Contractor need arrange for sufficient number of forms so that the forms in position are not disturbed within 12 hours of concreting or longer if in the opinion of the Engineer it would be necessary.

Construction Operations

Form setting

Forms shall be jointed neatly and shall be set with exactness to the required grade and alignment. After the forms are placed and aligned, the earth under the base of the form shall be thoroughly

damped in an approved manner. Sufficient rigidity shall be obtained to support the forms in such a position during the entire operation of compaction and finishing. All forms shall be cleaned and oiled each time before they are used.

Placing of reinforcements

The overall dimensions of the bar mats shall be such that when properly placed into the work, the extreme longitudinal wires of the mat will be located not less than 50 mm nor more than 100 mm from the edges of the slab. Except for dummy joints, the length of the bar mat shall be such that when properly placed into the work, the reinforcement will be clear of transverse joints by not less than 50 mm and not more than 100 mm when measured from the centre of the joint to the ends of the longitudinal wire of the fabric.

While overlapping the bar mats in either direction, the overlap shall be at least equal to the spacing between the bars in the respective direction.

The bar mats shall be placed in position as shown on the drawings. For placing the top layer of the reinforcement, the first stage of concreting shall be brought upto the level of the reinforcement and lightly compacted by a screed vibrator to obtain uniform level. The reinforcement bar mats shall then be placed on the compacted layer of the concrete and then the remaining depth shall be filled in with concrete. The time lag between laying of the two courses shall not exceed the initial setting time of the cement used. Displacement of the reinforcement during concreting operation shall be prevented.

Fixing dowel bars

The dowel bars in expansion joints and transverse construction joints shall be placed and supported in such a manner that they will be truly parallel with the gradient and the centre line to the pavement, and they shall remain in position during the placement and compaction of the concrete. They shall be placed at the mid depth of the slab and the drawings. Half length of the dowel bars shall be painted with one coat of hot bitumen of approved make or equivalent as shown on the drawings or as directed by the Engineer.

Fixing tie bars

Tie bars in longitudinal joints shall be placed approximately the mid depth of the slab and shall be securely held in the slabs on both sides of the joints.

Transporting and placing of concrete

The concrete shall be mixed in quantities required for immediate use and shall be deposited in position to the required depth and width of the pavement, sections, in successive batches and in continuous operation without the use of intermediate forms or bulk continuous between joints. The spreading shall be as uniform as possible to avoid re-handling of concrete.

Compaction and finishing

The surface of the pavement shall be compacted either by means of power driven finishing or by a vibration screed. For areas where the width of the slab is very small, hand compaction and finishing may be adopted. Immediately after the tamping or screeding has been completed and before the concrete has hardened the surface shall be inspected for irregularities with a profile checking template and any needed corrections made by adding or removing of concrete followed by further compaction and finishing.

Floating

As soon as practicable after the concrete has been struck off and a compacted it shall be further smoothened and compacted by means of longitudinal float operation from a foot bridge.

Straight edging

After the longitudinal float has been completed and excess water has disappeared but while the concrete is still plastic, the slab surface shall be tested for trueness with a 3 metre straight edge swung from handles 1 metre longer than one half width of the slab. Any depressions found shall be filled immediately with freshly mixed concrete, struck, compacted and refinished. High areas shall be cut down and refinished. No extra payment shall be made for the removal of the rejected concrete and for laying of the fresh concrete. Unless otherwise specified, and for laying of the pavement surface shall be obtained by belting or brooming or by a combination of both as directed by the Engineer.

Edging

After belting and/or brooming has been completed, but before the concrete has taken its initial set, the edges of the slab shall be carefully finished with a edger of 6 mm radius and the pavement edge shall be left smooth and true to line.

Joints

Expansion Joints :

Expansion joints shall be formed at the intervals shown on the drawing at right angles of the longitudinal axis of the pavement. The width of the joint shall be as shown on the drawing and shall be straight, truly vertical and shall extend from the bottom of the slab. The expansion joint shall be filled with an approved pre-moulded joint filler which shall extend from the bottom of the slab to 25 mm below the finished surface of the concrete. A timber or metal cap shall be fitted temporarily on the top of the joint filler and the top of this cap shall be flush with the finished surface. Care shall be taken that filler and the cap are set accurately in position and are maintained in position during placing and compaction of concrete. After the pavement has been struck off and finished the metal cap shall be removed. Under no circumstances shall any concrete be left above the expansion joint material or across the joint at any point. After about 15 days of concreting the cavity on the top of the joint filler shall be carefully cleaned of all loose materials and sealed with an approved joint sealing compound. The sealing shall not be done until the concrete is quite dry. The sealer and any primer required shall

be applied strictly in accordance with manufacturer's instructions. The joints shall be sealed flush with the surface of the concrete. The end of the sliding half of the dowel bar shall be provided with a PVC or G.I. sheets cap at least 75 mm long and minimum 25 mm length of this cap shall be filled with cotton waste dipped in hot bitumen as shown on the drawings.

Longitudinal and transverse construction joints

These shall be of top champhered and sealed type and shall be formed by placing the concrete against the face of the slabs concreted earlier. The face of the old concrete slabs shall be painted with bitumen before placing of fresh concrete.

Tie bars shall be used at construction joints and shall be of the dimensions and at spacing as shown on the drawings.

Curing

Immediately after finishing operations have been completed the entire surface of the newly laid concrete shall be covered against rapid drying and cured in accordance with the following methods.

Failure to provide sufficient cover material of whatever kind required or inadequate supplies of water to take care of both curing as well as other requirements shall be adequate cause for immediate suspension of concreting.

Initial curing

Immediately after completion of finishing operations, the surface of the pavement shall be entirely covered with wetting burlap, cotton or jute mats. The mats used shall be of such length (or width) that as laid they will extend at least 450 mm beyond the edges of the slab. The mats shall be placed so that the entire surface and both the edges of the slab are completely covered. The covering shall be placed as soon as the concrete has set sufficiently to prevent marring of the surface. Prior to being placed, the mats shall be thoroughly saturated with water and shall be placed with the wettest side down. The mats shall be so placed and weighed down as to cause them to remain in intimate contact with the surface covered, and the covering shall be maintained fully wetted and in position for 24 hours after the concrete has been placed or until the concrete is sufficiently hard to be walked on without suffering damage. Water shall be gently sprayed so as to avoid damage to the fresh concrete. If it becomes necessary to remove a mat for any reason, the concrete slab shall not be exposed for a period of more than half an hour.

Worn burlap or burlap with holes will not be permitted. Burlap reclaimed from previous use other than curing concrete shall be thoroughly washed prior to use for curing purposes. If burlap is furnished in strips, the strip shall be laid overlap at least 150 mm. Burlap shall be placed from suitable bridges. Walking on freshly laid concrete to facilitate placing burlap is not permitted.

Final curing

Upon removal of the burlap the slab shall be thoroughly wetted and then finally cured as under:

"Exposed edges of the slab shall be banked with a substantial berm of earth. Upon the slab shall then be laid a system of transverse and longitudinal dykes of clay about 50 mm high immediately covered with a blanket or sandy soil free from stones to prevent the drying up and cracking of clay. The rest of the slab shall then be covered with sufficient sandy soil so as to produce a blanket of earth not less than 37 mm depth after wetting. The earth covering shall be thoroughly wetted while it is being placed on the surface and against the sides of the slab and kept thoroughly saturated with water for 14 days and thoroughly wetted down during the morning of the 15th day and shall thereafter remain in place until the concrete has attained the required strength and permission is given, the covering shall be removed and the pavement cleaned and swept. If the earth covering becomes displaced during the curing period, it shall be replaced to the original depth and shall be re-saturated".

Removing of Forms

Forms shall not be removed from freshly placed concrete until it has set at least 12 hours. They shall be carefully removed and in such a manner that no damage will be done to the edges of the pavement. After the forms have been removed, the ends of all joints shall be cleaned and any honeycombed areas painted up with 1:2 mortar, after which the sides of the slabs shall be covered with earth to the level of the top of the slab. All ditches and drains shall be so placed as to provide effective drainage.

Opening to Traffic

Traffic shall be excluded from the newly constructed pavement for a period of 28 days where ordinary portland cement is used. Before the pavement is opened to traffic it shall be cleaned and the joints shall be filled and trimmed or topped out as required. The joint or line of separation between adjacent strips or slabs of concrete, when the pavement is constructed in lanes or strips, shall be cleaned and filled with bituminous material as directed.

Pipe Culverts

Materials

The drainage pipes unless otherwise shown on drawings or instructed by the Engineer, shall be made of RCC (Hume pipe) and shall be either Class NP3.

Pipe culverts shall be made of reinforced concrete pipe (Hume Pipe) and shall be of class NP2 or NP3 as decided by the Engineer or shown in the drawing. All pipes shall meet the requirements of IS:458 and shall be procured from approved manufacturers with collars as per manufacturers standard specifications. The Tenderer shall specifically mention the particular manufacturer's product he proposes to use.

Cement shall be ordinary Portland Cement as per IS:269.

Aggregate shall be as per IS:383 - Maximum size shall not exceed one third the thickness of the pipe or 20 mm whichever is smaller. For bedding concrete for laying the pipes, the maximum size of aggregate shall be 38 mm.

Fine aggregate for concrete shall be as per IS:383.

Laying of Pipes

Laying of Hume pipes and collars shall be done as per IS:783. Pipes shall be laid either in trenches or on supports as per drawing and/or Engineer's instructions. All pipe sections and collars shall be inspected carefully for defects before laying in the trenches. Broken or defective pipe shall not be used and shall be properly marked and removed from site as soon as the defects are detected. Pipes shall be laid true to line and grade as specified in the drawings and/or Engineer's instruction. The bedding of the pipes shall be 'First class bedding' or ordinary bedding as per IS:783. The profile of cutting of trenches, free working space provided on each side of the pipe, etc. shall be decided at site by the Engineer as per site condition. Side slope, shoring, bailing out water etc. as required shall be done by the Contractor without any extra cost to the Owner. Side slips, if there be any, shall be removed by the Contractor without any extra cost to the Owner. After laying of the pipes are completed, backfilling of the trenches shall be done in layers of 150 mm, clods and lumps broken, watered and compacted with iron rammers to the satisfaction of the Engineer. The surplus spoils shall be transported and filled in low areas within the plant area, as instructed by the Engineer. The filling shall be done as per specification.

All pipes and fittings shall be gradually lowered into the trench or placed on the supports by approved means taking due care not to damage them.

Under no circumstances the pipes shall be dropped into the trench or on supports from a height. The joints of pipes shall be grouted with 1:2 cement - sand mortar and the procedure of jointing shall be as per IS:783.

Pipes laid in trenches in earth shall be bedded evenly and firmly and as far up the haunches of the pipes as consistent with the load expected to be transmitted from the backfill through the pipe to the bed. This shall be done either by excavating the bottom of the trench to fit the curve of the pipe or by compacting the earth under and around the curve of the pipe to form an even bed.

Where the pipe is laid in trench in rock, hard clay, shale or other hard materials, the space below the pipe shall be excavated and replaced with an equalising bed of concrete (1:4:8 mix), sand or compacted earth as approved by the Engineer. In no place shall the pipe be laid directly on such hard material.

If end protection wall is shown in drawing, the wall shall be constructed with first class quality locally available bricks from approved source. All civil works connected with the protection work, like concrete, brick masonry, plastering etc. shall be done as per relevant Indian Standards and in

accordance with approved construction drawings. All materials used shall also conform to Indian Standards.

Roadside Drains

The road side drains shall be made in sizes and shapes as shown in the drawing and/or as instructed by the Engineer. The sides and bottom shall be neatly dressed after excavation. Proper connection shall be made to the culverts as per instruction of the Engineer. The excavation spoils shall be transported and filled in the areas outside the plant area as instructed by the Engineer.

Quality Control & Tolerance

The Contractor need establish and maintain quality control for the various aspects of the work, method, materials and equipment used.

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings or as directed by the Engineer. Permitted tolerances for roadwork's are described hereinafter.

i) Horizontal Alignment:

Horizontal alignments shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of ± 25mm therefrom. The corresponding tolerance for edges of the roadway and lower layers of pavement shall be ± 40mm.

ii) Longitudinal Profile:

The levels of the sub grade and different pavement courses as constructed, shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the Engineer beyond tolerances mentioned below :

Sub-grade	± 25mm
Sub-base	± 20mm
Base course	± 15mm
Wearing course	± 10mm

Tolerance in wearing course shall not be permitted in conjunction with the positive tolerance for base course if the thickness of the former is thereby reduced by more than 6mm.

iii) Surface Regularity of Sub grade and Pavement courses :

The surface regularity of completed sub-bases, base courses and wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table V.

The longitudinal profile shall be checked with a 3 metre long straight edge, at the middle of each traffic lane along a line parallel to the centre of the road. The transverse profile shall be checked with a set of three chamber boards at intervals of 10 metres.

TABLE – V

Permitted Tolerances of Surface Regularity for Pavement Courses

Sl. No.	Type of Construction	Longitudinal profile with 3 metre straight edge					Cross Profile
		Max.	Maximum number of Permissible in any length exceeding mm		Maximum permissible variation from specified profile undulations permitted 300 meters mm		
1.	Earthen sub grade	25	30	--	--	--	15
2.	Granular subbase	15	--	30	--	--	12
3.	Water bound macadam with over size metal (40-90 mm size)	15	--	--	30	--	12
4.	Water bound macadam with normal size metal (20-50 mm and 40-63 mm size), Bituminous penetration Macadam	12	--	--	30	--	8
5.	Surface dressing** (two coat over WBM (20-50 mm or 40-63 mm size metal), bituminous penetration macadam or built-up spray grout	12	--	--	30	--	8
6.	Open graded premix carpet, mix seal surfacing	10	--	--	--	30	6
7.	Bituminous macadam	10	--	--	--	20***	6

8.	Semi-dense carpet	10	--	--	--	20***	6
9.	Asphaltic Concrete	8	--	--	--	10***	4
10.	Concrete Pavements	8	--	--	--	10***	4

Notes

1. ** For surface dressing in all other cases, the standards of surface evenness will be the same as those for the surface receiving the surface dressing.

2. *** These are for machine laid surfaces. If laid manually due to unavoidable reasons, tolerance upto 50% above these values in this column may be permitted at the discretion of the Engineer. However, this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 on the table.

3. Surface evenness requirements in respect of both the longitudinal and cross profile should be simultaneously satisfied.

Rates

The rate for other items (building, drain, road, boundary wall etc.) in the schedule, unless specifically excluded in the contract, shall be deemed to include the cost of all materials consumed or used in the work or incidental to it as well as labour, tools, plant, equipment, templates, supports, scaffolds, testing approaches, security and safety measures, power, fuel, lubricants, storage, handling, transport, insurance's, taxes, royalties and other revenue expenses, accommodation, services, supervision, overheads, profits etc.

Method of Measurement

Sub-grade Preparation

Sub-grade preparation shall be measured as finished work in square metre and paid at the unit rate tendered. The rate shall include, the box cutting, rolling the sub grade to the slopes & camber shown in drawing and as per specification. The area to be considered for measurement shall be the area of soil exposed. The shoulder area shall not be considered. The cost of shoulder construction is deemed to be included in rate for sub grade preparation.

Soling Notes

Soling shall be measured as finished work in position in cubic metre and paid at the unit rate tendered for the thickness specified.

Sand-Gravel Sub-base

Sand-gravel sub-base shall be measured as finished work in position in cubic metre basis on the compacted volume of fill.

Water Bound Macadam

Water bound macadam shall be measured as finished work in position in cubic metres and paid at the unit rate tendered for the compacted thickness as specified. When a second layer of WBM is specified, second layer shall be measured separately in cubic metre and paid at the unit rate tendered for the compacted thickness as specified.

Rate quoted for second layer shall include the cost of surface preparation and rectification of damaged portion of first layer of WBM. No separate measurement will be made for it and paid.

Section-X Detailed Technical Specifications - Electrical

Table of Contents

1 Termination Points 601
1.1 TE-1: Incoming HT Power Supply 601
1.2 Essential Conditions for Electrical Work 601
1.3 Scope of Work: General 601
1.4 SCOPE OF SUPPLY 603
1.5 Detailed Specifications / Requirements of Scope of Work 604

2 Design Criteria 606
2.1 Estimation of Load 606
2.2 Equipment 606
2.3 Earthing 607
2.4 Protections 607
2.5 Metering 607
2.6 Indicating Lamps 607
2.7 General 608

3 Standard Specifications for Electrical Works 609
3.1 Transformer 609

4 Power Capacitors: 611

5 LT Panels and Control Cabinets 613
5.1 Main PMCC/PCC 613
5.2 MCC/ Control Panel 613
5.3 Standards 613
5.4 Construction 614
5.5 Metal Treatment and Finish 615
5.6 Busbars 615
5.7 Unit Module 615
5.8 Incomer Termination 616
5.9 Air Circuit Breaker (ACB) 616
5.10 Moulded Case Circuit Breaker (MCCB) 617
5.11 Miniature Circuit Breaker (MCB) 618
5.12 Motor Starters 618
5.13 For DOL 618
5.14 For RDOL 619
5.15 For VFD driven uni-directional feeder 619
5.16 For VFD driven bi-directional feeder 619
5.17 Control/Selector Switches 619
5.18 Current Transformers (CTs) 619
5.19 Indicating Lamps 620
5.20 Push Buttons 620
5.21 Space Heaters 620
5.22 Contactors 621
5.23 Fuses 621
5.24 Switches 621
5.25 Indicating Meters 621

5.26 Internal Wiring 622
5.27 Power Cable Termination 622
5.28 Labels 622
5.29 Control / Auxiliary Power Circuits 622
5.30 Control Wiring Terminal Blocks 623
5.31 Earthing of Switchgear / Distribution Boards 623
5.32 Tests 625

6 Motors 626
6.1 Type 626
6.2 Insulation 626
6.3 Speed 626
6.4 Cooling 626
6.5 Fans 626
6.6 Bearings 627
6.7 Terminal Box 627
6.8 Overloads 627
6.9 Variations 627
6.10 Noise and Vibration 627
6.11 Shaft 627
6.12 Lubrication System 628
6.13 Number of Starts 628
6.14 Space Heater 628
6.15 Balancing 628
6.16 Earthing 628
6.17 Painting 628
6.18 Tests 629

7 Power and Control Cables 630
7.1 HT Cable 630
7.2 LT Cable 630
7.3 Construction of 650V / 1100V Grade Cables 631
7.4 Cable Laying 632
7.5 Tests 632

8 Interconnection between 11KV Line and HT Substation 634
8.1 Codes and Standards 634

9 Variable Frequency Drive 635
9.1 Input Power 635
9.2 Environment 635
9.3 Output Power 635
9.4 Design Hardware 635
9.5 Control 635
9.6 Power Conditioning 636
9.7 Features 636

10 Internal and External Illumination and Other Electrical Works: 641
10.1 Illumination Levels 641

10.2 LED Fixtures 641
10.3 Area Lighting / External Lighting 642

11 Lightning Protection 655
11.1 Principle Components 655
11.2 Materials 655
11.3 Layout 656
11.4 Air Terminations 656
11.5 Down Conductors 657
11.6 Installation 658
11.7 Air Terminations 658
11.8 Down Conductors 658
11.9 Joints: 658
11.10 Bonds 659
11.11 Test Joints 659
11.12 Earth Termination Network 659

12 EMERGENCY DIESEL GENERATOR SET 661
12.1 Intent of Specification 661
12.2 Codes & Standards 661
12.3 Technical & Operational Requirements 661

1 Termination Points

1.1 TE-1: Incoming HT Power Supply

33kV HT Power shall be made available by TP Western Odisha Distribution Limited (TPWODL) at Contractor's HT Substation (to be provided for import of power). The Contractor shall apply for power from TP Western Odisha Distribution Limited (TPWODL) and payments will be done by OIL at actual. Supply and laying of HT Cable from nearby Source up to the Contractor's HT Substation including termination to the HT Metering Unit shall be in the scope of OIL. The Contractor's scope shall start from HT Sub-station.

1.2 Essential Conditions for Electrical Work

The Sub-contractor appointed by the Bidder for carrying out the electrical works shall be licensed electrical Contractor in appropriate class and approval from the competent authority shall be obtained before finalizing the Sub-Contractor for electrical works.

a) The electrical works shall be carried out strictly in co-ordination with OIL's project management consultant (PMC) and concerned Electrical Division, necessary approvals shall be taken from time to time.

b) Make of materials for electrical works shall be as per list of approved materials, brands and manufacturers. Materials which are not in the list; necessary approvals shall be taken from the competent authority of OIL before execution of the work and work should be started only after the approvals.

1.3 Scope of Work: General

The Scope of electrical works shall include design, manufacture, supply, delivery to site, inspection and testing at the Manufacturer's works, erection/ installation, testing and commissioning of all the electrical equipment/systems required for the MSW, Power Generation, Power Export plant on turnkey basis, as specified in this Section and the enclosed drawings, so as to make the system complete in all respects. The brief description of scope is given below.

1.3.1 Construction of 33 kV built-up power import & export (if applicable) sub-station including sub-station equipment such as 33 kV import & export (if applicable) Metering Kiosk (as per specification of TPWODL, 33 kV HT Panel, 33 kV/0.433 kV step-down Transformers (if applicable) of required capacity, 11 kV grade XLPE cable of adequate size from Metering Kiosk Panel to Transformers.

1.3.2 Wiring of sub-station building and provision of standard safety equipment for sub-station as approved by the TPWODL/ Electrical Inspector.

1.3.3 The Bidder has to obtain all necessary approvals from TPWODL / any other competent Authority. It will include approval of scheme, sanction of load to the releasing of power supply and bringing completion report from TPWODL.

1.3.4 Provision of 1.1 kV grade XLPE insulated extruded inner and outer PVC sheathed aluminium conductor armoured cable adequately sized from the Transformer up to PCC Panel and to the load point etc. complete along with the end termination with gland and crimping type of lugs.

1.3.5 The main PCC Panel shall comprise one ACB as incoming feeder and ACB/MCCB as outgoing feeders for various MCC in the plant. This may include loads, depending upon the process offered. Necessary LT check metering (as per specification of TPWODL, protections and indications shall be provided on the LV switchboard.

1.3.6 Provision of a complete indoor and outdoor cabling system. 1.1 kV grade, XLPE insulated, extruded inner and outer PVC sheathed, Aluminium conductor, armoured cables shall be provided for distribution of power to various DBs/ Panels and individual loads in the plant, while 1.1 kV grade, PVC insulated, extruded inner and outer PVC sheathed, stranded copper conductor, armoured cables shall be provided for control and 600V grade, PVC insulated, individual/overall shielded, twisted pair cable for instrumentation. These cables shall be laid in trenches, trays, pipes/conduits, buried in ground, as required, depending on the plant layout. The entire cabling system shall be done as per the approved drawings and documents.

1.3.7 Complete plant indoor and outdoor lighting system shall be provided, which shall be controlled from lighting Panels/switches installed in respective plant areas. The entire lighting system shall be as per the approved drawings with required Lux level as per IS Lux level calculation should be submitted.

1.3.8 Complete plant indoor and outdoor earthing and lightening protection system comprising electrode pits and conductors shall be provided inside and outside the plant to ensure proper system neutral earthing and safety earthing. The entire earthing and lightning protection system shall be as per IS 3043 & IS2309 and approved drawings.

1.3.9 LV capacitor bank, with control Panel consisting of automatic power factor correction (APFC) relay, shall be provided to improve the overall plant power factor up to a maximum of unity.

1.3.10 Harmonic filter to limit Harmonics generated in electrical systems as per directives of IEEE519. If harmonics are exceeding than limits specified in IEEE519; necessary harmonic filters (Active or Passive) shall be provided to control them within specified limit.

1.3.11 Local Start/Stop push button stations shall be provided near those motors which are not controlled from a local console/Panel.

1.3.12 All the motors shall conform to the requirements of latest editions of application Indian Standards. The motors shall be squirrel cage, TEFC type and shall be rated for continuous or intermediate duty as per application. The winding insulation shall be of Class 'F' while the temperature rise shall be limited to that for Class 'B'. The degree of protection of enclosure shall be IP 54 for indoor motors and IP 55 for outdoor motors. Outdoor motors shall be provided with canopy.

1.3.13 Complete electrical works within the terminal points comprising of the following:

- Suitable Transformers with 10% overload capacity.
- LT panel and sub panel for the motors as per requirement.
- Local Panels & Start Stop Push Button Stations.
- Internal illumination to the Lux levels as indicated in the electrical specifications.
- External Illumination to the Lux levels as indicated in the electrical specification.
- Power & Control Cables.
- Earthing with Earthing Pits.

1.4 SCOPE OF SUPPLY

The scope of supply covers this specification is listed below, but not limited to the followings.

S.NO	DESCRIPTION	QUANTITY	UoM
1	**ICOG panel:** 33kv, 3P, **A, **KA for * sec, draw out type VCB, with all accessories, metering, protection, etc.,	1	Set
2	**Distribution transformer:** 33/0.433kv, Dyn11, ***KVA, two winding transformer with all accessories	1	Set
3	**NSPBD (If required or Applicable):** 415V, 3P+N, **A, 50KA for 1 sec, non-segregated phase busduct with all accessories	1	Set
4	**Emergency Diesel Generator:** shall be rated for "Prime duty". Generator shall be rated of 415 V, 3 phase, 4 wire,50Hz supply. Generator Neutral shall be solidly earthed, with NSPBD, AMF panel and all accessories.	1	Set
5	**PCC Panel:** 415V, 3P+N, **A, 50KA for 1 sec, PCC panel with 4 pole dual incomer & outgoing feeders	1	Set
6	**MCC Panels:** 415V, 3P+N, **A, 50KA for 1 sec, MCC panels as required for process equipment	1	Lot
7	**VFD Panels:** 415V, 3P+N, **A, 50KA for 1 sec, VFD panels as required for process equipment		
8	**ACDB, MLDB, LDB Panels:** 415V, 3P+N, **A, 50KA for 1 sec, MCC panels as required for process equipment	1	Lot
9	**110 V D.C. system:** comprises of 1 set of storage battery banks, shall have 2 x FCBC and 1x100 % sectionalized DCDB with all other related equipment & accessories.	1	Lot
10	**UPS**: shall be suitable for connecting to a 415V, 3 phase, 4 wire, 50Hz system with a symmetrical fault level of 50kA rms. Nominal voltage output shall be 230V, 50Hz, Single phase with +/- 1% resolution. Dedicated battery bank	1	Lot

	with 2x100 % UPS, bypass servo stabilizer and all other related equipment & accessories.		
11	**Cables:** for MV cables & LV	1	Lot
12	**Illumination system:** for complete internal and external lighting of plant and associated auxiliaries, building, pump house, including roads.	1	Lot
13	**Termination and jointing kits:** shall be of proven design and make which have already been extensively used and fully type tested. Kits shall be complete with all accessories and consumables required for complete termination or jointing. Copper cable lugs & jointing ferrules for straight through joints shall form part of the kit.	1	Lot
14	**Earthing & Lightning system:** Complete below and above ground earthing of all equipment and factory premises	1	Lot
15	**Fireproof cable penetration seals:** shall be provided for all floor openings and wall openings (cable penetrations) in the switchgear rooms/ cable vaults	1	Lot
16	**supply and installation of following items:** • Rubber mats for switchboards • Caution boards • Sand buckets • First aid box • Sheet steel cover for the exposed electrical equipment/cable shaft/trench etc. • Cable route markers & Cable joint markers • Shock hazard chart • Erection hardware	1	Lot

1.5 Detailed Specifications / Requirements of Scope of Work

1.5.1 Design, Manufacture, inspection and testing at works, supply at site, erection, final check-up, painting, testing and commissioning of the electrical equipment form the scope of Work of the successful Bidder.

1.5.2 The scope of Work also includes civil Work such as excavation, laying of sand and bricks on laid cables, closing the excavation, making earthing pit chambers, foundation and pedestal for electrical equipment, grouting of cable tray supports in walls, making entries for cable conduits in walls and making good the surface to the original one, embedding concealed

conduits, junction boxes, etc. in walls and ceiling and making good the surface, foundation for street lighting poles, providing covers, chequered plates on cable trenches, etc.

1.5.3 Co-ordination with local authorities, such as TPWODL, Electrical Inspectorate, etc. for obtaining all the statutory approvals needed, preparing, submitting and obtaining approval of all electrical drawings and documents as well as obtaining approval of the electrical installation from these authorities shall also form a part the scope of the Work.

1.5.4 Preparation and submission of As-Built drawings in soft-copy on a CD and 2 sets of hard copies for installation, operation and maintenance manuals of the equipment supplied along with their catalogues shall also be furnished by the successful Bidder.

1.5.5 The electrical equipment/ items selected for this project shall be suitable for operation of technical Parameters specified below:

Incoming Power Supply	AC, 33KV, 3 Ph, 50 Hz
Outgoing Power Supply (If applicable)	AC, 11KV, 3 Ph, 50 Hz (To be confirmed from TPWODL)
Plant Power distribution voltage	AC, 415 V, 3Ph, 4 wire, 50Hz
Lighting and space heating	AC, 230 V, 1Ph, 2 wire
DC alarm, control and protection	DC, 24V, 2 wire
AC control	AC, 230 V, 1 Ph, 2 wire
Potential transformer secondary	AC, 110 V, 3 Ph, 50Hz
Ambient temperature	50 deg. Centigrade
System earthing	Solidly earthed
Voltage variation	± 10 % of rated voltage
Frequency variation	± 5 % of rated frequency
Combined voltage and frequency variation	± 10%
Fault level	18.4KA (11KV), 50KA (415V) 10KA (230V)

2 Design Criteria

2.1 Estimation of Load

The following assumptions are made to arrive at the maximum electrical demand of the water treatment plant.

2.1.1 Load Factor

Motors	0.85 (or as per BKW)
Auxiliary load (valve actuators, crane, etc.)	0.85 (or as per BKW)
Lighting load	1.0

2.1.2 Diversity Factor

Motors	1.0 (or as per application)
Auxiliary load (valve actuators, crane, etc.)	0.5 (or as per application)
Lighting load	1.0

Power Factor of Motors : As per the Manufacturer's Catalogue

Efficiency of Motors : As per the Manufacturer's Catalogue

2.2 Equipment

a) All the indoor electrical equipment will be rated and sized for 45oC design ambient temperature, while all the outdoor electrical equipment will be rated and sized for 50oC design ambient temperature.

b) The capacity of the transformers will be calculated based on the total simultaneous maximum demand (calculated based on the load factors, diversity factors, efficiency of motor and power factor of motor) plus 10% contingency. A transformer with the next higher standard rating recommended in the Indian Standards shall be selected. Similarly, the capacity of transformer for export of power (If applicable) shall be calculated based on maximum power available for export to grid.

c) All the power cables will be sized based on the continuous current rating of the load permissible voltage drop and short circuit current rating. The voltage drop will be limited to 3% at rated equipment current rating and 15% at starting.

d) The rating factors for variation in ground temperature, variation in ambient air temperature, grouping of cable, type of laying, depth of laying etc. shall also be considered for cable sizing.

2.3 Earthing

a) The material of earthing conductor laid above ground or buried in concrete shall be galvanized steel, while that of the conductor buried in soil shall be mild steel.

b) The size of the earthing conductor shall be designed as per the Indian Standards/ IEEE. The value of fault current shall be calculated based on the transformer capacity, its impedance and the main supply system fault level. Fault current withstand time for sizing of earth conductor shall be taken as three seconds. While sizing the buried earth conductor, a corrosion allowance of at least 20 % shall be taken.

c) Main earthing conductor outside and inside the building shall be planned in such a manner that the equipment is connected to the earthing system by minimum two connections in a reliable manner.

2.4 Protections

The following protections shall be provided for electrical equipment.

d) HT Substation:

- SF6 CB/VCB for transformer

e) LT switchboard:

- Thermal overload and short circuit protection features of MCCBs and MCBs for all feeders.
- Overload protection by thermal (bimetal) relays for contactors of motor feeders.

2.5 Metering

The following Metering will be provided on the LT switchboard.

a) LT Incomer:

- LT check metering as per requirement of TPWODL
- Ammeter with selector switch
- Voltmeter with selector switch
- Load monitor unit which shall include Kilowatt Meter, Power factor Meter, Kilowatt-hour Meter (with Modbus protocol on RS485 communication)

b) LT Outgoing Feeders:

- Ammeter with selector switch

2.6 Indicating Lamps

The following indications will be provided on the LV switchboard.

a) LT Incomer: Supply 'ON' (Red. Yellow & Blue)

b) LT Motor Feeders: Motor "ON', 'OFF" & 'Trip' indications (Red, Green & Amber).

2.7 General

All indoor boards/Panels and motors are proposed with a degree of protection of IP 54, while all outdoor equipment shall be double door with a degree of protection of IP 55.

a) The method of starting of motors shall be 'Direct-On-Line' (DOL) for motors with rating up to and including 7.5KW, 'Star-Delta' starting shall be used for motor rating from 10KW up to and including 55KW, Soft-starter shall be used for motor rating from 75KW and VFD shall be used as per process requirement.

b) LV power cables shall be with stranded aluminium conductor, XLPE insulation, extruded inner and outer sheaths and galvanized flat/wire armouring, control cables shall be with stranded copper conductor, PVC insulation, extruded inner and outer sheaths and galvanized flat/wire armoring.

c) All the electrical equipment, accessories and systems shall conform to the latest editions of the Indian Standards or other equivalent international standards.

3 Standard Specifications for Electrical Works

3.1 Transformer

This section covers the detailed requirements regarding supply, installation, testing, commissioning of outdoor transformers with on load tap changer, required for the plant.

Contractor to ensure that necessary certificate from the manufacturer as per Bureau of Energy Efficiency Standard and Labelling (S&L) program shall be obtained prior to the supply and installation of the transformer and all same be submitted to the TPWODL/Electrical Inspectorate at the time of obtaining the necessary approval.

3.1.1 Standards:

The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes

Except where modified by this specification, wherever applicable all material and equipment shall conform to the requirements of latest Indian Electricity Rule (IER) and below given standards including all amendments.

IS:11171 and IS:2026	- Dry type Transformer
IS:335	- Transformer Oil
IS:1271	- Classification of Insulating Materials
IS:3639	- Fittings and Accessories for Power Transformer
IS:2099	- High Voltage Porcelain Bushings
IS:2705	- Current Transformer

3.1.2 General Requirement:

The dry type cast resin transformers shall be AN (Air Natural) cooled and shall be provided for indoor applications.

The mechanical and electrical design of the transformers shall be based on the following conditions and requirements:

a) The design shall be based on site and service conditions as specified.

b) The maximum permissible temperature rise of the transformer windings is to be selected by the transformer manufacturer in accordance with the thermal classes of the insulation.

c) The transformers shall be capable of operating continuously at full load at any tap position within their temperature rise limit.

d) Neutral points shall be brought out and grounded.

e) Doors shall be suitable to be opened from outside.

All the materials used shall be of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions without distortion or deterioration or the setting-up of undue stresses in any part and also without affecting the strength and suitability of the various parts for the work which they have to perform.

g) Similar parts, particularly removable ones, shall be interchangeable.

h) Nuts, Bolts and pins used inside the transformer and tap changer shall be provided with lock washers or lock nuts.

i) Labels shall be provided for all identifiable accessories like relays, valves, CT, thermometer pockets, switches etc.

j) All internal connections and fastenings shall be capable of operating under overloads and over excitations allowed as per specified standards, without injury.

k) The transformers must be of suitable size so as to be installed in a room of dimensions 6 m x 6 m x 4 m. Care shall be taken to provide appropriate clearances on all sides as per the latest standards and practices.

4 Power Capacitors:

Power capacitor banks of suitable KVAR rating shall be provided across the main bus bar of PMCC with Automatic Power Factor Correction Relay (APFC) for maintaining the power factor of the installation at not less than unity and more than 0.95.

The Contractor shall submit detailed calculations for arriving at the correct KVAR rating.

4.1.1 Standards:

Unless otherwise specified, the units shall conform to the following Indian Standards:

IS: 22534	:	Specification for Shunt Capacitors for Power Systems
IS: 5535 (Part II)	:	Shunt Reactors

4.1.2 Construction:

- The capacitor shall be of mix dielectric type consisting of elements wound from high purity soft annealed aluminium foil and layer of biaxial oriented polypropylene. The element must be assembled either in Parallel or in series Parallel combination for desired capacity and voltage ration with proper insulation. It shall be housed in a metal container. The leads shall be taken out through bushing and unit shall be hermetically sealed after fine vacuum drying and impregnated with highly purified nom PCB oil.
- The capacitor shall be either with internal element fuse or external fuse with internal discharge resistance.
- The capacitor bank shall comprise of suitable number of single-phase units in series Parallel combination. However, the number of Parallel units in each to the series stack shall be such that failure of one unit shall not create an over voltage on the units Parallel with it. The complete bank with the accessories shall be metal enclosed, indoor floor mounted and free-standing type. Each capacitor case and cubicle shall be earthed to a separate earth bus. The capacitor panel shall be of sequential operation type.
- Each unit shall be fitted with a low loss discharge device to discharge capacitor to reduce the voltage to 50V within one minute as per IS: 22534. The unit shall be capable to withstand satisfactorily an over voltage up to 110% of its rated voltage and 135% of rated KVAR including manufacturing tolerances.
- Each capacitor unit shall be individually protected by HRC fuse, rated for load current and interrupting capacity so that a faulty capacitor unit can be disconnected without causing the motor to be disconnected.

- The capacitor bank shall be complete with all parts that are necessary for efficient operation. This shall include steel rack assembly, copper bus bars, copper connecting strip, foundation channel, fuse, fuse clip etc. The fuse breaking time shall be coordinated with the pressure built up within the unit to avoid explosion.

Parameters for Power Capacitor

1.0	**Site Conditions**	
1.1	Maximum ambient temperature	50° C
1.2	Minimum ambient temperature	5° C
1.3	Relative humidity	95%
1.4	Altitude	150 m above MSL
1.5	Environment	Tropical
1.6	Output KVAR	As per approved calculation
1.7	Rated voltage	415 V +/-10%
1.8	Rated frequency	50 Hz +/-5%
1.9	No. of phases	3
1.10	Location of capacitors	Indoor
1.11	Nature of control	By APFC relay sequential operation and by start/stop push button in manual mode
1.12	Type of capacitor bank	Mix dielectric
1.13	Insulation level	2.5KV (rms)

4.1.3 Tests:

All tests shall be conducted in accordance with the latest edition of IS:22534 and as applicable for the controls. Type test certificates for similar capacitor units shall be furnished.

5 LT Panels and Control Cabinets

5.1 Main PMCC/PCC

- The main PMCC shall be metal clad totally enclosed, rigid, floor mounted, air insulated, cubicle type for use on 415V, 3 phase, 50Hz system. The PMCC shall be single/double front, non-draw out type compartmentalized.
- Each Panel of PMCC shall consist of several compartments.
- The equipment shall be designed for operation in high ambient temperatures and high humidity tropical atmospheric conditions. The equipment shall be for indoor installation. 10% spare feeders with minimum one (1) no. of each type and rating shall be provided in PMCC, complete in all respects.

5.2 MCC/ Control Panel

- The MCC / Control Panel shall be metal clad totally enclosed, rigid, floor mounted, air insulated, cubicle type for use on 415V, 3 phase, 50Hz system. The MCC / Control panels shall be single front, non-draw out type and non-compartmentalized type.
- The Local / Sub MCC cum Control Panel shall have all controls mounted on the body and with only user required controls approachable from the outside.
- The equipment shall be designed for operation in high ambient temperatures and high humidity tropical atmospheric conditions. The MCC/Control Panel shall house the Intelligent Logic Controllers. The equipment shall be for indoor installation.
- 10% spare feeders with minimum one (1) no. of each type and rating shall be provided in MCC complete in all respects.

5.3 Standards

The equipment shall be designed to conform to the requirements of:

IS: 25623 and IEC: 439	Factory built assemblies of switch gear and control gear.
IS: 4237	General requirements for switch gear and control gear not exceeding 1000 Volts
IS: 2147	Degrees of protection provided by enclosures for low voltage switch gear and control gear
IS: 375	marking and arrangement of bus bars
IS: 2959	AC conductors of voltage not exceeding 1000 Volts
IS: 4064 (part II)	Air brake switches and fuse combination units for voltage not exceeding 1000 Volts
IS: 694 and IS: 25130	PVC insulated cables and aluminium conductors

IS: 12425	Direct action electrical indicating instruments
IS: 9224	Low voltage fuses
IS: 2516	Alternating current circuit breakers
IS: 2705	Current transformers
IS: 3156	Voltage transformers

5.4 Construction

- The structure of the Panels shall be totally enclosed, free standing/floor mounted as applicable for the type of main or sub MCC, with the assemblies made up of requisite rigid welded structure frame made of structural steel sections and of dust and vermin proof construction with cold rolled sheet steel sections and of dust and vermin proof construction with cold rolled sheet steel of not less than 2 mm thickness or of pressed and former sheet steel of not less than 3mm thickness.
- The doors, covers, barriers etc., shall be made of minimum 1.6 mm thick steel. All Panel doors, removable cover, gland plates shall be provided with gaskets. The structure shall contain horizontal bus bars running throughout the length of the unit and be readily accessible. Each vertical Panel structure shall contain a vertical cable / wire way with provision for suitable cable supports. The cable compartments shall have hinged door.
  - Each vertical section shall be divided into the following well defined zones by metallic insulated barriers:
  - Main bus bar chamber at top or bottom
  - Unit chamber
  - Cabling chamber at the right-hand side of unit chamber
  - Vertical riser chamber behind unit chamber
  - Horizontal wire way at top, in front of main bus bar chamber
- The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 3mm thickness and 75mm height.
- The maximum height of floor mounting cubicle Panels shall be 2500mm and maximum operating height shall not exceed 1800mm.
- And a wall mounted Panel shall be 1500 mm.
- The Panel shall be provided with a degree of protection of not less than IP54. Panel shall be extendable on both sides by addition of vertical sections.
- Provision shall be made for permanently earthing the frame and other metal parts of the Panel through an aluminium earth bar running throughout the full length of the Panel at the top/bottom. It shall be possible to earth the Panel at two independent points through earthing terminals.

5.5 Metal Treatment and Finish

All steel Work used in the construction of PMCC/MCC/Control panel be given degreasing, de-rusting, phosphatizing and passivation treatment (7/9 tank process) followed by powder coating by paint of shade RAL7032.

5.6 Busbars

The bus bars shall be air insulated and made of high conductivity, high strength aluminium complying with the requirements of grade E91E of IS: 50252. The bus bars shall be suitably braced with non-hygroscopic SMC supports, to provide a through symmetrical fault withstand capacity of LV side of transformer for one second. The neutral as well as the earth bar shall also be capable of withstanding the fault level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent bus bars. Porcelain insulator will not be accepted. The main horizontal bus bars shall be positioned at the top/bottom portion and suitable colour identification shall be provided. Suitable barrier shall be provided in front of the vertical bus bar against accidental contact. High tensile bolts and spring washers shall be provided at all bus bar joints. An earth bus of adequate size made of copper flat shall be provided at the top/bottom of the Panel. Necessary calculations shall be done for selection of busbar sizes.

5.7 Unit Module

- Cubical type panels shall be fabricated out of sheet steel not less than 1.6 mm thick. Wherever necessary, such sheet steel member shall be stiffened by angle iron frame work. General construction shall employ the principle of compartmentalization and segregation for each circuit. Unless otherwise approved, incomer and bus section panels or sections shall be separate and independent and shall not be mixed with sections required for feeders. Each section of the rear accessible type panel shall have hinged access doors at the rear.
- Each module shall be suitable for mounting a required number of power contactors, bimetal relay, auxiliary contactors, push buttons, isolator / fuse switch, ACB, MCCB, MCB, control fuses, main fuses, indicating lamps, Meters, power and control contacts, terminal block cum secondary isolating contacts etc., to suit non-reversing, reversing and assisted start motor applications. Isolator / fuse switch, Meters with selector switches, indicating lamps, push buttons & bimetal relay reset button shall be mounted on the module door.
- Each module shall be provided with an individual door and the door shall be mounted on the main structure. The front doors shall be provided with concealed hinges. Module doors shall be interlocked mechanically with isolator/fuse switch/ACB/MCCB to prevent unintentional opening of the door while the unit is in energized condition. Means for defeating this interlock shall be provided.
- Padlocking arrangement shall be provided to permit locking of the isolator / fuse switch in "OFF" position.

- The main and control contacts shall be self-aligning type suitable for taking a mismatch up to +/- 4 mm.
- The main power contacts shall be capable of withstanding a short circuit current.
- Each vertical Panel shall be fitted with a label on the front and rear. The PMCC as a whole shall also be fitted with a label indicating the switch gear rating and duty. Each relay, instrument, switch, fuse, contactor etc. shall be provided with a separate label. OIL/PMC shall approve type and wording of all labels.

5.8 Incomer Termination

Incomer termination shall be suitable for receiving bus trunking or cable. Cable termination shall invariably be through terminal blocks or brought out solid terminals.

5.9 Air Circuit Breaker (ACB)

All Air Circuit Breakers shall be 4-Pole with minimum 50 kA breaking capacity conforming to IS: 13947 (Part - II). Rated current shall be as per approved capacities. The equipment shall be complete with following:

- Air circuit breakers shall be draw-out type, with 3 positions (isolate, test, service).
- Necessary isolating plugs and sockets.
- Necessary mechanism interlock and automatic safe shutters gear with arrangement for pad locking.
- The motor operated spring charged mechanism shall be complete with motor, opening spring, closing spring and all accessories to make the mechanism a complete operating unit.
- 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.
- The charging mechanism shall be provided with mechanical indicators to show “charged” and “Discharged” conditions of the springs. Failure of any spring, vibration or mechanical shock shall not cause tripping or closing of the circuit breaker.
- 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.
- The circuit breaker mechanism shall make one complete closing operation, once the push button has been operated and the first device in the control scheme has responded, even

though the PB is released before the closing operation is complete, subject to the condition that there is no counter-impulse for tripping.

- 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 be provided on the operating mechanism.
- All operating mechanisms shall be provided with "ON"-"OFF" mechanical indication as well as electrical indication.
- Necessary bus bars with bolted type neutral links.
- ACB shall be provided with microprocessor-based releases having built in over load, short circuit & earth fault protection. Microprocessor release shall be EMI/EMC certified.
- Necessary set of auxiliary switches.
- Necessary set of CTs with ratios as approved.
- Necessary identification, metering requirements as specified in incomer. ON-OFF indication lamps, selector switches, fuses, ammeter, voltmeter, etc.
- In case of 4 pole breaker neutral shall be fully rated with adjustable settings from 50% to 100% of I_n.

5.10 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 equals to the ultimate short-circuit capacity.
- Each pole of MCCB shall be fitted with a bi-metallic thermal element for inverse time delay protection and a magnetic element for short circuit protection. Alternatively, they shall be fitted with a solid-state protection system. Such a protection system shall be fully self-contained, needing no separate power supply to operate the circuit breaker tripping mechanism. Thermal element shall be adjustable. Adjustments shall be made simultaneously on all poles from a common facility. Thermal elements shall be ambient temperature compensated.
- The MCCBs shall be provided with the following features.
  - Common trip bar for simultaneous tripping of all poles
  - Shrouded terminals
  - Time for clearing short circuit current of 20 sec.

5.11 Miniature Circuit Breaker (MCB)

- 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 so that tripping of one pole simultaneously trips all the other poles.
- The magnetic element tripping current classification shall be of the type suitable for the connected load. Where this is not specified, it shall be Type "C".
- The short circuit rating shall be not less than that of the system to which they are connected.

5.12 Motor Starters

- All motor starters which have starting time less than 6second shall conform to type-2 co-ordination. Motor starters which have starting time greater than 6seconds, Contractor shall follow switchgear manufacturer suggestions.
- Air break starter contactor shall be electro-magnetic type for uninterrupted duty as per IS:2959 unless specified otherwise. The insulation class for the coils shall be class 'B'. Each Contactor shall be provided with 2NO + 2NC auxiliary contacts. In case these are not available in the main contactor an additional auxiliary contactor shall be provided.
- Thermal overload relay shall be of three-element positive acting bi-metallic ambient temperature compensated type with adjustable setting. These relays shall be hand reset type.
- Relay shall be either directly connected or CT operated as per Manufacturer's recommendation depending on motor KW rating. Reset button shall be independent of start/stop push button.
- Motor starter feeder shall have provision for Local Push Button Station.
- Motor starter feeder shall have arrangement for following minimum feedback and commands, further the selection on feedback and commands shall be as per process requirement –

5.13 For DOL

- Auto/Manual feedback
- Trip feedback
- Run feedback
- Start stop command

5.14 For RDOL

- Auto/Manual feedback
- Trip feedback
- Forward/Open feedback
- Reverse/Close feedback
- Forward/Open command
- Reverse/Close command

5.15 For VFD driven uni-directional feeder

- Auto/Manual feedback
- Trip feedback
- Run feedback
- Start stop command
- 4-20mA analog variable

5.16 For VFD driven bi-directional feeder

- Auto/Manual feedback
- Trip feedback
- Forward/Open feedback
- Reverse/Close feedback
- Forward/Open command
- Reverse/Close command
- 4-20 mA analog variable

5.17 Control/Selector Switches

- All control/selector switches shall be flush mounted on module door and shall be rotary, stay put, maintained contact. Ammeter selector switches shall have made before break feature.
- The selector switches shall have four positions for reading three phase currents and fourth shall be 'OFF' position. The Voltmeter selector switch shall have five position – three for the phase-to-phase voltage, the fourth for phase to neutral voltage and fifth shall be 'OFF' position. Remote/Local/Off selector switches for motor feeders shall be lockable in 'OFF' position. Properly designated escutcheon plates clearly marked to show the operating position shall be provided with all switches.

5.18 Current Transformers (CTs)

- Current transformers shall be cast resin wound primary or bar primary type and shall be able to withstand the thermal and mechanical stresses arising from the maximum short circuit and momentary duties of the equipment. The secondary rating of current transformers shall be 1A.
- The polarity markings shall be clearly marked on the CTs and the lead termination of the terminal block.
- The core laminations of the CTs shall be high-grade silicon steel. Magnetizations characteristics, performance calculation and protection settings of the CTs shall be provided.
- The accuracy class for CTs shall be 1.0 and 5P20 for Metering and protection purposes respectively. Where multi-ratio current transformers are provided and VA ratings of the current transformers shall be indicated; a label shall be provided, clearly indicating the connection required for alternative ratios.
- These connections shall also be shown on Panel wiring diagrams. Identification labels shall be fitted giving type, ratio, output and serial numbers and duplicate rating labels shall be fitted on the exterior of the mounting chamber suitably located to enable reading without the removal of any cover or metal sheeting forming part of the structure of the switch board.

5.19 Indicating Lamps

On all the incomers of panels, ON/OFF indicating LED lamps shall be provided and shall be suitable for operation on AC supply. Lamps shall be provided with suitable current limiting series resistors. Translucent lamp covers shall be provided to diffuse light.

5.20 Push Buttons

- Start/stop push buttons shall be suitable for Panel mounting and comprise of a contact element and actuator.
- The contacts shall be of 5A continuous current rating at 240VAC. Each push button shall be provided with 2NO + 2NC contacts. Colour of push buttons shall be RAL7032. Emergency stop push buttons shall be lockable in operated position. Push button knob for emergency stop push buttons shall be shrouded to prevent accidental operation.

5.21 Space Heaters

- Each cable alley and busbar chamber shall be provided with space heaters to prevent moisture condensation and maintain cubicle temperature above the ambient.
- The space heaters shall be located at the bottom of the switchboard and shall be controlled through a thermostat with an adjustable setting and a manually operated switch. For space heater 6A DP switch shall be provided.
- Each vertical Panel shall also be provided with 6A plug socket & switch.

5.22 Contactors

- Power contactors shall be air break type, having three power contacts and 2NO + 2NC auxiliary contacts conforming to IS: 2959. Contactors provided shall be AC-3 Duty type as per IS: 3947 Part 4.
- It shall be capable of making and breaking starting current of motors of corresponding rating. Auxiliary contacts shall be rated for at least 6A and shall be break before make type. Insulation class of coil shall be minimum class B.

5.23 Fuses

- All power and control fuses shall be of link type. Screw type 'DZ' fuses will not be acceptable. All fuse links shall be HRC cartridge type and shall generally conform to IS: 22025.
- Re-wire able fuses will not be acceptable. Fuses shall be provided with visible indicators to indicate operation status.
- Fuses shall comply with the requirements of IS:9224, Part-2. All fuses shall be readily accessible for replacement. It shall not be necessary to remove any piece of equipment or to disconnect wiring for replacing the fuses. Fuses carriers and solid link carriers and bases shall be made of plastic molded insulating material of an approved make. Ceramic materials will not be accepted. Fuses and links functionally associated with the same circuit shall be mounted side by side.

5.24 Switches

Switches shall be air break type as per IS:4047. The switch operating handle shall be front mounted and interlocked with the door such that the door cannot be opened when the switch in 'ON'. The live parts shall be shrouded with suitable insulating barriers so as to prevent accidental contact with the live parts after opening the module front door. Motor control switches shall be suitable for reliable and safe starting and stopping of 3 phase AC motors even under heavy starting locked rotor conditions. Switches shall be heavy duty, quick make and quick break type AC 3 duty. Switch contacts shall be silver plated and contact springs shall be of stainless steel. Switch handles shall have provision for locking in both open and closed positions. Mechanical ON-OFF indication shall be provided on the switches.

5.25 Indicating Meters

All voltmeters and ammeters shall be flush mounted of size minimum 96mm conforming to class 1.0 of IS:1248 for accuracy. All voltmeters shall be protected with MCB.

- Ammeter with suppresses scale current rating shall be provided for specific requirements.
- Instrument dials shall be white with black numbers and lettering. Dials shall be Parallax free. All indicating instruments shall have provision for zero adjustment outside the cover.

- Normal maximum Meter reading shall be of the order of 60% of normal full-scale deflection. Watt-hour Meters shall be of the induction type and shall be provided with reverse running stop. One power factor Meter shall be provided for the incoming feeder of PMCC.

5.26 Internal Wiring

All internal wiring for controls, indications, etc. shall be of with suitable FRLS copper conductor cables. Wiring shall be suitably protected within switch board. Runs of wires shall be neatly bunched, suitably supported and clamped. Means shall be provided for easy identifications of the wires. Identification ferrules shall be used at both ends of the wires. All control wiring meant for external connections are to be brought out of terminal board.

- Internal wiring for control circuits shall be made with 650V grade single or multi-strand copper PVC wires. The minimum size of control wiring shall be 1.5sqmm copper for power, CT and other circuits. The wiring shall be terminated in the respective terminals with suitable crimp type sockets. There shall not be more than two wires connected to a terminal. Horizontal as well as vertical wire ways shall be provided. At the top, a horizontal wire way shall connect the inter Panel wiring.
- Internal wiring terminal blocks shall be of 650 V grade with contacts of rating not less than 10 amps. They shall be of the screw type with barriers between adjacent contacts. The wire termination to the terminal block shall be of the screw type suitable for crimp type sockets.

5.27 Power Cable Termination

Gland plates of adequate size and 3mm thickness shall be provided at the bottom of cable chamber to facilitate cable entry from bottom. Double compression type, Nickel chrome plated brass gland shall be provided. Crimp type sockets made of tinned copper or aluminium shall be provided for terminating cables. Suitable shrouds shall be provided to prevent accidental contact with live outgoing terminations of other feeders while carrying out maintenance of one feeder. The individual cores of power and control cables shall be neatly dressed and supported at regular intervals inside the cable chamber, before connecting them to the relevant terminals. Termination kits for cable terminations shall be provided, as required.

5.28 Labels

Labels shall be anodized aluminium with white engraving on black background. They shall be property secured with fasteners.

5.29 Control / Auxiliary Power Circuits

- Control circuit voltage shall be 230VAC. Auxiliary power supply voltage shall be 240VAC, tapped from before the switch-fuse unit of the incomer with isolating switch and fuses.
- All wiring for control & auxiliary power circuits shall be colour coded as follows:

AC circuits with	Red, Yellow or Blue determined by the phase which the wire is associated

AC phase wire	White
AC neutral	Black
DC circuits	Grey
Earth connections	Green

- Printed 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. Ferrules shall fit tightly on the wires, without falling off when the wire is removed. Ferrules shall be of white colour with black lettering.
- Each wire shall be identified by a letter to denote its function followed by a number to denote its identity, at both ends. Unused cores of multicore cables shall be ferruled U1, U2 etc., at both ends and connected to spare terminals. Spare auxiliary contacts of electrical equipment shall be wired to terminals blocks.

5.30 Control Wiring Terminal Blocks

- Terminal blocks shall be screwing clamp, rail mounted type for connection of copper conductors. Rating shall not be less than 10A.
- All terminals and terminal rails shall be numbered for easy identification the same number shall reflect in control wiring drawings for ease of identification.
- Not more than two wires shall be connected on one terminal. Where duplication of terminal block in necessary, suitable solid bonding links shall be incorporated in the design of the terminal block.
- Provision shall be made to insert terminal labels or shrouds between two successive insulating barriers.
- Connections to the terminals shall be at the front. Terminals shall be numbered for identification and grouped according to function and engraved black-on-white labels shall be provided on the terminal blocks describing the function of the circuit.
- Terminals for circuits with voltage exceeding 125V shall be shrouded. Terminal blocks at different voltages shall be segregated into groups and distinctively labeled.
- Current transformer secondary leads shall be brought to terminal blocks, where a facility shall be provided for short circuiting and grounding the secondary.
- All wiring shall be terminated on terminal blocks, using crimping type lugs. 20% spare terminals shall be provided in each terminal block.

5.31 Earthing of Switchgear / Distribution Boards

- Each switchgear / Distribution board shall be provided with an earth bus running along its entire length. The earth bus shall be located at the top/bottom of the board/Panel.
- Earth bus shall be adequately sized to carry the rated symmetrical short circuit current of the associated board / Panel for one second. Necessary calculations shall be done for selection of busbar sizes.
- Earth bus shall be supported to withstand stresses generated by the short circuits & momentary current of the associated switchgear / distribution boards.

- Positive connections of all non-current carrying metallic parts and the frames of equipment mounted in the switchgear / distribution board to the earth bus shall be maintained through insulated conductors of adequate size. Earthing of draw out equipment frames shall be achieved through a separate plug-in-contact.
- All instrument and relay cases shall be connected to earth bus by means of 650V grade, PVC insulated, stranded and tinned copper, 1.5sqmm conductor, looped through the earth terminals of the case.
- The scope of Work will also include the rubber mat required to be spread in front of all the Panels. The mat shall have a thickness of 12.5 mm and shall have dielectric strength suitable for the Panel voltage ratings.

Parameter for LT Switchgear

1.0	**Site Conditions:**	
	Maximum ambient temperature	50^0C
	Minimum ambient temperature	5^0C
	Relative humidity	95%
	Altitude	150 m above MSL
	Environment	Tropical
	Ratings	
	Rated voltage , phase and frequency	415VAC, 3 phase, 4 wire, 50Hz
	Type of construction	• Single/double front, fixed compartmentalized type for PMCC • Single/double front non-compartmentalized type for MCC and Local control panels
	Maximum system voltage	457V
	One minute power frequency withstand voltage	
	Power circuit	2500V
	control circuit	1500V
	Auxiliary circuit connected to secondary of CTs	2000V
	Continuous current rating of bus bar under site reference ambient temperature of 50^0C	To be decided by the Contractor on the basis of the plant load.
	short circuit withstand for bus bars and droppers	
	Short time (1 sec) at 415 V	to be decided by the Contractor based on the fault level available at HV side and the impedance of the transformer

	Dynamic rating	To be decided by the Contractor based on the fault level at LV side
	Starters	
	Type	• For motor ≤ 7.5KW: DOL • For motor 10KW to 55KW: Star Delta • For motor 75KW: Soft Starter • VFD shall be used as per process requirement
	Contactor rated duty as per IS: 2959 and 25544	Uninterrupted
	Utilization category as per IS: 2959 and 25544	AC3
	Cable entry	Top or bottom

5.32 Tests

The design of the switchgear / distribution board shall have been type tested in accordance with the relevant sections of IS: 25623. In absence of type test certificates, the following type tests have to be carried out by the Contractor free of charge to the satisfaction of OIL/PMC. Verification of short time current withstands and peak current withstand of main and vertical bus bars.

- Temperature rise tests on main bus bars, b\vertical risers, power contacts and control contacts.
- Routine test shall be conducted on the Panel in accordance with IS: 25623.
- Dielectric tests.

6 Motors

- Materials, workmanship and standard: All the materials used in the manufacture of motors shall be of high grade, free from defects and imperfection.
- The motors shall be built to conform to the Indian Standard Specification as listed below along with other relevant codes.

IS: 325	Induction motors
IS: 1231	Dimensions of 3 phase foot mounted induction motors
IS: 4691	Degrees of protection provided by enclosure for rotating electrical machinery
IS: 4729	Measurement and evolution of vibration of rotating electrical machinery
IS: 6362	Methods of cooling of rotating electrical machines

6.1 Type

- Squirrel cage, horizontal shaft mounting, induction motor for indoor duty shall be TEFC with IP54 protection. Motors for outdoor duty shall be TEFC with IP-55 protection.
- The motors used shall be of high efficiency; minimum eff2 motors shall be used.
- For potentially explosive areas flameproof motors shall be used, the selection shall be made on the basis of its zone of installation.

6.2 Insulation

Motors shall be provided with class 'F' insulation with temperature rise limited to class 'B' insulation. The insulation shall be given tropical and fungicidal treatment for successful operation of motor in hot, humid and tropical climate as per applicable standard. For motors for outdoor duty, account shall be taken of heating due to direct solar radiation.

6.3 Speed

Speed of motor shall be selected based on its application. The manufacturer shall furnish the recommended standard and the economical speed.

6.4 Cooling

Motors shall be either fan cooled or self-ventilated. The Fan shall be mounted on the motor shaft only.

6.5 Fans

For TEFC motors axial flow fans shall be mounted on rotor shaft for efficient circulation of air. Fans shall be of corrosion resistant made up of die cast Aluminium or Polypropylene. They shall be suitable for rotation in either direction without affecting motor performance.

6.6 Bearings

- Motors shall preferably have greased lubricated ball or roller bearings. The bearings shall be adequate to absorb thrust produced by the motor and driven equipment assembly. Bearings shall be lubricated by grease injection from outside.
- In case of oil lubricated bearings, a drain plug and oil level sight glass to be provided.

6.7 Terminal Box

Terminal box of the motor shall be suitable for top and bottom entry of cables and capable of being rotated through 360^0 in step of 90^0. The box shall be of weather proof spring washer, check nuts, cable glands and lugs. The terminal box shall have sufficient space for installation of termination kit. Separate terminal box shall be provided for space heater etc.

6.8 Overloads

The motor shall have the standard short time overload capacity permitted by the applicable standard. The motor ratings shall be at least 15% over the BHP required by pump/ equipment at duty point or 10% above the maximum HP required by the pump / equipment in its entire operating range, whichever is higher.

6.9 Variations

The motor shall be capable of producing rated output without reduction in life span when operated under either of the following variations in supply conditions:

- Variation of supply voltage from rated value : + 10 %
- Variation of supply frequency from rated value : + 5 %
- Combined voltage and frequency variation : 10% (absolute sum)

The motor shall be capable of starting and accelerating the driven equipment with applicable method of starting without exceeding the temperature rise limit as 25.5% of rated voltage at motor terminals.

6.10 Noise and Vibration

The motor shall be designed to operate with least noise and vibration. Special precaution shall be taken for smooth running of the motor. The noise level must be within the limit of international standards.

6.11 Shaft

The rotor shaft shall be forged to shape from open hearth carbon or alloy steel and heat treated to obtain high rigidity.

The shaft shall be designed to rotate without vibration and distortion at 25% over the rated speed and shall have ample strength and stiffness to resist twisting on short circuit. The normal speed and the critical speed of the shaft shall be stated.

6.12 Lubrication System

The bearing shall be equipped with all accessories and devices for lubricating the bearings while the motor is in service. Oil cooling / grease cooling arrangement shall be provided.

6.13 Number of Starts

The motor shall be designed to allow the required number of consecutive starts for the application envisaged with at least 1 hot restart.

6.14 Space Heater

The outdoor motors and indoor motors rated 30KW & above shall be provided with space heater.

6.15 Balancing

The motor shall be balanced both statically and dynamically so as to run perfectly, smoothly vibration-free. Site balancing of the motor and driven equipment shall also be done during trial running before commissioning.

6.16 Earthing

Two earth terminals shall be provided for the motors on base. One separate earth terminal shall be provided inside the terminal box.

6.17 Painting

External parts shall be finished and produce neat and durable surfaces which will prevent rusting and corrosion. The surface shall be degreased and all rust, scales, sharp edges removed and treated with red oxide primer and two coats of finish paint as per shade 632of IS:5.

Parameters for Motor

1.0	**Site Conditions**	
	Maximum ambient temperature	50^0C
	Minimum ambient temperature	5^0C
	Relative humidity	95%
	Altitude	150 m above MSL
	Environment	Tropical
	Application	As per process equipment
	Type	Squirrel cage induction type
	Efficiency	eff2
	System voltage phase, frequency	415 V, 3pH, 3 wire , 50 Hz
	Starting method	DOL/Star-Delta/Soft starter/VFD

	Starting current restriction	6 x FLC in DOL and 2 x FLC in S/D
	Type of insulation	Class F
	Space heaters	For motors rated 30 KW and above

6.18 Tests

The following routine tests in accordance with IS:325 of latest edition shall be performed in presence of the Engineer:

- Insulation resistance test.
- Measurement of no load current and speed at rated voltage and rated frequency.
- Measurement of locked rotor current at reduced voltage or rated voltage and at rated frequency.
- High voltage test.
- Reduced voltage running up test at no load to check the ability of motor to run up to full speed at no load in both the directions of rotation with one third of rated line voltage applied to stator terminals.

The following additional test shall be performed to verify the performance, characteristics and guarantees. They shall be in accordance with IS: 325 of latest edition:

- Measurement of stator resistance
- Temperature rise test
- Momentary overload in torque test
- High voltage test
- Over speed test

Each type and rating of the motors should have been type tested in accordance with IS: 325. In absence of type test certificates, type tests shall be carried out without any extra cost to OIL.

7 Power and Control Cables

7.1 HT Cable

- Cable of 11KV (Earthed) grade shall be armoured & conform to IS: 7098 (Part-II). The size of the cable shall be suitable for adequate electrical loading with multi-stranded, Compacted, circular shaped, aluminium conductors. The conductor screen and insulation screen both shall be extruded semi-conducting compound and shall be applied along with the XLPE insulation in a single operation of triple extrusion so as to obtain continuously smooth interfaces. Method of curing for cable shall be day curing / gas curing /steam curing.
- The necessary calculations such as voltage drop calculation, fault calculation, etc. shall be done for sizing of cables.
- The metallic screen of each core shall consist of copper tape with minimum overlap of 20%.
- The manufacture shall suitably design the semi conducting screen and shall clearly indicate the thickness and resistively of screed for both conductor and insulation. The thickness of this screen and resistively shall be as per requirement of relevant IS.
- XLPE insulation shall be suitable for a continuous conductor temperature of 90^0C and short circuit conductor temperature at 250^0C.
- The cable shall have distinct extruded PVC inner sheaths and outer sheaths of black colour as per IS. The armouring shall be of galvanized steel as per relevant IS.

7.2 LT Cable

- Cables for low & medium voltage and industrial heavy-duty application shall be multicore XLPE insulted PVC sheathed and armoured of voltage grade 1100V conforming to IS:7098 Part-I. Conductor shall be stranded Aluminium/Copper for power cable and stranded Copper of size 1.5 mm for control/signal cables.
- **The cable sizes up to 4 sq mm shall be copper conductor and 6sqmm and above can be copper/aluminium conductor**.
- The necessary calculations such as voltage drop calculation, fault calculation, etc. shall be done for sizing of cables.
- Cable for internal wiring purpose in conduits shall be single core stranded copper conductor, PVC insulated conforming to IS:694.
- All cable shall be delivered to site as complete coils with wrapping in non-returnable drums and seals intact, accompanied by manufactures test certificate and indicating the date of test.
- The length of cable on each drum shall be determined by the manufacture considering the transport limitations from works to site.

- The Contractor shall obtain OIL's project management consultant' approval for the drum length before packing cables on drums. No joints shall be allowed unless the actual length required is more than a drum length.

7.3 Construction of 650V / 1100V Grade Cables

- The cables shall be of stranded aluminium/copper conductor, XPLE insulated extruded inner and outer PVC sheath, flat / round galvanized steel armour.
- Cables up to 10sqmm conductor size have round steel wire armour. Above 10sqmm size flat steel armour shall be used. For 3½ core cables the current carrying capacity of the neutral conductor shall be 75% of that of the main phase conductors.
- The cables shall operate satisfactorily without any damage / deformation in shape and size at site conditions and at a continuous conductor temperature of 70^0C.
- The cables shall successfully withstand the rated short circuit current for the duration specified by the manufacture without exceeding conductor temperature of 160^0C.
- Cores shall be identified by different colors of PVC insulation. Following colour scheme shall be adopted.

Single Core	Red, Black, Yellow or Blue
Twin Core	Red and Black
Three Core	Red, Yellow and Blue
Three & half Core	Red, Yellow, Blue and Black

- For multicore cables, cores shall be numbered. Further spare cored shall be provided in control cables as follows:

up to 5/C	No spare core
Above 5/C up to 9/C	1 spare core
Above 9/C up to 14/C	2 spare cores
Above 14/C	3 spare cores

- Control cable cores shall be 3/C, 5/C, 7/C, 9/C, 14/C & 19/C.
- The cable shall be selected based on the following criteria:
  - Continuous current of the circuit
  - Maximum voltage drop of 15% during starting and 3% during normal running condition of the equipment.
  - Short circuit withstand time corresponding to system fault current and fault clearing time by the circuit protection.
  - Various de-rating factors for ambient air temperature, type of laying, grouping etc.

7.4 Cable Laying

- In open ground the cables shall be laid in buried trench of 750m deep and 450mm wide, covered with 75mm height fill of fine river sand all over the cables and one layer of brick placed on the sand filled with earth up to ground level, including excavation, laying of cables, bricks and filings of the sand and earth.
- For lying of cable under the roof, above ground or inside the concrete trench, ladder type GI cable trays shall be used; same shall be supported by MS angles at maximum interval of 1500 mm.
- Minimum gap between cable trays in a rack shall be 250 mm. All cable trays and supports shall be provided with red oxide primer following by 2 coats of finish paint of shade 632 of IS:5. The earth continuity of cable trays shall be maintained between each section of cable tray.
- Each run of cable tray shall be effectively bonded to an earth continuity conductor.
- When the cables are passing under the road, Hume pipe/GI pipe shall be used for mechanical protection from one end of the road to another.
- The minimum safe bending radius for al type of PVC cables shall be 12 times the overall diameter of the cable.
- Wherever practicable, large radius may be provided. At joints and termination, the bending radius of individual cores of a multi core cable shall not be more than 15 times its overall diameter.
- Cables of different voltages and also power, control and signal cables shall be put in different trenches or racks with adequate separation. Power and control/signal cables shall as far as possible cross each other at right angles.
- All cables should be suitably earthed. The cable termination with glands etc. shall be provided.

7.5 Tests

- Routine tests as per IS: 7098 shall be carried out for each type & size of cables used for the project. Type test certificates to be furnished. In absence of type certificates for each test shall have to be carried out without any extra cost to OIL.
- At site after installation, HV test & continuity test shall also be done on cables:
- The LT cable termination shall include the following:
  - Making necessary holes in bottom gland plates for fixing cable gland.
  - Fixing cable gland, connecting armour clamp to cable armour.
  - Dressing cable, provide termination kit, necessary to make termination complete.
  - Putting cable lugs, crimping them on to cores of cables, taping base conductors up to

lugs wherever necessary.

- Termination of individual core to equipment terminals.
- Supply and fixing of cable & core identification ferules.

8 Interconnection between 11KV Line and HT Substation

The intent of the specification is to define the general requirements of 11KV cable connections through trifurcating cable seal end box from the tapping to the transformer substation of Municipal Solid Waste Processing Facility.

8.1 Codes and Standards

All standards, specifications and codes of practice referred to below, shall be of the latest editions including all applicable official amendments and revisions as on date of opening of the Bid. In case of conflict between this specification and those (IS Codes, Standards, etc.) referred to herein, the former shall prevail. All Work shall be carried out as per following standards and codes:

IS: 104	Ready mixed paint brushing, zinc chrome priming
IS: 3925	Aluminium conductors for overhead transmission purposes
IS: 12425	Electrical indicating instruments
IS: 2099	Bushings for AC voltage above 1000 V
IS: 24256	Inductor fittings for overhead power lines, with nominal voltage greater than 1000V
IS: 2551	Danger notice plates
IS: 2540	Porcelain post insulator above 1000 KV
IS: 9920	AC Switches above 1000 V

9 Variable Frequency Drive

The drive should be designed to meet the following specifications:

9.1 Input Power

The drive should be self-adjustable to accept an input supply voltage of AC, 3 phase& neutral of 415 V ± 10%, 50Hz ± 5%.

9.2 Environment

- Storage ambient temperature range: -10 to 50^0 C.
- Operating ambient temperature range: 5 to 50^0 C without de-rating.

9.3 Output Power

The output voltage should be adjustable from 0 to rated input voltage. The output frequency range should be adjustable from 0 to 50Hz. The inverter section shall produce a pulse width modulated (PWM) waveform using latest generation techniques.

9.4 Design Hardware

The drive hardware shall employ the following power components:

- Diode or fully gated bridge on the input.
- DC bus inductor on all ratings as required.
- Switching logic power supply operating from the DC bus.
- Phase to phase and phase to ground MOV protection.
- Microprocessor based inverter logic isolated from power circuits.
- Latest generation inverter section.
- Inverter section shall not require commutation capacitors.
- Customer Interface common for all horsepower ratings. Interface shall include an LCD digital display, programming keypad and operator keys option.
- Common control connection for all ratings.
- Peripheral Interface to enable attaching common options.

9.5 Control

The drive should be programmable or self-adjusting for operation under the following conditions:

- Operate drive with motor disconnected.

- Controlled shut down, when properly fused, with no component failure in the event of an output phase to phase or phase to ground short circuit and annunciation of the fault condition.
- Adjustable PWM carrier frequency within a range of 2-25KHz. Selectable Sensor less Vector or V/Hz mode.
- Selectable for variable or constant torque loads. Selection of variable torque shall provide 115% of rated VT current for up to one minute. Selection of constant torque shall provide 150% of rated CT current for up to one minute.
- Multiple programmable stop modes including – Ramp, Coast, DC-Brake, Ramp-to-Hold and S-curve.
- Multiple acceleration and deceleration rates.
- Adjustable output frequency up to 50 Hz.

9.6 Power Conditioning

- The drive should be designed to operate on an AC line which may contain line notching and up to 10% harmonic distortion. An input isolation transformer shall be required for protection from normal line transients and the K factor shall be 4.0 or less.
- PF shall, after rectification, if required for lower frequencies shall not be lower than 0.95.

9.7 Features

9.7.1 Interface:

The drive shall provide a removable Human Interface Module to show drive operating conditions, adjustments and fault indications. The display should be removable under power without causing a fault and shall be visible and operable without opening the enclosure door. The display shall consist of 2 lines of 16-character alphanumeric, backlit LCD with the display being configurable for simultaneously displaying two values using customized multi-lingual text and user scaled units. The module also shall provide LED indication of drive direction and commanded direction. The display should be capable of remote mounting by means of cable connection up to 10 Meters (33ft) from the drive and shall be capable of being used as a hand-held terminal.

9.7.2 Control Mode:

Programming shall provide the ability to select sensor less vector or V/Hz mode. The sensor less vector mode shall use the motor nameplate data plus motor operating data, such as IR drop, nominal Meter current and Meter up time. The volts per hertz mode shall be programmed for squared, cubed, straight-line, pre-programmed or full custom patterns.

9.7.3 Current Limit:

Programmable current limit shall be from 20% to 160% of constant torque rating. Current limit should be active for all drive states; accelerating, constant speed and decelerating. The drive shall employ PI regulation with an adjustable gain for smooth transition in and out of current limit.

9.7.4 Acceleration / Deceleration:

Acceleration / Deceleration setting shall provide separate adjustments to allow either setting to be adjusted from 0 seconds to 3600 seconds. A second set of remotely selectable acceleration/deceleration setting shall be accessible with Control interface option. An adaptive current limit circuit shall be disabled in programming for fast acceleration of low inertia loads.

9.7.5 Speed Regulation:

The programmable speed regulation modes shall include the following:

- Open Loop
- Slip Compensation with 0.5% speed regulation
- Droop – Negative Slip Compensation with 0.5% speed regulation
- Traverse Function
- Closed loop encoder feedback with 0.1% speed regulation
- Process PI control

9.7.6 Speed Profiles:

Programming capability shall allow the user to produce speed profiles with linear acceleration/ declaration or "S-Curve" profiles that provide changing acceleration/deceleration rates. "S-Curve" profiles shall be selectable for fixed or adjustable values.

9.7.7 Adjustments:

- The digital interface should be used for all set-up, operation and adjustment settings.
- All adjustments shall be stored in non-volatile memory (EEPROM). No potentiometer adjustments shall be used.
- The drive shall provide EEPROM memory for factory default values.

9.7.8 Process Control:

- The internal process PI regular shall have both proportional and integral gain adjustments well as error inversion and output clamping functions. The feedback shall be configured for normal or square root functions.
- If the feedback indicates that the process shall be moving away from the set point, the regulator shall adjust the drive output until the feedback equals the reference. Process control shall be enabled or disabled with a hardwire input.

- Transitioning in and out of process control shall be tuned for faster response by preloading the integrator. Protection should be provided for a loss of feedback or reference signal.

9.7.9 Run for Power:

A user programmable restart function should be provided to automatically restart the equipment after restoration of power after an outage. A maintained 2-wire start input shall be provided for this function.

9.7.10 Line Loss Restart:

This programmable function shall select the reconnect mode of the drive after recovery from a line loss condition. The reconnect modes shall be – Last Speed.

Speed Search, Track Volts, or Use Encoder. Disabling this feature will force the drive to start from zero hertz.

9.7.11 Overload Protection

The drive shall provide Class 20 motor overload protection. Overload protection should be speed sensitive and adjustable for motors with speed ranges of 2:1, 4:1 and 10:1. A viewable Parameter shall store the overload usage in percent. An alarm bit shall be used to adjust a process to eliminate an overload trip.

9.7.12 Auto Economizer:

- This feature automatically shall reduce the output voltage when the drive shall be operating in an idle mode (drive output current less than programmed motor FLA).
- The voltage should be reduced to minimize Meter current in a lightly loaded motor thus reducing KW usage. If the load increases, the drive shall automatically return to normal operation.

9.7.13 Terminal Blocks:

Separate terminal blocks shall be provided for control and power wiring.

9.7.14 Flying Start:

The drive should be capable of determining the speed and direction of a spinning motor and adjusts its output to “pick-up” the motor at the rotating speed. The flying start feature should be operable with or without encoder feedback.

9.7.15 Ride Through:

The control logic should be capable of “riding through” a power outage of up to 2 seconds in duration.

9.7.16 Analog Output:

- An output signal should be jumper selectable for 0–10VDC or 0–20mA which shall be user programmable such that it shall be proportional to one of 13 process Parameters including output frequency, output current, output power and other.
- A programmable offset should be provided to allow modification of the analogue output to obtain 2–10VDC or 4–20mA. Programmable gain adjustments for both upper and lower settings shall allow for system calibration.

9.7.17 Reference Signals:

The drive should be capable of the following input reference signals:

- Digital pulse input
- Digital MOP
- Remote potentiometer
- Serial
- 0–10VDC
- 4–20mA

The remote potentiometer should be also programmable to be used as a trim pot for the 0–10VDC or 4–20mA signals. Programmable gain adjustments for both upper and lower setting shall allow for system calibration. The analogue inputs shall be programmable for normal, inverted or square be root operation.

9.7.18 Loss of reference:

In the event of loss of the 4–20mA reference signals, the drive should be user programmable to the following:

- Fault and stop
- Alarm and maintain last reference within 10%
- Alarm and go to pre-set speed
- Alarm and go to minimum speed
- Alarm and go to maximum speed
- Active for Process Pl reference or feedback

9.7.19 Digital I/O:

Contact output ratings shall be 230VAC/30VDC, 5.0 Amp resistive, 2.0 Amp inductive. All four contacts shall be provided with programmable to different conditions. Factory settings shall be as follows:

- Run Contact
- Fault Contact
- Alarm Contact

9.7.20 Operator Devices:

The drive shall provide an option for Start, Stop, Jog, Reverse and Speed Control as an integral part of the Human Interface Module.

9.7.21 Control Interface:

- All control interface cards shall provide input terminals for access to fixed drive functions that include start, stop, external fault, speed and enable.
- Four additional inputs shall be to be programmed to one of 24 different input Modes for functions such as reverse, pre-set speed access, jog, second acceleration/deceleration time access, process trim, speed/torque and local control selection.
- Inputs shall be programmable to configure the drive for standard 3-wire, 2-wire, EC, 4-20 mA DC and serial operation requirements.

10 Internal and External Illumination and Other Electrical Works:

Illumination system shall consist of lighting fixtures complete with LED lamps / luminaires. All materials, fittings and appliances used in the installation shall conform to the relevant IS specification and shall be anticorrosive painted for treatment plant area.

10.1 Illumination Levels

The following minimum levels of illumination shall be provided in the respective areas:

Sr. No.	Description	Lux Level
1	Security Terminal	100
2	Weighbridge Control Station	200
3	**HT Sub-station:**	
	• HT Panel Room, LT Panel Room	200
	• Transformer Room	100
4	**Biogas Purification System:**	
	• Biogas Genset Room	200
	• Panel Room	200
	• Toilets	10
5	**Workshop & Store:**	
	• Workshop	200
	• Store	100
6	**Processing Sheds:**	
	• Working Area	200
	• Non-working Area	50
11	Parking and other Outdoor Area	20
12	Roads & Pathways	10
#	Maintenance Factor (for LED Lights): • Outdoor Area • Indoor Area	 0.8 0.9

10.2 LED Fixtures

- LED lights and fixtures shall necessarily low power consuming.
- LEDs shall operate on AC input voltage.
- LED shall not emit ultra-violate light.

Sr. No.	Description	Minimum Value
1	Input voltage AC	85-260 V
2	Input frequency	50 Hz
3	Life	50,000 glow hrs.
4	Working temperature	-5^0 to + 50^0 C
5	Working humidity	10% to 90% RH
6	Color temperature	White / Day Light
7	Wattage	<1.2 W per LED
8	Lumens / Watt	Minimum 100
9	Finishing	excellent
10	Power factor	Minimum 0.95
11	Warranty	5 years
12	Heat sink	Good thermal management system should be provided & LED must be mounted on heat Sink conductive aluminum bars With suitable large surface area by means of fins to dissipate the heat to ambient air.
13	Ingress protection level	IP 65 for lamp compartment and driver unit
14	Body of fitting	Die cast aluminum/ aluminum extrusion / aluminum sheet
15	Power efficiency	Minimum 80%

10.3 Area Lighting / External Lighting

10.3.1 External Electrification:

The scope of this specification covers design, manufacture, inspection of manufacturer's works and installation of MS/high tensile steel galvanized octagonal street light poles. The specifications of poles are as under:

10.3.2 Specifications for Octagonal Poles:

10.3.2.1 Introduction:

This specification determines the requirements of the octagonal poles in respect of design, manufacture, testing and supply of galvanized poles, base plate and bracket arms for use in street lighting.

10.3.2.2 Scope:

- This specification covers tapered octagonal single piece columns of required mounting height.
- High tensile steel octagonal poles of 3mm thickness with hot dip galvanized in the bath tub with minimum thickness of galvanizing as 36 microns.
- Galvanized base plate of MS having thickness of 25mm shall be considered.
- Octagonal poles shall be of flanged type to be fixed on the foundation bolts.

- The octagonal poles shall be designed for 180 km/hr. maximum wind speed.
- Galvanized iron junction box of adequate size, 2.7mm thick (water tight) shall be provided for each street light pole. The box shall have arrangement to receive designed size and number of cables. The terminal strip selected shall be suitable for the same.
- The box shall also be provided with a required rating/capacity MCB for controlling the individual lighting fixture. It shall be wired up in the respective phase.3C x 2.5sqmm PVC insulated multi-strand copper wires shall run from the junction box to the lighting fixture. The wires shall run through the pipe. The wires shall be protected to avoid any damage at the entry point by providing rubber grommet. A suitable clamping arrangement shall also be provided. An arrangement for earthing to the pole shall be provided.
- Two numbers of 50mm diameter G.I. conduits shall be provided in the foundations from the directly buried main cable up to the junction box for incoming and outgoing cables with G.I. clamps of size 25 x 3 mm.
- Suitable cement concrete foundation for the octagonal pole shall be designed by the successful bidder considering soil bearing capacity of 10 Tons/sq. m.
- An earthing bolt (M6) shall be provided with a suitable nut to receive two number of 8 SWG G.I. earth wire.

10.3.2.3 General Standards:

- Hot dip galvanizing shall be in accordance with IS 2629-1966 except otherwise modified by provisions of this specification for poles and brackets.

10.3.2.4 Material:

- The steel used shall be welded, ageing resistant and suitable for hot dip galvanizing when such surface protection is required.

10.3.2.5 Manufacture:

- The octagonal pole shall be evenly tapered with single longitudinal welding from base to top. It shall be fabricated in one single section and shall be no circumferential weld joint.
- Electrodes used shall be compatible with the grade of steel being used and have mechanical properties at least equal to those of the steel used.
- All welds shall comply with the following basic requirements:

<u>Base Plate:</u>

100% penetration between plates of all thickness. No fissures on inside or outside surface. No under cutting on the outside surface. Blow holes, spherical inclusions beyond standard minimum thickness shall be refused.

Detectable angular inclusions shall not be acceptable.

Longitudinal Welds:

60% penetration between plates of all thickness. No fissures on inside or outside surface. No undercutting on outside surface. No blowholes.

10.3.2.6 Galvanizing:

- All components of the columns and brackets shall be hot dip galvanized after completion of fabrication. No further touching up, finishing or modification shall be done after galvanizing. The overall length of each section/bracket shall be immersed in one dipping operation.
- The galvanizing coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale or blister nor be removable while handling or packing.
- There shall be no impurities in the zinc or additives to the smelter bath which could have a deleterious effect on the zinc coating.
- Before pickling, all welding, drilling, cutting, binding etc. must be completed and all grease, paint, varnish, oil, welding slag etc. completely removed. All protuberances, which would affect the life of the galvanizing, should also be removed.
- During pickling each article shall be completely immersed in one dip. Care shall be taken to ensure that the pickling solution is completely removed.

10.3.2.7 Thickness of Zinc Coating:

The weight of zinc deposited shall be not less than 86 microns.

10.3.2.8 Brackets:

The bracket shall be hot dip galvanized after fabrication. The bracket shall be manufactured as per the approved drawing and with best workmanship. The bending of the pipes shall be without any kinks/visible marks. Arms shall be symmetrical.

10.3.2.9 Electricals:

The octagonal pole shall be provided with a door flush with the pole surface without any projection. Required door reinforcement shall be determined by the manufacturer. Inside the door a suitable plate shall be welded for mounting 6A MCB and neutral link. Three core 2.5sqmm copper wires shall be run for each luminaire individually.

10.3.2.10 Cable Laying:

- The cable laying shall be from supply point to the feeder pillar panel and from feeder pillar panel to street lighting poles.
- The cable from supply points up to the feeder pillar shall be laid underground in excavated trench RCC pipe and HDPE pipe. The trench shall be at least 750mm deep and 300mm wide sand cushioning of 20mm shall be provided before laying the cable. The cable shall be protected with good quality bricks on all the sides. At road crossings, the cable shall be laid in 100mm diameter RCC Hume pipe of NP-2 class or GI pipes shall be used.
- The cable from feeder pillars to the lighting poles shall be laid in suitable sized HDPE pipes buried at a depth of 750 mm. Loop of at least 1 m shall be provided on either side of the pole.
- Cables shall be laid in complete, uncut lengths from one termination to the other.

10.3.2.11 LED Fittings:

- LED lights and fittings shall necessarily low power consuming.
- LEDs shall operate on AC input voltage.
- LED shall not emit ultra-violate light.

Sr. No.	Description	Minimum Value
1	Input voltage AC	85-260 V
2	Input frequency	50 Hz
3	Life	50,000 glow hrs.
4	Interchangeability	Suitable for pole pipe bracket
5	Total harmonic distortion	<15% maximum
6	Working temperature	$-5^0$to $+50^0$ C
7	Working humidity	10% to 90% RH
8	Color temperature	White, 6000^0 K to 7000^0 K
9	Wattage	<1.2 W per LED
10	Lumens / Watt	Minimum 100
11	Finishing	excellent
12	Power factor	Minimum 0.95
13	Warranty	5 years
14	Heat sink	Good thermal management system should be provided & LED must be mounted on heat Sink conductive aluminum bars with suitable large surface area by means of fins to dissipate the heat to ambient air.
15	Ingress protection level	IP 65 for lamp compartment and driver unit

Sr. No.	Description	Minimum Value
16	Body of fitting	Die cast aluminum/ aluminum extrusion / aluminum sheet
17	Power efficiency	Minimum 80%

10.3.2.12 Area Light Control:

- All area lights inside premises are proposed to be controlled from one control pillar.
- For automatic ON/OFF operation of the area light automatic timer shall be provided with energy saving device.

10.3.2.13 Light Fittings:

The lighting fixtures shall comply with the following requirements:

- The fixture shall be suitable for operation on a nominal supply voltage of 240Volts, single phase, 50Hz with voltage variation of +/-10%. All fixtures shall be designed for minimum glare. The finish of all parts of the fixtures shall be such that no bright spots are produced, either by direct light source or by reflection. For multi lamp fluorescent fittings, the circuit shall be designed in such a manner to reduce the stroboscopic effect to a minimum.
- The lighting fixture ballast shall comply with the following requirements.
  - Fluorescent light fittings shall be of high power factor type and shall be supplied with control gear and all necessary accessories for mounting.
  - The ballast shall be of the inductive and heavy-duty type copper winding filled with polyester or equivalent. They shall be free from hum and protected from the atmosphere. HPSV lamp ballasts shall be provided with taps. For multi lamp fittings a separate choke shall be provided for each lamp.
  - Outdoor lighting shall be carried out with sodium vapour lamp fixtures. All other indoor areas shall be illuminated by using fluorescent tube fixtures or high bay sodium vapour luminaries complete with reflectors. Office areas shall have decorative type fixture.
  - All lighting fixtures shall be supplied complete with lamps and all necessary accessories for satisfactory operation. Lighting fixture reflector shall generally be manufactured from sheet steel or aluminium of not less than 20SWG.They shall be readily removable from the housing for cleaning and maintenance without disturbing the lamps and without the use of tools. The following type of lighting fixtures shall be supplied:

- Fluorescent lamp lighting fixture of standard channel mounted type, suitable for surface mounting, completely wired, complete with mounting accessories, control gear etc. and with 1No. of 36/40 watt fluorescent tube.
- Industrial type fluorescent lamp lighting fixtures suitable for surface mounting complete with internal wiring, mounting rail, vitreous enamelled sheet steel reflector, control gear, mounting accessories and with 2 Nos. 36/40 watt fluorescent tubes.
- Decorative type fluorescent lamp lighting fixtures suitable for surface mounting complete with mounting rail and internal wiring, vitreous enamelled sheet steel reflector, louver, control gear, mounting accessories and with 2 Nos. 36/40 watt fluorescent tubes.
- Industrial bulk head type fixture with 60W incandescent lamp.
- Industrial fixture with VE reflector with 60W incandescent lamp.
- 250/150/70W colour corrected outdoor heavy duty HPSV light fixture provided with clear heat resistant front glass with tropicalizing gasket and other accessories and lamp. The fixture shall have die-cast aluminium housing.
- Each fixture shall be complete with a four-way terminal block for the connection and looping of incoming and outgoing supply cable. Each terminal shall be able to accept two nos. 2.5 sq.mm copper conductor cables and shall be provided with an earthing terminal suitable for 12SWG GI wire.
- Incandescent lamp fixtures shall be well glass type, complete with die cast housing and reflector both of which shall be vitreous enamelled. The fixture shall be suitable for satisfactory use in mildly acidic atmosphere.
- Lighting fixture starters shall be of safety type i.e., if the lamp fails to ignite at the first start, no further starting shall be possible without attending to the lamp. Starters shall have bimetal electrodes of high mechanical strength.
- The enamel finish shall have a minimum thickness of 2 mils for outside surface and 1.5 mils for inside surface. The finish shall be non-porous and free from blemishes, blisters and fading. On completion of manufacture, all surfaces of the fixture shall be thoroughly cleaned and degreased. The fixture shall be free from scale, rush, and sharp edges and burrs.
- All light reflecting surfaces shall have optimum light reflecting co-efficient such as to ensure the overall uniform light output.
- The fixture capacitors shall be suitable for operation at 240VAC +/-10%, single phase, 50Hz, with a suitable value of capacitance to correct the power factor of the corresponding lamp circuit to the extent of 0.925 lag. The capacitors shall be hermitically sealed preferably in a metal container to prevent see page of impregnating material and ingress of moisture.

- Lamp holders for fluorescent tubes shall be of spring loaded, low contact resistance bi-pin rotor type, resistant to wear and suitable for operation at the specified temperature without deterioration in insulation value, contact resistance or lamp hording quality.
- Lamp holders for incandescent lamps shall be GLS type.
- Louvers shall be of polystyrene egg box type. Appropriate captive type fixing devices shall be incorporated for securing the louvers.
- For potentially hazardous/explosive are flameproof type fittings shall be used, the same shall be selected on the basis of zone of its installation.

10.3.2.14 Emergency Light Fittings:

Emergency light fitting shall be 240V self-contained 2 x 10W fluorescent tubes with built in AMF battery having charging facility and six hours back-up time. The emergency light fitting shall be provided at strategic locations of each area.

10.3.2.15 Receptacle Units:

Industrial type receptacle units of approved make of 5/15A, 240 V, 6 pin socket outlet with interlocked switches conforming to IS: 32554 and sockets conforming to IS: 1293 shall be supplied. The units shall be suitable for mounting flush on stove enameled sheet steel boxes generally conforming to IS: 5133 (Part I). At each floor/room of every building, 2 nos. of such receptacle units shall be provided. 415 V, 63 A, 4 pin power receptacles with switch shall be provided for welding sets. Welding sockets shall be provided at ground floor pipe gallery of filters and shall be fed from 415V PMCC. Welding socket shall be operated for maintenance purpose during plant shutdown when all the motor feeders from the PMCC are switched off.

10.3.2.16 Ceiling Fans:

- Ceiling fan shall be suitable for 240 V, 1 phase, 50 Hz and shall be complete with standard mounting accessories such as suspension rod, top and bottom canopy, regulator, rubber reel etc.
- The fan shall be of 1200 mm sweep and shall conform to IS:374. Fans shall be provided in offices, control rooms, Laboratory and Store.

10.3.2.17 Exhaust Fans:

- Impeller shall be with blades of aero foil design. Blades shall be mounted on stream lined hub. Impeller shall be mounted directly on motor shaft.

- Casing shall be of heavy gauge construction properly reinforced for rigidity. It shall be provided with suitable support.
- In case of vane axial fans, guide vanes shall be provided on the discharge side. Motor shall be totally enclosed and rated for 240V, 1phase, 50 Hz. The speed of the fan shall not exceed 1500RPM.
- Necessary calculations shall be done for the selection of exhaust fans; same shall be submitted for approval.

10.3.2.18 Tests:

- Type tests, acceptance tests and routine tests for the lighting fixtures, accessories and receptacles covered by this specification shall be carried out as per the relevant standard.
- Manufacturer's type and routine test certificates shall be submitted for tests conducted as per relevant standards for the fixtures, accessories and receptacles.
- The following routine tests shall be conducted as per the relevant Indian Standards.
  - Each fixture shall be tested at 1500VAC (RMS), 50Hz for one minute and no flash over or breakdown shall occur between current carrying parts and ground.
  - Insulation resistance of each fixture shall be tested at 500VDC and the insulation resistance so measured shall not be less than 2 megaohms between all current carrying parts and ground.
  - All luminaries provided with glass covers shall be subjected to thermal shock- proof test. This test shall be conducted to ensure that the cover glass will withstand sudden variation in surface temperature due to rainfall or splashing water when the lighting fixture is lit. The cover glass shall be heated in an oven to attain a steady temperature of 100^0C and then plunged into cold water. No crack should develop.
  - Contractor shall ensure use of calibrated test equipment having valid calibration test certificates from standard laboratories traceable to National.

10.3.2.19 Wiring for Illumination System:

- Wiring shall include switches, small power receptacles, lighting distribution boards complete with junction boxes, pull boxes, terminal blocks, glands, conduits & accessories and supporting & anchoring materials.
- All materials, fittings and appliances used in the installation shall conform to the relevant IS specification and shall be suitable for its application.

10.3.2.20 Type:

Wiring is to be done in the looping system without any jointing. Phase wires shall be looped in switch control points and neutral shall be looped at outlet points. For recess conduit system MS conduit and for surface conduit system GI conduit shall be used. Recess conduit system shall be used in office, laboratory, control room etc.

10.3.2.21 Point Wiring:

Point wiring shall include all works necessary to complete wiring of a switch circuit of any length from the tapping point on the distribution circuit to the following via switch with:

- Ceiling rose and connector: for ceiling / exhaust fan points
- Back plate: for fluorescent fittings with down rods etc.,
- Socket outlet: for socket outlet points
- Lamp holder: for wall brackets, bulk head and similar fittings.

The following shall be included in point wiring:

- Switch board
- Ceiling rose or connectors as required
- Any special or suitable round block for neatly housing the connector and covering the fan hook in case of fan point.
- Wooden box, bushed conduit, porcelain tubing where cable passes through wall etc.,
- Metallic covering on conduit up to 1.5 m from floor.
- Earth wire from six pin socket outlet point/fan regulator/fixture to common conduit earth wire system.
- All fixing accessories such as clips, rails, screws, pin plugs, wooden plugs etc., as required.
- Connection to ceiling rose, connectors, socket outlet, lamp holders, switch and fan regulator etc.,
- Looping the same switch board and inter connections between points on the same circuit
- Providing fish wire in conduits for recessed conduit works.

10.3.2.22 Load on Circuit:

Lighting circuits and small power circuits for sockets, exhaust fans/axial flow fans shall be separate. Each circuit shall not be loaded more than 60% of MCB rating. It shall, however, be ensured that in one switchboard, wiring of one circuit is only provided.

10.3.2.23 Size of Conductor:

The smallest copper conductor to be used for lighting circuits shall be 1.5sqmm and for power circuits 2.5sqmm. Neutral conductor and earth continuity wire shall be brought to each switchboard situated in rooms and halls. These shall be terminated inside the switchboard situated connectors. The switchboard shall be of adequate size to accommodate one number 5 amps socket outlet and required nos. of piano key type control switches with spares for future use.

10.3.2.24 Conduit Capacity:

PVC insulated cables conforming to IS: 694 – 1977 drawn in one conduit shall not occupy more than 60% of conduit capacity.

10.3.2.25 Rigid Steel Surface Conduit:

- Rigid conduits shall be solid drawn on ERW, finished with galvanized surface. No conduct less than 16 SWG for 32 mm diameter and below and 14 SWG for above 32 mm diameter shall be used. Minimum diameter of steel conduit shall be 20 mm. The conduit wiring shall be complete in all respect including accessories. Conduit shall conform to IS: 9537. Conduit pipes shall be joined by means of screwed couplers and screwed accessories only. In long distance straight run of conduit, inspection type couplers at reasonable intervals or as directed by the Engineer for easy maintenance, shall be provided. Thread of a conduit shall be between 13 mm to 19 mm long, sufficient to accommodate pipes to full threaded portion of coupler accessories.
- The layout of conduit shall be such that any condensation or sweating inside the conduit is drained out. Suitable precautions shall be taken to prevent entry of insects inside the conduits.
- The outer surface of conduit including all accessories forming part of conduit system shall be protected against rust when such system is exposed to weather by being painted with two coats of oxide paint, before they are installed. After installation, all accessible surfaces of conduit, pipes, fittings, etc., shall be painted with approved finish colour.
- Suitable junction inspection boxes according to requirements shall be provided to permit periodical inspection and to facilitate replacement or wires. If necessary, the boxes shall be mounted flush with the wall of ceiling. Minimum 65 mm depth junction boxes shall be used in roof slabs and depth of boxes in other places shall be as per IS: 2667 – 1977.

10.3.2.26 Rigid Steel Recessed Conduit:

- In this system of wiring, no bare or twist joints shall be made in through run of cables. If the length of final circuit / sub-main is more than the length of the standard coil, joints shall be made by means of approved mechanical connectors in suitable and approved junction boxes.

- The chase in the wall shall be neatly made and in ample dimensions to permit the conduit to be fixed in the manner desired. In case of buildings under construction, conduits shall be buried in the wall before plastering. These shall be grouted and covered with 1:4 cement and mortar, neatly finished at the plane of the un-plastered brick Work and cured. Under no circumstances finished plastered surfaces shall be allowed to be chased for the conduit Work. Before taking up chasing on the wall, the routes shall be marked and got approved by the Engineer. The horizontal chase shall be avoided as far as possible. In case of exposed brick / rubble masonry Work, special care shall be taken to fix the conduit and accessories in position along with the building Work.
- MS Conduit pipes shall be fixed by heavy gauge saddles secured to suitable wood plug or other approved manner at an interval of not more than one Meter but on both ends of couples or bends or similar fittings. Saddles shall be fixed at a distance of 30 cm from the center of such fittings. The saddles shall not be less than 20 gauge for larger diameter of conduits.
- All conduits after erection shall be tested for electrical continuity.
- Fixing of standard bends or elbows in roof slab shall be avoided and all curves shall be maintained by bending the conduit itself with a long radius which will permit easy drawing of wires.
- Suitable junction / inspection boxes according to requirement shall be provided to permit periodical inspections and to facilitate replacement of wires. Such boxes shall be located and arranged suitably so those are not in irregular positions. These locations shall also be specifically shown in the conduit layout of the shop drawings and approval shall be obtained before installation. However, number of such boxes shall be minimized. The boxes shall be mounted flush with the wall or ceiling. Minimum 65 mm depth junction boxes shall be mounted flush with the wall or ceiling and depth of boxes in other places shall be as per IS: 2667-1977.
- All outlets such as switches, wall sockets, etc., shall be flush mounting type.

10.3.3 Earthing:

Earthing system for the plant shall be carried out in compliance with the requirements of IS: 3043 and the following specifications:

10.3.3.1 Pipe Electrode:

GI pipe electrodes shall be of medium class, 40 mm diameter and 3 m in length. Galvanizing of the pipe shall conform to relevant Indian Standard. GI pipe electrodes shall be tapered at the bottom and provided with holes of 12 mm diameter drilled not less than 75 cm from each other and up to 3 m height from bottom. The electrode shall be buried in the ground vertically with the top not less than 200 mm below ground level.

10.3.3.2 Plate Earth Electrode:

For plate electrodes, minimum dimensions of the GI electrode shall be 600mm x 600mm x 3.15mm thick and copper electrode shall be 300mm x 300mm x 1.7mm thick. Heavy duty CI/MS frame with cover shall be suitably embedded in the masonry enclosure.

10.3.3.3 Location:

- Normally earth electrodes shall not be situated less than 2 m from any building. Minimum two (2) nos. of earth electrodes shall be provided for each building. Care shall be taken that the excavation for earth electrodes may not affect the column footing or foundation of the building.
- The location of the earth electrode shall be such that the soil has reasonable chances of remaining moist, as far as possible. Entrances, pavement and roadways shall be avoided for locating the earth electrodes.

10.3.3.4 Earthing Lead Connection:

In case of plate earth electrodes, the earthing lead shall be securely bolted to the plate with two bolts, nuts, check nuts and washers. In the case of the of pipe electrodes, they shall be connected by means of bolt, nuts, washers and cable socket. All connecting materials shall be GI construction. The earthing lead will be securely connected at the other end of above ground main earthing grid.

10.3.3.5 Equipment Earthing Connection:

Each transformer body and neutral, GOS & lightning arrestor shall be connected to separate earth electrodes by two separate distinct earth lids. LT motors, switchgear, distribution boards and other electrical equipment shall be earthed at two separate points and connected to earth electrodes through above ground main earthing grid and GI flat risers (from earth electrodes to above ground main earthing grid).

10.3.3.6 Size of Earthing Conductor:

The earth strips shall be of galvanized steel and shall be of the following sizes:

Main earthing grid	75 mm x 10 mm
LT Switchgears / Switchboards / Capacitor Panels	50 mm x 6 mm
Motors, Lighting Distribution Boards	25 mm x 3 mm
Junction Boxes, lighting fixtures, PB stations, small motors, exhaust fans etc.	4 Sq. mm flexible copper cable from earthing strip to equipment (suitable ring type lugs to be used at both ends)

The earthing system shall be designed in such a way that overall earth resistance is less than 1ohm.

The soil resistivity shall be measured at site by the Contractor. If required, number of earth electrodes to be increased by the Contractor to achieve the required earth resistance.

10.3.3.7 Earthing Pit:

Earthing pit shall be of minimum 1200mm x 1200mm. An inspection chamber of size 300 mm x 300 mm x 300 mm in cement concrete of 1:3:6, 50 mm thick for side walls and 100 mm thick for bottom, shall be provided. The chamber shall be provided with CI cover on MS frame. The cover shall be hinged to the frame and shall be with padlocking arrangement. The frame and cover shall be painted with anticorrosive paint.

A watering pipe, medium class, perforated, of minimum 20mm diameter shall be provided and to be attached with earth plate. A funnel with mesh shall be provided on the top of this pipe for watering the earth.

10.3.3.8 Testing:

The Engineer may ask the Contractor to carry out earth continuity tests, earth resistance measurements and other tests in his presence. The Contractor shall have to bear the cost of all such tests.

10.3.3.9 Type of Earthing:

Following type of earthing shall be used:

Equipment	**Type of Earthing**
Lighting Poles	GI Pipe Electrode
Transformer Body	GI Plate
Lightning	GI Plate
Motors	GI Plate
PMCC, MCC, Control Panels	GI Plate
Gas Engine Body	GI Plate
Transformer Neutral	Copper Plate
PLC Panel	Copper Plate
Gas Engine Neutral	Copper plate

11 Lightning Protection

For tall structures & buildings, lightning protection system shall be provided as per relevant IS.

11.1 Principle Components

The principal components of a lightning protective system are:

- Air terminations
- Down conductors
- Joint and bonds
- Testing joints
- Earth terminations
- Earth electrodes

11.2 Materials

The materials of air terminations, down conductors, earth termination, etc. of the protective system shall be reliably resistant to corrosion or be adequately protected against corrosion. The material shall be one of the following –

- **Copper**: Solid of flat copper strip of at least 98% conductivity conforming to relevant IS specifications shall be used
- **Copper Clad Steel**: Copper clad steel with copper covering permanently and effectively welded to the steel core shall be used. The proportion of copper and steel shall be such that the conductance of the material is not less than 30% of conductance of the solid copper of the same total cross-sectional area.
- **Galvanized Steel:** Steel thoroughly protected against corrosion by a zinc coating shall be used.
- **Aluminum**: Aluminum, 99% pure, and with sufficient mechanical strength, and protected against corrosion shall be used. Aluminum should not be used underground, or in direct contact with walls.
- All air terminations shall be of GI and all down conductors shall be of GI or aluminum, except where the atmospheric conditions necessitate the use of copper or copper clad steel for air terminations and down conductors.
- The recommended shape and minimum sizes of conductors for use above and below ground are given in below Table:

Sr. No.	Material and Shape	Minimum Size
1	**Above Ground:**	
	Round copper wire or copper clad steel wire	6 mm diameter
	Stranded copper wire	50 Sq. mm
	Copper strip	20 mm x 3 mm
	Galvanized iron strip	20 mm x 3 mm
	Round aluminum wire	8 mm Diameter
	Aluminum strip	25 mm x 3 mm
2	**Below Ground:**	
	Round copper wire or copper clad steel wire	8 mm Diameter
	Copper strip	32 mm x 6 mm
	Galvanized iron strip	32 mm x 6 mm

11.3 Layout

The system design and layout shall be done in accordance with IS: 2309-1989 and specified in the tender documents.

11.4 Air Terminations

- Air termination networks may consist of vertical or horizontal conductors, or combinations of both. For the purpose of lightning protection, the vertical and horizontal conductors are considered equivalent and the use of pointed air terminations, or vertical finial is, therefore, not regarded as essential.
- A vertical air termination, where provided, need not have more than one point, and shall project at least 30 cm, above the object, salient point or network on which it is fixed.
- For a flat roof, horizontal air termination along the outer perimeter of the roof shall be used. For a roof of larger area, a network of parallel horizontal conductors shall be installed. No part of the roof should be more than 9meter from the nearest horizontal protective conductor.

- Horizontal air terminations should be carried along the contours such as ridges, parapets and edges of flat roofs, and where necessary, over flat surfaces, in such a way as to join each air termination to the rest, and should themselves from a closed network.
- All metallic projections including reinforcement, on or above the main surface of the roof which are connected to the general mass of the earth, should be bonded and form a part of the air termination network.
- If portions of a structure vary considerably in height, any necessary air terminations or air termination network for the lower portions should be bonded to the down conductors of the taller portions, in addition to their own down conductors.

11.5 Down Conductors

The number and spacing of down conductors shall be as specified, or as directed by the Engineer-in-charge.

- A down conductor should follow the most direct path possible between the air terminal network and the earth termination network. Where more than one down conductor is used, the conductors should be arranged as evenly as practicable around the outside walls of the structures.
- The walls of light wells may be used for fixing down conductors, but lift shafts should not be used for this purpose.
- Metal pipes leading rainwater from the roof to the ground may be connected to the down conductors, but cannot replace them, such connections should have disconnecting joints.
- In deciding on the routing of the down conductor, its accessibility for inspection, testing and maintenance should be taken into consideration.

Provision when external route is not available.

- Where the provision of external routes for down conductors is impracticable, for example, in buildings of cantilever construction from the first floor upwards, down conductors should not follow the outside contours of the building. To do so would create a hazard to persons standing under the over hangs. In such cases, the down conductors may be housed in an air space provided by a non-metallic and non-combustible internal duct and taken straight down to the ground.
- Any suitable covered recess, not smaller than 76 mm x 13 mm, or any suitable vertical service duct running the full height of the building may be used for this purpose, provided it does not contain an unarmored or a non-metal sheathed cable.
- In cases where an unrestricted duct is used, seals at each floor level may be required for fire protection. As far as possible, access to the interior of the duct should be available.

The lightning protective system should be so installed that it does not spoil the architectural or aesthetic beauty of the buildings.

11.6 Installation

- The entire lightning protective system should be mechanically strong to withstand the mechanical forces produced in the event of a lightning strike.
- Conductors shall be securely attached to the building, or other object to be protected by fasteners, which shall be substantial in construction, not subject to breakage, and shall be of galvanized steel or other suitable materials, with suitable precautions to avoid corrosion.
- The lightning conductors shall be secured not more than 1.2 m apart for horizontal run, and 1 m for vertical run.

11.7 Air Terminations

All air terminals shall be effectively secured against overturning either by attachment to the object to be protected, or by means of substantial bracings and fixings which shall be permanently and rigidly attached to the building. The method and nature of the fixings should be simple, solid and permanent, due attention being given to the climatic conditions and possible corrosion.

11.8 Down Conductors

- The down conductor system must, where practicable, be directly routed from the air termination to the earth termination network, and as far as possible, be symmetrically placed around the outside walls of the structure starting from the corners. In all cases consideration to side flashing must always be given.
- Practical reasons may not sometimes allow the most direct route to be followed. While sharp bends, such as arise at the end of roof are in-escapable (and hence permissible), re-entrant loops in a conductor can produce high inductive voltage drops so that the lightning discharge may jump across the open side of a loop. As a rough guide, this risk may arise when the length of the conductor forming the loop exceeds 8 times the width of the open side of the loop.
- When large re-entrant loops as defined above cannot be avoided, such as in the case of some cornices or parapets, the conductors should be arranged in such a way that the distance across the open side of a loop complies with the requirement indicated above. Alternatively, such cornices or parapets should be provided with holes through which the conductor can pass freely.
- Bonding to prevent side flashing. Any metal in, or forming a part of the structure, or any building services having metallic parts which are in contact with the general mass of the earth, should be either isolated from, or bonded to the down conductor. This also applies to all exposed large metal items having any dimension greater than 2 m whether connected to the earth or not.

11.9 Joints:

- A lightning protective system should have as few joints as possible.
- Joints should be mechanically and electrically effective, for example, clamped, screwed, bolted, crimped, riveted or welded.
- With overlapping joints, the length of the overlap should not be less than 20mm for all types of conductors.
- Contact surfaces should first be cleaned, and then inhibited from oxidation with a suitable non-corrosive compound.
- Joints of dissimilar metals should be protected against corrosion or erosion from the elements, or the environment and should present an adequate contact area.

11.10 Bonds

- Bonds have to join a variety of metallic parts of different shapes and composition, and cannot therefore be of a standard form.
- There is the constant problem of corrosion and careful attention must be given to the metals involved, i.e. the metal from which the bond is made, and those of the items being bonded.
- The bond must be mechanically and electrically effective, and protected from corrosion and erosion by the operating environment.
- External metal on, or forming part of a structure, may have to discharge the full lightning current, and its bond to the lightning protective system should have a cross-sectional area not less than that employed for the main conductors.
- Structures supporting overhead electric supply, telephone and other lines must not be bonded to a lightning protective system without the permission of the appropriate authority.
- Gas pipe in no case shall be bonded to the lightning protective earth termination system.

11.11 Test Joints

Each down conductor should be provided with a test joint in such a position that, while not inviting unauthorized interference, it is convenient for use when testing.

11.12 Earth Termination Network

- An earth station comprising one or more earth electrodes as required should be connected to each down conductor.
- Each of the earth stations should have a resistance not exceeding the product giver by 10ohms multiplied by the number of earth electrodes to be provided therein. The whole of the lightning protective system, including any ring earth, should have a combined resistance to earth not exceeding 10ohms without taking account of any bonding.
- If the value obtained for the whole of the lightning protection system exceeds 10ohms, a reduction can be achieved by extending or adding to the electrodes, or by interconnecting the individual earth terminations of the down conductors by a conductor installed below ground, sometimes referred to as a ring conductor. Buried ring conductors laid in this manner are considered to be an integral part of the earth termination network, and should be taken into account when assessing the overall value of resistance to earth of the installation.

- A reduction of the resistance to the earth to a value below 10ohms has the advantage of further reducing the potential gradient around the earth electrode when discharging lightning current. It also further reduces the risk of side flashing to metal in, or of structure.
- Earth electrodes should be capable of being isolated and a reference earth point should be provided for testing purposes.

12 EMERGENCY DIESEL GENERATOR SET

12.1 Intent of Specification

This section covers the requirements of Diesel generator set. The indicative emergency loads (subject to OEM consideration) in plant to be supported by DG set.

12.2 Codes & Standards

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest edition (including amendments) of the following Indian Standards (IS), IEC publications and other codes except where modified and/or supplemented by this specification.

IS/IEC 60034	Rotating electrical machines
IS 15999	Rotating electrical machines
IS 13364	AC Generators driven by IC engines
IS 10000	Method of tests for IC Engines
IS 4503	Heat exchangers
IS 803	Storage Tanks
ISO 8528	Reciprocating internal combustion engine driven alternating current generating sets
ISO 3046	Reciprocating internal combustion engines performance
BS: 5514	Methods of tests for IC engines.
BS 2613	Specification for electrical performance of rotating electrical machines

Indian Electricity Act and rules framed there-under

Fire Insurance Regulations

Regulations laid by the office of the Chief Electrical Inspector to Government

Regulations laid by the office of the MOEF

Regulations laid by the office of the Pollution control board

12.3 Technical & Operational Requirements

DG SET shall be rated for "Prime duty". Generator shall be rated of 415 V, 3 phase, 4 wire,50Hz supply. Generator Neutral shall be solidly earthed.

The DG SET will provide power for essential loads, following the loss of main power The normal operating condition of the DG SET is de-energized and ready. Generator set will start and come into

operation automatically in the event of total power failure in the plant. However, changeover shall be done by the operator using mechanical interlock key which is interlocked between Main power ACB & DG set ACB. Manual starting facility from remote location will also be provided.

The DG SET shall have auto and manual mode of starting enabled through an Auto/Manual selector switch. In auto mode the DG SET shall start automatically on receipt of mains failure signal. Under manual mode the unit shall be started from a push button.

All the controls required for starting shall be integrated to achieve automatic starting sequence both in auto mode and manual mode of operation when a single start signal is initiated.

The DG SET unit shall be capable of starting the largest motor with under direct online starting method, while carrying the remaining emergency loads. Voltage drop in the Generator shall be limited to 10% during starting of motor using DOL starter while delivering base load.

Voltage levels shall be maintained as follows:

Power supply	: 415V, 3 Phase, 50 Hz, 4 wire
Motors rated > 0.2 kW and = 200 kW	: 415V, 3 Phase, 50Hz
Motors rated up to 0.2 kW	: 230V 1 phase, 50Hz
Control supply for contactor-controlled feeders	: 220V DC or 24VDC, 2 wire
Panel lighting and space heaters	: 230V 1Phase, 2wire, 50Hz
Permissible AC Voltage variation	: +/- 10%
Permissible frequency variation	: +3% to – 5%
Combined voltage & frequency variation	: 10%

Short circuit level for 415V system shall be as follows:

Three phase symmetrical short circuit rating	: 50 kA for 1 sec
Momentary short circuit current rating	: 105 kAp

Diesel engine shall be directly coupled to a generator, mounted on a common steel base and installed in the DG SET room. Diesel engine shall be suitable for HSD or LDO as per IS 1460.

Section-XI Detailed Technical Specifications

- Control & Instrumentation

Table of Contents

1 INTENT OF SPECIFICATION 665

2 DESIGN REQUIREMENTS 667

2.1 General 667

3 DESIGN CRITERIA 671

3.1 General Requirements 671
3.2 Environmental Conditions 671
3.3 Power Supply and Air Supply 672
3.4 Instrument Accuracy, Standard Scales and Ranges 673

4 PROGRAMMABLE LOGIC CONTROLLER (PLC) SYSTEM 676

4.1 Design Requirements 676
4.2 PLC Configuration 682
4.3 Time Synchronization 683
4.4 OPC/MODBUS/ Interface Ports 683
4.5 Spare requirements 686
4.6 System Requirement & Specification 687
4.7 System Grounding 690
4.8 Tests to be performed during FAT of PLC system 691

5 CLOSED CIRCUIT TELEVISION (CCTV) 693

5.1 General Requirements 693
5.2 Design Requirements 693
5.3 Tests for CCTV System Equipment 697
5.4 Power Supply 697

6 FIELD INSTRUMENTATION 698

6.1 General Requirements 698
6.2 Minimum Requirement of Field Instruments 698
6.3 Transmitters, Switches, Gauges and Panel Mounted Instruments 700

7 ERECTION HARDWARE 708

7.1 General Requirements 708
7.2 Process Connections 708
7.3 Guideline for Installation and Routing Of Instrument Piping 711

8 INSTRUMENTATION AND CONTROL CABLES 717

8.1 General 717
8.2 Specification and Standards 718

1 INTENT OF SPECIFICATION

1.1.1 This section covers technical requirements of the Control and Instrumentation (C&I) for the safe, reliable, continuous and satisfactory operation of Bio- CNG plant and other auxiliary systems envisaged for this project. The work shall be consistent with modern BIO-CNG based plant practices and shall be in compliance with all applicable codes, standards, guidelines and safety requirements in force on the date of award of the contract.

1.1.2 It is not the intent to specify completely herein, all details of design and construction of the equipment. However the equipment will confirm, in all respects, to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operations up to vendor's guarantee in a manner acceptable to Owner who will interpret the meaning of drawing and specifications and will have the power to reject any work or materials which in his judgment, are not in full accordance herewith.

1.1.3 It is not the intent or purpose of this specification to specify all individual system/ components since the bidder has full responsibility for engineering and furnishing of complete system.

1.1.4 All local gauges as well as transmitters, sensors and switches for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance of equipment under the scope of specification shall be provided on as required basis within the quoted lump sum price. However, bidder shall supply any additional local gauges/switches/transmitters/sensors for reasons mentioned above or required by owner without any additional cost to the Owner.

1.1.5 In the event of conflict between requirements of any two clauses or specification documents, the more stringent requirements shall apply unless confirmed otherwise by the Owner in writing before the award of this contract based on a written request from the Bidder for such clarification. The decision of the Owner/Owner's representative shall be final and binding in all such cases.

1.1.6 Proven Product shall be offered by the bidder.

1.1.7 All equipment's, systems and accessories including PLC furnished under the specifications shall be from the latest proven product range at the time of supply and of a qualified/reputed manufacturer (as per approved vendor list by the Owner). The equipment/ devices offered shall be suitable for satisfactory performance for their respective application. The Owner reserves the right to reject any work or material in which in his judgment is not in full accordance therewith.

1.1.8 The drawings enclosed with the specification are indicating the minimum requirement, which shall be binding on bidders. Any further improvement required during detailed engineering and execution shall also be implemented by bidder. Bidder shall confirm that the type, make, model of all bought out items supplied by the bidder under the specification shall be subject to the approval of the Owner during detailed engineering stage.

1.1.9 The scope of work pertaining to BIO-CNG system for C&I shall include design, detailed engineering, documents generation, manufacturing, shop inspection and testing, supply, packing, forwarding, unloading, storage & handling at site, erection, field calibration, testing and commissioning at site, trial operation, performance testing at shop and site, submission of all drawings/documents, O&M manuals, obtaining statutory approvals from government and other agencies required during manufacture and commissioning, training of Owner's personnel, etc., and finally handing over a fully functional system / equipment to Owner along with the supply of all consumables, tools and tackles, testing instruments covering all the Instrumentation & control (C&I) equipment /services specified in this specification. It is not the intent to specify herein all details of materials/ equipment to be supplied. Any item related to this work not covered in this specification but necessary to complete the system will be deemed to have been included in the scope of the work.

1.1.10 Any wrong supply shall be replaced and any wrong erection shall be re-erected promptly to comply with the design requirements to the satisfaction of Owner.

2 DESIGN REQUIREMENTS

2.1 General

2.1.1 The Instrumentation and Control equipment system called for in this specification consists of a fully coordinated and integrated PLC based system for carrying out the functions of measurement system, control system, protection and interlock system and operating system. The system shall be complete with hardware and software along with the Human Machine Interface (HMI) capable of operating together as an integrated system. The system shall include but not be limited to panels, cables, control desk, cabinets, field instruments and erection hardware, control elements and devices to perform the various functions of the above systems as specified. The system shall be up-gradable, evolutionary in both hardware and software.

2.1.2 The design, material selection, constructional features, manufacture, inspection, testing and performance of all Instrumentation & Control equipment shall comply with all currently applicable statutory regulations and safety codes in the locality where the equipment are to be installed.

2.1.3 The I&C equipment design shall be suitable for continuous operation under the environmental conditions specified under Project information.

2.1.4 All the electronic circuitry shall be built-up with plug in modules providing maximum flexibility and easy servicing.

2.1.5 On failure of power supply or PLC / microprocessor fault, output shall be automatically switched over to fail safe mode – either locking in place or driving to open / closed position as required.

2.1.6 All signal schemes shall be audio-visual. When one fault is being announced, the system shall be capable of receiving the second fault. The audio signal shall be automatically silenced after a pre-selected time. The fault shall be always available in the alarm page of operator work station, until the fault is cleared and acknowledged.

2.1.7 SS Legend plates shall be provided on the cabinet front and back, desk face, local panels, junction boxes, transmitter racks, instruments, Control valves etc., for all items supplied to identify the equipment.

2.1.8 The Inside & outside colour of all instrumentation cabinets, control desks, consoles, local cabinets, marshalling cabinets, system cabinets, junction boxes, transmitter racks, etc. shall be **RAL 7032 / 7035** or equivalent international code. The inside colour of all these cabinets shall be Brilliant white.

2.1.9 All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, anti-vibration pads, kick plates and other accessories.

2.1.10 Unless otherwise specified cable entry for panels / desks / cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust.

2.1.11 Screened cables shall be of twisted pair type and shield shall be earthed at one end only inside the control room.

2.1.12 All the equipment fed from electrical system and installations shall meet the statutory requirements of relevant Indian Electricity Rules.

2.1.13 Conduits, junction boxes, and pull boxes shall be properly grounded.

2.1.14 All the cores of the cables shall be marked with ferrules. Identification no. of the cores shall be incorporated at regular short intervals. Metals tags shall be provided at both the ends of the cables for identification.

2.1.15 After completion of cable laying work, all cable bushings on the cabinets & desk shall be filled with fire resistant sealing compound against the floor and pipe. The instrumentation earthing system wherever necessary must run to a common pit as per standard. All the cables entering the main control room shall be properly filled and sealed with fire resistant sealing compound against the floor and pipe.

2.1.16 All electronic/electrical instruments, junction box and control panel shall be suitable for area classification as per IEC/NEC/IS codes. Certified intrinsically safe / explosion proof equipment shall be used, in general, in hazardous area.

2.1.17 Programmable Logic Controller (PLC) based control system shall be designed with 1:1 hot redundant configuration. CPUs shall have word length of 32/64 bits minimum.

2.1.18 Following components shall be redundant as well: communication processors, memory modules, rack power supply units, bulk IO power supply units, IO communication modules, data highway, Serial link interface module for connecting I/O modules and high speed data network connecting the operator stations.

2.1.19 Measurement system shall be complete with processor, signal conditioning, monitoring cards and function cards. The system shall also be capable of transmitting the data to the HMI display unit for display to operator.

2.1.20 Operator cum Engineering Stations (OES) with minimum RAID-5 configuration, shall be freely assignable and functionally Interchangeable between themselves. Printers shall be network compatible and shall be freely assignable.

2.1.21 Trending and logging facilities shall be provided for all those parameters whose trends are necessary for safe and efficient operation of the system and measurement of performance.

2.1.22 The P&IDs and interlocks submitted by vendor shall be verified by HAZOP/PMC consultant engaged by OIL. The recommendations of the consultant(s) shall be incorporated by the vendor.

2.1.23 Temperature elements/ RTD shall be connected to PLC with transmitters. Use of process actuated switches shall be limited and subjected to owner approval. Smart transmitters shall be used in place of process switches.

2.1.24 All RTD supplied for this project shall be duplex element type. Temperature transmitters connected with duplex sensors shall have bump less change over facility to second sensor in case first sensor fails .This change-over is to be alarmed.

2.1.25 Bidder shall include all the measurements necessary for the safe, efficient, reliable and fully automatic operation of the entire plant including all fail-safe requirements and recommendations of each equipment manufacturer.

2.1.26 All I&C cables including twisted & shielded , FRLS PVC insulated ,compensating cable, special cable, Fiber Optic cable shall be shielded and armoured. Direct cables between cabinets (whichever is not routed through conduits) shall be treated with Anti-Rodent treatment.

2.1.27 Control rooms shall be air-conditioned and control room shall be provided with fire detection system and portable fire extinguishers.

2.1.28 Cable gallery, if provided, shall be with Fire protecting Spray system.

2.1.29 Process connection & piping including, all impulse piping, pneumatic piping/tubing, valves, valve manifolds, fittings and all other accessories shall be provided on as required basis for proper installation & completeness of impulse piping system and air supply system, as stipulated elsewhere in the specification.

2.1.30 Bidder shall follow KKS Tagging philosophy.

2.1.31 Bidders to confirm to the Hazardous area classification requirements as applicable for I&C equipment. Bidders shall envisage intrinsic barriers / explosion proof enclosures etc., as required and mount them suitably as recommended in the statutory classification.

2.1.32 All statutory requirements including PESO, ATEX, IBR, Pollution Control board etc., shall be met as required.

2.1.33 All specified documentation shall be submitted in both soft and hard copies as per Owner's requirement and format.

2.1.34 The annunciation system shall be an integral system to PLC and shall be displayed in OWS etc. Annunciation shall be provided by bidder for each and every instrument, valves, limit switches, drive etc. All the field contact for this purpose shall be acquired through control system.

2.1.35 The instrumentation to be provided for each of the plant auxiliary shall be as per the technical specification document / drawings wherever provided for the respective systems as a minimum requirement for bidding purpose. However, for completeness of each of the plant auxiliary and its associated equipment, Bidder shall also provide all the necessary instruments to the process requirement even if it is not specifically indicated in the given technical Specification document / drawings.

2.1.36 The instrumentation, operation and control philosophy proposed is specific to the plant design. Any improvement over the proposed typical Control & Instrumentation scheme shall be accepted so long as it does not deviate from the basic intent and general philosophy enumerated herein and elsewhere in this specification.

2.1.37 All PLC, I/O cards, remote I/O cards shall be with required protection class and should withstand temperature up to 60 Deg.C temperatures.

2.1.38 All cables shall be terminated in the terminal block and marshalling rack. No signals shall not be wired directly to the controller panel. Ferruling shall be double cross ferruling (i.e.) source and destination addresses shall be marked on both sides of the tube ferruling.

2.1.39 Bidder shall provide local push button station (LPBS) for local start/ stop/emergency stop monitoring of auxiliaries and equipment as per requirement. LPBS start/stop feedback signals and Emergency stop feedback signals are to be taken to PLC for indication. The requirement

shall be decided during detailed engineering. All local panels shall be minimum IP 65 with canopy.

2.1.40 PLC supplier shall prepare graphics (dynamics in nature) for the complete plant with proper tag nos. for drives, binary inputs, analogue inputs, status of drives etc. for the hardwired and soft link signals interfaced with existing plant DCS as per format of DCS.

2.1.41 The proposed BIO-CNG PLC system shall be time synchronized with the GPS master clock system.

3 DESIGN CRITERIA

3.1 General Requirements

3.1.1 The design criteria given in this section supplements the requirements stated in other sections of this specification and the drawings enclosed herewith. These shall be fully met by all equipment/systems and accessories furnished as per this specification.

3.1.2 The equipment and systems shall be designed and constructed to meet all specification requirements and perform accurately and safely under the environmental and operating conditions described or implied in this specification without undue heating, vibration, wear, corrosion or other operating troubles. It will be the responsibility of the Bidder to fully acquaint himself with the functional requirements and operating conditions, for equipment systems and accessories offered for this project. Additional features shall be provided where required to meet the service conditions, functional or descriptive requirements stated in individual clauses for these equipment/systems.

3.1.3 The equipment, systems and accessories furnished as per this specification shall be designed and constructed to meet all specification requirements and performance specifications during the continuous service life of the plant. The equipment or components that cannot meet this life expectancy or specified design and operational requirements during the entire service life shall be identified and their expected failure rate shall be indicated by the Bidder in his proposal. When no such information is furnished, the equipment shall be deemed to have been certified by bidder suitable for the above service life and requirements.

3.1.4 All the hardware / software shall be latest and field proven as available in the market. Bidder shall only offer latest system available with him at the time of supply / dispatch & for the PLC system and software up to handing over of the project and whenever at later stage such updation takes place for the system offered by him or by his collaborator without any additional cost. The software / hardware lock shall be provided for all OWS/EWS for security reason.

3.1.5 During execution of the project or at the time of dispatch, any latest product is launched or introduced then the same shall be supplied without any price implication.

3.1.6 Even after the guarantee period, the Bidder shall be responsible for providing spare parts and other required support at reasonable cost during the service life of the plant as indicated above. Any exception to these requirements shall be clearly indicated in the Schedule of Technical Deviations.

3.1.7 Bidder shall also guarantee supply of spares for at least 15 (Fifteen) years after commissioning of the plant. In case of future upgradation of a product in terms of hardware, bidder shall remain committed to upgrade the supplied system.

3.2 Environmental Conditions

Instruments for location in outdoor/indoor/air-conditioned areas shall be designed to suit the environmental conditions indicated below and shall be suitable for continuous operation

in the operating environment of a coal fired utility station without any loss of function, or departure from the specification requirements covered under this specification.

3.2.1 All equipment/systems for air-conditioned areas shall also be designed and constructed to operate indefinitely without loss of function, departure from specifications or damage during periods of air conditioning failure in summers when temperature may rise up to 55 deg. C even.

3.2.2 The period for which the equipment/system can function satisfactorily without A/C shall be mentioned by the bidder.

i. Outdoor Locations

S.No.	Design Temp.	Pressure	Relative humidity	Atmosphere
1.	Maximum 55 °C	Atmospheric	100%	Air (dirty)
2.	Minimum 4°C	-do-	5%	Air (dirty)

ii. Indoor Locations (Excluding the heat self-generated by equipment)

S.No.	Design Temp.	Pressure	Relative humidity	Atmosphere
1.	Maximum 50 °C	Atmospheric	95%	Air
2.	Minimum 4°C	-do-	5%	Air

iii. Air-Conditioned

S.No.	Design Temp.	Pressure	Relative humidity	Particle size	Atmosphere
1.	Normal 24 °C $\pm$ 5°	Atmospheric	50% $\pm$10%	15 microns	Air
2.	* Maximum 50 °C	do	95%	*50 microns	Air

*During air-conditioning failure for short durations.

3.3 Power Supply and Air Supply

Power Supply

A UPS (Uninterrupted Power Supply System)

Dedicated, redundant UPS system of reputed make with chargers and dedicated 2 x 100% Ni-Cd Battery bank with resistive load for discharge of battery shall be provided for BIO-CNG system.

B Power Supply Monitoring Facility

The power supplies for all control panels are **to be monitored for under voltage/over voltage.** Necessary **alarms are to be initiated** for under voltage/over voltage.

1) Loss of single power source in case of redundant power supplies is to be alarmed in PLC for all control panels by providing voltage monitoring relays.

Each electronic cabinet shall be equipped with redundant power supply source & auto change over circuit with changeover time less than 10 ms in order to guarantee hold capacity of feeders for modules and I/O signals. 24V DC power supply system located inside the cabinet, shall furnish power supply to the equipment via. selector circuit mounted on DC output, made of block back-up diodes, with the aim of preventing energy exchange between power sources. A continuous monitoring apparatus watches the voltage and alarms power supply failures.

PLC shall be supplied with UPS power supply, all system devices requiring 24V/48V DC power shall be arranged by bidder by providing 100% parallel redundant with automatic change over 240V AC UPS to 24/48V DC converter. AC to DC convertor shall be SMPS based and shall have wide range of AC/DC input voltage (85-264 V AC & 90-350 VDC). It shall have the necessary diagnostic functions like indications for DC OK, automatic overload monitoring etc. The MTBF for the power supplies shall not be less than 500,000 hours (in Accordance with (IEC – 1709).

3.4 Instrument Accuracy, Standard Scales and Ranges

3.4.1 Instrument Accuracy

All instruments/systems furnished as per this specification shall meet the accuracy requirements indicated in these specifications. The minimum requirements to be met by all equipment/systems are indicated below:-

All instruments shall be constructed to perform normally and meet all guarantees when subjected to the service conditions listed in the applicable sections.

Resistance temperature detector elements shall have a resistance characteristic which is linear with respect to temperature within plus or minus one-half of one per cent of the top range value, Class-A accuracy.

Transmitters for pressure shall transmit a signal which is linear with respect to the measured pressure accuracy shall be within plus or minus 0.075% of the measured range span.

Flow meter transmitters shall produce transmitted signals within plus or minus one- tenth of one percent of the measured span range when operating between 25 and 100 percent of full scale flow value. The accuracy guarantee shall include the effect of errors in the differential head measuring device, square root converter and signal generator, but not the primary device.

Transmitters for level shall transmit a signal which is linear with respect to the measured level within plus or minus one-tenth of one percent of the metered level range span based on a specific gravity of 1.00.

Transmitter accuracy mentioned above shall be inclusive of the combined effects of hysteresis, repeatability and linearity etc. All transmitters shall have less than one-half of one percent shift in output with a 50° C change in ambient temperature.

Where temperature compensation networks are furnished, they shall produce corrections which are in accordance with theoretical requirements over the specified variations, over a flow range from 10 percent to 100 percent of maximum flow, subject to a plus or minus tolerance of one-half of one percent of the maximum flow.

Accuracy requirements of other instrument type are given in the appropriate specification paragraphs.

3.4.2 Instrument Scales

Instrument scales will be black graduations in white dials and where practicable with scale divisions based on multiples of 10. The smallest division shall preferably be a whole number approximately 1% of the scale range if not otherwise impracticable.

All Instrument scales and charts shall be calibrated and printed in Metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units as follows:-

1.	Temperature	:	Degree centigrade (deg. C)
2.	Pressure	:	Kilograms per square centimeter (kg/cm2)
3.	Draught	:	Millimeters of water column (mm wcl.)
4.	Vacuum	:	Millimeters of mercury column (mm Hg) or water column (mm wcl)
5.	Flow (All gases)	:	Tonnes/hour.
6.	Flow (Steam)	:	Tonnes/ hour
7.	Flow (liquid)	:	Tonnes/ hour
8.	Flow base	:	Based – 760 mm Hg, 15 deg.C
9.	Density	:	Grams per cubic centimeter
10	Speed	:	RPM
11.	Frequency	:	Hz
12.	Differential Pressure	:	kg/cm2
13.	Level	:	mm
14.	Conductivity	:	micro S/cm
15.	Analytical parameter	:	Ppm or ppb as specified in respective case.

Pressure instrument shall have the unit suffixed with ‘a’ or ‘g’ to indicate absolute or gauge pressure.

Scales and charts of all instruments shall have linear graduations, and the Bidder shall offer devices for square root extraction or other functional operations required for this purpose. Local indicator scales may be non-linear if approved by the Owner.

All Instruments and Control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plug-in connection at rear.

3.4.3 Instrument Ranges

Instrument ranges will be selected to have the normal reading preferably at 60- 75% of full scale. Deviation indicators shall have the null position at mid-scale.

3.4.4 Protection, Class of Cabinets / Panels, Enclosures etc.

1. All panels, desks cabinets, consoles & enclosures furnished at least comply with the requirements of protection classes as indicated below.

    1. In-door Air-conditioned (A.C.) areas - IP32 (min.)
    2. In-door Non A.C. areas:
        a) Ventilated enclosures - IP42
        b) Non-Ventilated. IP54
    3. Out-door IP65

2. Distribution boxes, junction boxes, cold junction compensation boxes, terminal boxes and all other field mounted equipment to be furnished as per this specification shall have weather protection conforming to IP 65.

3. The design of panels, cabinets, enclosures and packaging density of components mounted therein shall be such that the temperature rise does not exceed 10 deg. C above the ambient under the worst conditions.

4. The panels housing electronic hardware shall be provided with flame and smoke detectors by bidder and necessary annunciation shall be provided by bidder.

5. Enclosures for peripheral equipment's like printers, etc. shall take care of noise and shall ensure minimum possible noise disturb to the working personnel.

4 PROGRAMMABLE LOGIC CONTROLLER (PLC) SYSTEM

The PLC for system shall have the following features:

1. The PLC system shall fulfill all demands emanating from the domains
   - Automation
   - Monitoring
   - Process control
   - Management
   - Engineering
2. Uniform operator machine interface
3. Reliable user guidance
4. Comprehensive redundancy concept
5. Modern object oriented software structure
6. Shall be able to communicate with external system and intelligent field equipment
7. Simple central project planning and configuration aids
8. Integrated documentation system
9. Integrated diagnosis and service
10. Commissioning support

The Control System shall have on-line simulation & testing facility.

1. The system shall have the flexibility to easily reconfigure any controller at any time without requiring additional hardware or system wiring changes and without disabling other devices from their normal operation mode. Modifications shall not require switching off power to any part of the system.
2. Fault Diagnostics

   Complete software for microprocessor-based systems including the communication software between systems; the software shall be also included for equipment performance test, life evaluation, equipment capability curve and alarm analysis, Management information system, etc.

3. Bidder to calculate the actual BOQ (No. of PLC panels, I/O Modules, CPU Modules, Fiber optic interface etc.) of the offered PLC as per technical specification/system requirement, PLC spare philosophy, CPU loading etc. for their entire system

4.1 Design Requirements

1. The Instrumentation and Controls shall be designed for maximum availability, reliability, operability and maintainability.

   All components shall function in a satisfactory manner within their rated capacity under the specified conditions for entire life of the plant.

2. All I&C equipment shall be designed for their specific application and shall be furnished for required control, protection, alarm and remote monitoring. The application and selection of these C&I equipment including signal converters, interposing relays, microprocessors, etc. shall be the responsibility of bidder.

3. The PLC panels shall include Interposing relays, Marshalling / termination cabinets for termination and system cabinets for each control system.

4. PLC equipment shall employ latest microprocessor based technology, as required to comply with the project specification. A truly integrated PLC is envisaged with all the self-sustaining subsystems communicating with each other over the bus network and thus ensuring that the system has a truly global database.

5. The fundamental functions of control, alarm, monitoring and protection shall be functionally and physically segregated to greatest practicable extent so that failure of a function does not result in the failure of other functions. Special attention should always be given to the independence of the protection function so that safety of plant personnel and equipment is preserved.

6. Control system shall comply with following general failure criteria :

    a) No single fault can cause the complete failure of the control system.

    b) The control system shall be structured to reflect the redundancy provisions of the plant so that no single fault within the control system can cause the failure of the duty equipment or make the standby equipment unavailable.

    c) As a result of a control system fault, a plant item or control function shall always respond to its controls at the actuator level (i.e., remote manual control). That item or control function shall be required to be isolated from automatic control system.

    d) No single random fault in the entire automation and control system will cause a load loss, forced outage or unit trip.

    e) No two simultaneous faults shall lead to or potentially cause damage to plant

    f) Safety related Instrumentation and Control shall be designed with a fail- safe mode.

    g) No single fault shall jeopardize the functioning of the entire system.

h) The control and automation system and the field instruments and actuators as well as it's support systems, power supplies and data networks shall be immune to the electromagnetic interference and shall conform to the internationally accepted standards.

i) To meet the operational and safety requirements, the control system hardware and software shall conform to a modular, hierarchical architecture.

7. To meet the above failure criteria, the I&C system shall incorporate self-checking facilities so that internal faults can be detected within the system itself prior to any resulting disturbance to the process. In addition, the protection and safety systems shall incorporate channel redundancy or diversity of measurement as well as self-checking and adequate test facilities. For some important systems, "on line" test shall be employed with no effect to the proper functioning of the protection system.

8. In order to make sure that the PLC is an extremely user friendly system a centralized engineering subsystem is envisaged. An integrated subsystem has to be provided which takes over the complete task of planning, I/O allocation, generation of function schemes and wiring documentation (in design stage) and finally the automatic linking and loading of the planned functions in the target hardware.

9. The complete engineering of all the automation and data acquisition functions should be possible from this central tool. This shall include all modulating and sequence control functions as far as the automation is concerned, generation of plant graphics, logs and other MMI functions. In addition the central engineering system must support all service, maintenance and commissioning assistance functions.

10. The measurement for the functions of control, indication and protection may be appropriately combined, provided, the integrity of measurement is ensured by adequate channel redundancy. Where a signal is required for control purposes only or for both control and data indication, the signal shall be derived from the conditioned output of a number of detectors. Where a signal is required only for data indication, then it may be derived directly from a detector, if necessary via a suitable conditioner. For some critical parameters, three independent measurements shall be provided. Median signal shall be selected for control and direct wired indication. Alarm shall be provided for large deviation from the median signal.

11. For selected protection applications, multi-channel measurements shall be provided. Facilities for the on-line testing of each independent channel shall be provided without loss of protection. Each measurement channel shall include discrete transmitters and instrument loops, i.e. multi-channel measurement of the same process variable shall not be derived from common instrument.

12. Both redundancy and diversity of trip criteria shall be considered to achieve sufficient guarantee against non-operability or unnecessary operation of the protection system. The principle of de energized to trip (Fail safe logic) shall be adopted.

13. Individual control elements shall be equipped with permissive to prevent the in- appropriate operation of the item and "active interlocks" to trip the item in case of dangerous operation conditions.

14. Each of the multifunction controller together with its I/O and drive level control modules is to be understood as a self-sustaining automation island, which executes the function allocated to it independently and is not affected by a disturbance in the adjacent island. For the purpose of lateral communication between the automation islands, a high speed bus (the so-called control bus) should be provided which should be solely responsible for the automation (control) signal exchanges.

15. Alarms shall be provided for all abnormal conditions over which the operator has control in the control room, plus those abnormal conditions which are of interest to the operator because they may affect plant operation or security.

16. The following colors shall be selected for equipment status indicating lights :

- Red----energized, running, valve open
- Green----de-energized, stopped, valve closed
- Light yellow ----abnormal, discrepancy
- White----control power available

17. AC power from UPS supply for control cubicles of each control and monitoring system shall be derived from two independent sources shall be furnished to guard against the total loss of power supply. The arrangements of power supplies shall be such that no single fault could interrupt both supplies and no control system malfunction shall occur as a result of supply changeover.

18. The functions of PLC System are achieved through bus communication units, bus interfaces, process controllers, I/O modules and computers. The system shall be versatile and provide the user, the flexibility to freely choose configuration and redundancy. The system shall ensure very high reliability and safety through complete distribution and decentralization which goes right down to the individual I/O level.

19. Interposing relays with suitable contact rating shall be provided between PLC and MCC/SWGR with Interposing relay panels for giving command signals ON/OFF or OPEN/CLOSE. Interposing relays shall have minimum 2 NO and 2 NC contacts.

20. All parameters on which protection is achieved through pressure/ temperature/ flow switches; the measurement shall also be made available through transmitters. Provision of transmitter/remote sensor will be applicable for 70% protection signals which will be decided during detailed engineering"

21. Also the system shall have the flexibility to easily reconfigure any controller at any time, without requiring additional hardware or system wiring changes and without disabling the devices from their normal operating mode.

22. The system shall execute all control functions with the help of a set of pre-programmed functions resident in controllers. The offered system shall have provision for open system architecture to establish communication to any other system using open system standards such as UNIX, WINDOWS NT, WINDOW XP/7/8, TCP/IP, OSF, MOTIF, SQL Access etc.

23. The system shall be provided with extensive diagnostic features so that a system failure can be diagnosed down to the module level giving location and nature of fault. Ease of maintenance and trouble-shooting shall be a primary consideration in equipment selection.

24. The system shall provide inherent safe operation under all plant disturbances and component failures so that under no circumstance safety of the plant personnel or equipment is jeopardized.

25. All process input/output cards shall have built in galvanic/optical/electronic isolation for each input and output channel.

26. The failure of each controller module and each I/O module shall be indicated on control cubicles and all operator stations.

27. For all the trip signals (very high/very low), the alarms (High/Low) shall appear for correcting the process by the operators.

28. Bidder to submit the Logic for entire plant in SAMA format only (Any other format of Logic shall be based on owner acceptance).

29. Necessary software shall be supplied for uploading the data for chart less recorders.

30. External resistance shall be connected at field side equipment (Process switches, transmitters, JB, Limit switches, SOV JB etc.) by bidder for each Input and output to & from field side equipment for enabling short circuit and wire break detection feature of the PLC input & output modules.

External resistance shall be connected by bidder at MCC end TBs for each Input and output signal to & from MCC for enabling short circuit and wire break detection feature of the PLC input & output modules.

31. All Operating Stations shall be provided with 24" LED colored TFT monitor.

32. Redundant Historian server (Historical Data Storage & Retrieval system) with Work station (raid 5 concept).

33. RIO panel which is placed in remote area shall be provided with Air conditioned panel and GUI.

4.1.1 Main Controller Characteristics

Each controller envisaged for this project shall have following features as minimum:-

i) Processing word length of 32/64 bit
ii) 64 Mbytes RAM(min)
iii) Redundant power supplies (Both CPU and IO power supplies)
iv) Power Fail Auto Restart (PFAR) feature
v) Watch Dog timer
vi) Memory protection
vii) Direct Memory Access feature
viii) Self-monitoring & diagnostic feature
ix) Easy modification of control functions
x) RISC/CISC based
xi) Real time data controller, Computer/PC based soft controller are not acceptable.

4.1.2 Controller Redundancy

1. All functional controllers for sequence control, functional controllers for closed loop control and functional controller for DAS & monitoring shall be provided with hundred percent hot standby controllers. DAS function can also be integrated within CLCS/OLCS controller. All processors for modulating controls shall have self-tuning facility.

2. All the 100% hot back up controllers shall be identical in hardware and software to their corresponding main controllers. Further, each of the 100% hot backup controller shall be able to perform all the tasks of their corresponding main controller. The 100% hot backup controller shall continuously track/update its data corresponding to its main controller. There shall be an automatic and bump less switchover from the main controller to its corresponding back-up controller in case of main controller failure and vice versa. The changeover shall take place less 5 m sec. Engineered solution for redundancy in CPU are not acceptable. Dual redundant controllers shall be placed separately.

3. Any switchover from main controller to 100% hot backup controller and vice versa, whether automatic or manual shall not result in any process upset or any change in control status. The transfer from main controller to the back-up & vice-versa shall be indicated as alarm on all operator station (OS).

4. In case of switchover from main controller to backup controller, the backup controller shall be designated as the main controller.

5. All the input variables shall be available to the main controller as well as its 100% hot backup controller so that any failure within the main controller shall not degrade the input data being used by the 100% hot back-up controller and vice-versa.

6. The CPUs shall not be loaded over 60% of the Individual capacity even under worst data loading conditions. Each controller shall have battery backup or NVRAM for program memory.

7. Each of the corresponding communication controllers shall also have same spare capacity as that of controller.

8. For controller, the worst loading condition shall include the following tasks:

    a) All process inputs scanning and processing is in progress and all the data is transmitted over the main data bus every one (1) second.
    b) All closed loop controls in operation
    c) All open loop controls in operation
    d) All output devices are in operation with rated performance/speed.
    e) Control/information request is initiated on all control operating stations.
    f) In burst mode operation (in case of major equipment trip), 100 digital alarms are generated per second for a period of 10 seconds.

    Note: 1 set of hot redundant Controller means physically two no. separate Controller

4.2 PLC Configuration

1. The PLC configuration will have a hierarchy of industrial grade open system architecture for Management Information System (MIS) and closed system architecture for plant operation and control system

2. The specification of Peripherals for Operator Station, Engg Station & printers for PLC/microprocessor based system shall be as same as mentioned below.

3. The closed system architecture for plant operation and control system is secure and deterministic system for real time operations of the plant.

4. Industrial grade managed type Ethernet switches with in built diagnostic features, 20% spare ports & redundant 24 V DC power supply shall be provided with control system.

5. PLC Network shall also be provided with external surge protection system and firewall.

6. The PLC shall be functionally and topographically distributed, (i.e. the control for 3 similar equipment for e.g. Pump A, B and C should be in different set of module racks). In case of redundant Analogue and Binary Signals, these will be connected to different input modules.

7. All the operator stations will be 'work stations' and are required to reside on the main redundant bus running on IEEE 802.4 or IEEE 802.5 to facilitate determinism.

4.3 Time Synchronization

Time synchronization signals shall be provided from Master Clock System for PLC. Bidder to consider suitable GPS master clock in scope of supply & necessary provision and cables for the above requirement.

4.4 OPC/MODBUS/ Interface Ports

The Bidder shall provide OPC/MODBUS on TCP/IP Protocol as decided during detailed engineering to interface with other control systems like Plant DCS, UPS system, Numerical relays and any other interface required. The Bidder shall include in his scope the relevant software & hardware for communication with the equipment/systems. Above quantities is minimum & guaranteed by bidder, which shall be finalized as per requirements during detailed engineering. Applications for redundancy & bidirectional shall be decided during detailed engineering. In addition, Hardwired signal interfacing shall also be provided for any signal required for interlock, control & protection.
The interfacing between two systems shall be effectively immune to the types of electrostatic and electromagnetic interference. To end this, If the control system is located in different building then the communication link cable shall be through fibre optic cable with necessary EI-Optical converter and de-converter units at both the ends and this special cable are in the scope of the bidder.

4.4.1 Technical Specification for PLC

1 PLC should be sourced from original manufacturers; PLC from system house shall not be acceptable. PLC system shall be complete with hot standby redundant CPU of word length of 32

/ 64 bits(preferably 64 bits) minimum, Input / Output modules, dual serial link interface module for connecting Input / Output Modules, dual Communication Processors, dual Memory modules and redundant Power supply units. Power supply unit shall be hot redundant for each CPU & I/O rack.

2 Redundant CPUs in hot standby mode shall operate on fault tolerant mode with continuous self and cross monitoring facility. Failure of the active CPU shall not adversely affect the operation of the plant in any perceptible way. Failure of the active CPU will lead to transfer of the tasks being performed to the other healthy CPU within fastest possible transfer time without causing any output to drop during the Transfer period. In the Event of the both the CPU failure, the system shall revert to the Fail-safe mode. The CPUs shall not be loaded over 60% of the Individual capacity even under worst data loading conditions. It shall be possible to switch from the active to the back-up CPU and vice versa from operating station as well from the CPU front panel. (The worst data condition of PLC means all modules in active mode, printer in operation, OLCS&CLCS logics active and process in running condition). Engineered solutions for redundancy in CPU & I/O cards are not acceptable.

3 The system shall be of modular construction and expandable by adding hardware modules and incorporating them in the address register.

4 The memory unit of the CPU shall be field expandable. The memory capacity shall be sufficient (min. 64 MB) for complete system operation and shall have the capability for future expansion at least to the tune of 40%. The application program / sequence logic etc. shall be stored in non-volatile memory (EPROM). However, all the dynamic memories shall be provided with battery backup with at least for 360 hours. Lithium or Ni-cd battery shall be used.

5 The data communication system of the PLC including that of its redundant system bus with hot backup and other allied buses such us I/O bus, local bus etc., shall fulfil the following minimum features. The bidder shall furnish all the calculation details of CPU utilization and Bus loading. Bidder shall also furnish communication protocol used for the offered PLC.

6 Communication links between CPU and Input & Output (I/O) modules and between CPU and workstation shall be dual redundant. In no case failure of a link shall affect the control of the plant.

a) The communication system design shall ensure that any single point failure on the system bus / media shall not disrupt not more than single message and disrupted message shall be automatically retransmitted after the standby communication link takes over control.
b) Failure or physical removal of any station / modules connected on the system bus shall not lead to any loss of communication.
c) Diagnostics display both at operating workstation and module front end shall be provided for easy fault detection.
d) Bus change over from active bus to standby bus, during failure of active bus shall be performed automatically and bumpless transfer. Such event shall be suitably logged or alarmed.

e) The system communication between PLC module / stations and the operator stations shall be conducted at high speed 100 MBPS with Ethernet based open protocol with no collision feature to avoid data jamming / overloading of the system. The communication bus, serial link etc. shall have adequate protection against electrical noise and mechanical damage.
f) The bidder shall provide Redundant OPC/IEC communication as decided during detail engineering to interface with other control systems, transmission rate shall be 100/1000 Mbps or better.
g) System should have open bus structure and should allow further extension facility and connection with any third party system.
h) Network shall also be provided with external surge protection system and industrial firewall.

7 Man Machine Interface (MMI) shall be industrially ruggedized Operator's station based on latest window based market available software along with its peripherals like 24" (minimum) LED monitor, printer, mouse. Engineering functions shall normally be carried out from dedicated workstation. The engineering station EWS shall also be worked as operating station through password / Hardware lock. The monitor refresh time shall be least possible.

8 The Operator's station shall perform the following minimum requirements.

Selection of Auto / Manual, Open / Close operation, sequence auto, start / stop operation etc.
a) Dynamic mimic display detecting the entire process for control monitoring purpose.
b) Alarm monitoring, report generation, logs, calculations and printing of logs, reports, trends etc.
c) Online / historical trending, historical storage and retrieval of data.

9 Software provided shall be latest, modular, upgradable and industrially proven. It shall have capability for multi-tasking, multi programming, multi user operation in real time environment and support for third party system. Bidder shall provide the following minimum requirements:

a) Required software for fulfilling the complete implementation of the control logics, operation displays, logs, data storage, and retrieval, diagnostic and other functional requirements as indicated in this specification.
b) Detail documentation on all programming software's and this shall be part of the O & M manual.
c) Supply of Licensed version of all software both in edit and run mode with multi – user license. All the third party software should be latest and market available.
d) Bidder shall provide and connect suitable communication hardware / software/ cables and other accessories required for connecting all numerical relays as per IEC – 61850 of auxiliary in PLC.
e) Bidder shall provide firewall (hardware) in various layers to protect PLC from other network as per ISA – SP – 99.

10 PLC shall specifically meet the following requirements:

a) PLC shall have extensive self-diagnostic capability. Self-diagnostics shall include both module level diagnostics as well as channel level diagnostics.
b) PLC shall have redundant processors/controllers. This shall mean the fulfillment of the following requirements:
    i) Automatic synchronization of primary processor/controller of PLC with secondary processor/controller
    ii) Bumpless switchover to secondary processor/controller of PLC when the primary fails.
    iii) Automatic program and data equalization in the event of any on-line program / edit executed in the primary processor/controller of PLC.
    iv) Automatic "Forcing Bit" update in the secondary processor/ controller of PLC when any "Forcing is applied in the primary processor/controller of PLC.

11 The Bidder shall have to furnish all technical details in respect of each and every electronic card/module as employed on the various solid state as well as microprocessor based systems and equipment including conventional instruments, peripherals etc.

4.5 Spare requirements

1 The PLC shall be provided with the capacity and capability to handle either 10% additional modules for each type of modules or 10% over and above the specified number of modules connected to the system bus without any additional hardware or software requirements. These additions shall not result in decrease in system response time (i.e. control response time, display response time, etc.).

2 10% spare relays of each type and rating, mounted and wired in relays cabinets. All contacts of relays shall be terminated in terminal blocks of relay cabinets, additionally in each of the relay cabinets, 10% spare terminal blocks shall be provided so that additional relays can be mounted and wired. In case bidder's system employs marshalling cabinet for all inputs, the spare terminals, fully wired up to marshalling cabinets are also to be provided.

3 Wired-in "usable" space for 10% modules in each of the system cabinets for mounting electronic modules shall be provided by the bidder. Empty slots between individual modules/group of modules, kept for ease in maintenance or for heat dissipation requirement as per standard practice of Bidder shall not be considered as wired-in "usable" space for I/O modules. Field Terminal assemblies, PCB/ Connectors (if any in the offered system), corresponding to the I/O modules shall be provided for above-mentioned 20 % blank space.

4 10% spare fully wired I / O channels shall be provided in each I / O module. In addition to this 10% or minimum one no. extra assigned complete spare cards (whichever is more) fully wired mounted in the cabinets for each type of I / O modules shall also to be provided

5 The spare capacity as specified above shall be uniformly distributed throughout all controller systems. The system design shall ensure that above-mentioned additions shall not require any additional controller/processor/Peripheral drivers in the system delivered at site. Further, these additions shall not deteriorate the system response time/ duty cycle, etc. from those stipulated under this specification and shall meet other redundancy / functional requirement. Above criteria shall be applicable for PLC & any other microprocessor based control system

4.6 System Requirement & Specification

1 The system shall have high MTBF and shall be hot maintainable. The system hardware shall be designed to be fault avoidant by selecting high grade components of proven quality and properly thermally de-rated design. The system shall have extensive fault monitoring, self- surveillance & on-line self- diagnostic capability so that failure up to module / card level is immediately detected. Each of the modules shall have its self–diagnostic system. The operator station located at the control room shall be used for fault data presentation and monitoring purpose.

2 The system shall have capability to automatically check & correct gain & drift for ADCs on-line.

3 All data exchanged in a bus shall be fully monitored & checked for validity.

4 Following operations will be performed on I/Os, as required:

a) Square root extraction
b) Pressure & Temperature compensation
c) Responsibility check of all inputs (analog specially), validate and quality tagging like good, bad, suspects etc.
d) Channel wise engineering unit conversion.
e) Contact bounce filtering with adjustable time constant.

5 Interface of the system with MCC / Switchgears, and contactors (AC&DC) shall be in the form of potential free contacts via interposing relay modules mounted in the respective switchgear or MCC unit. All other interfacing relays shall be mounted in a separate cabinet or a separate section of the PLC cabinet.

6 For AC solenoids and contactors directly driven from output cards.

4.6.1 Specifications for Operator Station, Engineering Stations

Each operating station & Engineering workstations and any other workstations/PC envisaged in plant shall be as per latest trends at the time of supply.
All OWS shall be interchangeable PERIPHERALS FOR OPERATOR STATION, ENGINEERING STATION & SERVER SYSTEM.

4.6.2 Full flat Monitors with LED back lighting

1 The bidder shall furnish OS/ES PC with coloured full flat monitors with LED back lighting. OS/ES PC with monitors shall have a fast cursor control device like a track ball/optical mouse. All monitors shall be of high resolution colour graphics type and with not less than 32 colours. The picture frequency shall not exceed 85 Hz. The resolution required is 1920 X 1080 pixels or better. The picture shall be stable and completely free of any flickering. The screen illumination shall be enough to give good readability. The screen dimensions shall not be less than 24" screen diagonal and is of industrial grade systems.

2 Antiglare hard coating shall be provided. High reliability and long life 24" (Industrial type) or better higher size monitors like 50/52'' LED screen shall be supplied by the bidder. Monitors shall be equipped with all adjusting elements accessible on the front plate.
3 The offered system shall be able to work in 24 / 7 days environment and is of industrial nature.
4 Monitors along with keyboard & optical mouse shall be mounted on supervisory control console specified elsewhere in the specification.

4.6.3 Software License:

a) The Bidder shall provide software licenses for all the software being used in PLC / any other electronic/microprocessor-based system. The software licenses shall be provided for the project (e.g. Organization or site license) and shall not be hardware/machine specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good, and it shall not be necessary for Owner to seek a new license/renew license due to upgradation / change of hardware / machine in PLC / any other electronic/ microprocessor based system at site. All licenses shall be valid for the continuous service life of the plant.
b) In case the s/w license is dependent on no of points, then quantity to be considered is 30% above the finally implemented points.
c) Laptops shall be provided with all master software loaded and engineering of PLC & any other control system.

4.6.4 Software Upgrades

For Owner support, the Bidder shall periodically inform the designated officer of the Owner about the software upgrades/new releases that would be taking place after the system is commissioned so that if required, same can be procured & implemented at site.
PLC supplier should periodically inform and provide software patches for all PLC software till continuous service life of the plant.

Software Documentation and Software Listings

All technical manuals, reference manuals, user's guide etc., in English required for modification/editing/addition/deletion of features in the software of the PLC /any other microprocessor-based control system shall be furnished. The Bidder shall furnish a comprehensive list of all system/application software documentation after system finalization for Owner's review and approval.

The software listings shall be submitted by the bidder for source code of project specific application software and all special-to-project data files.

4.6.5 Programming, Diagnostic and Engineering Workstation

The Engineering stations provided with PLC shall have all the function of programming/ configuration/modification/ reconfiguration and documentation. The features and facilities to be included are as under:-

- Configuration or re-configuration of a system.
- Possibility to introduce or modify parameters.
- Documentation of system configuration.
- Calculation program functions.
- Graphic editing program.

1 This workstation shall be able to design, configure, monitor document or trouble shoot the process activities as desired.

2 The workstation shall be used for designing and redefining control strategy, configure system modules, modify the configuration, build and implement computing logic's, alarms and display functions, save and retrieve system configuration schemes, monitor process variable, tune or adjust process parameters, display and trend information, produce system documents etc. The station shall be able to produce generic logic control drawings, configuration drawings etc.

3 Control engineering software system shall include text, computer aided design, ladder diagrams, logging data base, graphic package etc.

4 Combined with a printer, the engineering station generates logic control drawings configuration drawings, module list, specification list, and function blocks for cross reference list.

5 Engineering station shall have capability of online and offline program modification without affecting the performance of the system / process. While online, connected to process, the engineering station shall provide real time tuning and trouble shooting. On offline, the engineering station allows control system configuration.

6 The proposed workstation can be used to implement or redefine process control strategy for control computing, logic, alarm, list display of process functions. In addition, the station shall have elaborate facility for diagnostic functions.

7 The diagnostic station shall assist in detection of system faults and malfunctions and faults in field inputs along with identification of their locations. It provides automatic display and recording of such disturbance and thereby enhances the system availability. Sensors, binary switches, transmitters, input/output processing modules, controllers, peripherals and multipurpose bus communication system etc. are fully and comprehensively monitored. For this purpose all processors, modules etc. shall have self-diagnostic features and disturbance shall be communicated to central diagnostic station. All failures, anomalies and missing functions shall be automatically detected, alarmed & displayed with clear text, showing the exact origin and the kind of failures. The failure shall also be signalled at concerned equipment.

8 Detailed information of disturbance message shall be displayed in engineer's OS and printout. Typically an engineer's OS shall also have facility to windows for progressive detailing of diagnostic information wherein a permanently displayed window for plant diagnostics shows disturbance of the over-all system level. By activating a cursor/key a station diagnostic window is opened to show the details of station with all installed equipment's. The diagnostic data for an item of equipment identified as disturbed can be called up for subsequent windows and finally the last window can be opened to obtain information such as type, location and possible causes of disturbance and suggestion for its rectification. Any alternative method of diagnostic display is also acceptable, which provides the detailed information during disturbance.

9 The system shall have extensive diagnostic software to identify all failures up to card level as well as field inputs. This shall include failure of power supplies, I/O cards, peripherals controllers etc. Failure of analogue I/O cards, binary cards / modules shall also be displayed on the engineering cum diagnostic station. The alarms regarding major subsystems shall be displayed on the alarm OS. Further details shall be available on the engineer's/ programmer's OS in form of a graphic and in other display formats. The field input faults/ failures shall be reported with nature and type of fault/failure clearly identified.

4.7 System Grounding

i) The automatic control system shall be designed for grounding to the station ground mat at a single connection point. Insulated ground bus from this point shall be furnished to the control logic cabinets and shall be connected to an insulated copper grounding strap in each cabinet. The control panel and local instrument cabinets shall be grounded to the station ground mat.

ii) Shields on electronic cables shall be grounded as required. When shielding terminations are required in cabinets furnished under this specification, suitable terminals and supports shall be furnished.

iii) The control logic cabinets shall be equipped to accept the single point system ground, which at this point will be isolated from the building ground. Any internal component grounds or commons shall be connected at the system ground, which shall be kept isolated from the building ground.

iv) Any required electrical ground or common from components not mounted in the control logic cabinets shall be brought to a terminal block connected within the component. This terminal block connection shall be located with the other terminals and shall be available from connection through the shield of the field wiring to the system ground specified within the logic cabinet. Isolation from building ground and case ground shall be inherent in the component design.

v) All panels and cabinets shall be provided with a continuous bare copper ground bus o minimum 6 mm x 25 / 50 mm cross section. The ground bus shall be bolted to the panel structure and effectively ground the entire structure. Each Ground bus shall have provision at each end for connection of ground leaks (6 mm x 50 mm GI Flats) by suitable bolting. All system cabinets shall be brought to a common system ground by the bidder. Electronic earthing resistance shall be < 0.5 ohms.

vi) Each circuit requiring grounding shall be individually and directly connected to the panel ground bus by ring tongue type compression lugs. For electronic system cabinets the system ground bus shall be insulated from the cabinet enclosure and shall be separately connected to the system ground. All system cabinets shall be brought to a common system ground by the bidder.

vii) The Bidder shall furnish his recommendations regarding grounding requirements for all equipment / systems and shall specifically indicate the deviations if any from the above requirements as a part of his proposal.

4.8 Tests to be performed during FAT of PLC system

Following minimum tests shall be performed during FAT at manufacturer's place of PLC system:

1) Hardware Inspection of PLC Sub System
   - i) Heat run test
   - ii) Hardware check / physical software package check
   - iii) I/O loading specification
   - iv) PLC start-up and power fail restart
   - v) PLC processor back-up function

vi) Communication redundancy

2) Application Inspection for Logic Functions
   i) Ladder logic functional check and graphic screen check
3) Application Inspection for PLC Panels
   i) General arrangement
   ii) Appearance and construction
   iii) Panel wiring
   iv) Panel functional check
   v) Power supply redundancy check
4) PLC System Checks
   i) PLC Scan time functional test
   ii) PLC/IO panel/Engineering station functions
   iii) Diagnostic and process alarm test

In addition to above test, Bidder shall also perform other tests as per approved QAP & FAT procedure.

5 CLOSED CIRCUIT TELEVISION (CCTV)

A complete integrated Plant Security and Surveillance CCTV system complete with all hardware and software as required shall be provided. The system to be provided shall include all necessary hardware, software, firmware, interfaces and accessories, all related civil and masonry work required for implementing a fully functional CCTV system for a modern power generation utility. Bidder offered CCTV shall include but not limited to the details specified in subsequent paragraphs.

5.1 General Requirements

a. All plant security and surveillance CCTV components and accessories shall be from the latest proven product range of qualified manufacturers. The sensors offered should be of one single make. The plant security and surveillance CCTV package including sensors should be supplied by one approved systems bidder, who can supply the complete equipment. The bidder should have in-house capabilities to manufacture the package, testing facilities etc.

b. The design of the security & surveillance system shall take into account the potential security risks to the Biogas plant.

c. The bidder shall provide the cameras at locations as required in the plant area for proper monitoring of the plant, and the same shall be subject to review and approval by OIL during detailed engineering stage. However, the bidder shall not provide less than 20 nos. of cameras.

d. Key Locations e.g. Main Gate, Weighbridge, Tipping Floor, MSRC Shed, Manual Sorting Station, Compost Shed, Digesters, Biogas Genset Building, ETP, Store etc. shall be provided with high resolution CCTV Cameras with adequate storage of Historical Data in the central Control Room.

5.2 Design Requirements

Specific Design requirement

a. CCTV monitoring is envisaged in the Bio CNG control room. This room will house PCs, Network controllers, Multiplexers, Video recorders, monitors and other associated accessories.

b. All cameras for CCTV system shall be connected to suitably located in groups through single mode Fiber Optic cable for transferring camera video signals. RTUs will then be connected to a network controller through CCTV LAN. Network controllers shall be capable of accommodating number of RTUs.

c. All camera images shall be continuously recorded. System offered shall allow to record and hold camera images for a minimum period of 30 days. Facility for transferring camera images to separate recorders/ data storage devices and play back facility of the same shall be provided.

d. Camera image monitoring and viewing facilities shall be provided at CBG plant control room.

e. Alarm & Display monitors shall be provided as follows:

The system shall have the following facilities:

(a) Zooming
(b) Pan control
(c) Tilt control
(d) Computer interface
(e) Logging printer part
(f) Multiple prepositions
(g) Programmability
(h) Alarm interface
(i) In built IR

The Bidder shall indicate details of the video and controls in his proposal.

5.2.1 Camera Mounting

The camera shall be mounted such that a clear, unobstructed view of the scene to be observed is generated. The mounting bracket / pole and accessories shall be designed to ensure a proper, rigid support to the camera. The installation shall be done in a manner that the camera and its components / accessories are easily accessible for maintenance and there is minimal risk of accidental damage.

5.2.2 Camera Enclosure

a. Enclosure shall be suitable for accommodating the PTZ cameras. The enclosure shall feature a removable / sliding / hinged type cover to allow easy access to the camera, lens and the camera mounting platform. The camera mounting platform shall be constructed from rigid non-conducting material. It shall be removable and shall allow for adjustment of height. Glands shall be provided for easy installation of the power and video cables. An optically clear and distortion free viewing window shall be provided. The housing shall be suitable for obstruction free viewing. The enclosure shall have a powder coated or epoxy finish. Mounting brackets to suit the location of installation shall be supplied. The protection class of these enclosures shall be IP 65 or better. Cameras installed in hazardous areas shall be suitably certified for use in those areas.
b. For outdoor camera enclosures in addition to the requirements detailed above, thermostatically controlled heater, blower with filter and sun shroud shall be provided along with necessary wipers.

c. The system shall be powered by UPS power supply.

5.2.3 CCTV Monitoring System

Purpose of CCTV monitoring system shall be to meet the following :

a. To provide the plant operators with an overview of the important plant equipment so that they can ascertain that there are no obvious mechanical problems.
b. Display of images in a multiplexed fashion.
c. Recording of images in a time lapsed fashion and playback facility of images.
d. CCTV system shall be of proven design in dust laden atmosphere and shall be of reputed make.
e. The system shall be time synchronized with Master clock system for time stamping.

f. The CCTV system shall be complete in all respect and generally will comprise the following:
   i. Colour Dome cameras with pre-configurable locations.
   ii. Necessary software for displaying camera images with multiplexing facility.
   iii. Necessary camera poles, camera housing and related accessories, necessary civil & masonry works.

5.2.4 CCTV Cameras:

The cameras shall be rugged high speed PTZ digital dome cameras with inbuilt PTZ driver unit & RS 485 receiver unit, 1/4 inch image format fully performance colour CCD dome cameras. These cameras should provide high resolution and high sensitivity suitable for operation both in natural and artificial sighted areas.
The cameras should have features as mentioned below:

a. Suitable for night-time surveillance.
b. Manual or Automatic colour/infra-red switching.
c. Automatic picture enhancement to give a balanced picture where there is too little/too much light.
d. Remote camera setup, with on screen menu display.
e. Back light composition
b. Automatic white balance, with mode selection options
c. Contour correction and contrast compression control.
d. Synchronization selection for Gen lock, external V-lock, mains lock and internal free-running.
e. Cameras provided with auto IRIS lens, low lux density
a. lux) suitable for functioning in darkness (night shot Capability) and Infra-red illuminator.

Redundant Database Servers
The Database Server contains a database of all network-connected cameras and their configuration. The Database Server shall be able to be use in a redundant configuration, using two separate Database Servers (being executed on separate Workstations). The backup Database Server shall be continuously synchronized with the master Database Server to ensure that it is always up-to-date and ready for a fail-over, when required.

5.2.5 Application Software Functions

i. Live Video
ii. Single/Selected Camera Accessibility
iii. Quad View feature
iv. Sequence View feature

a) Camera settings

i. Operators shall be able to change important settings for an individual camera. The details are grouped into several sections:

a. Camera Details
b. Camera Connection
c. Camera PTZ Control
d. Security
e. Camera Deletion

ii. Camera Details

The operator shall be able to configure the following parameters for each Camera:

1. Name
2. Location
3. Description
4. Camera Number (for fast numeric keypad call-up)

iii. Camera Connection

The operator shall be able to configure the following parameters for each camera:

1. Camera Streamer Type
2. Resolution: The multiple resolutions shall be supported depending on the functionality of the camera and camera streamer.
3. Video Frame Rate: The multiple supported frame rates (in frames per Second) shall be provided.
4. Choice of five levels of video compression, equally distributed from minimum to maximum compression
    1. Streamer IP Address
    2. Streamer Camera Number (when connected to a multiple port Camera Streamer)
    3. Choice of frame rate or bandwidth limited streaming
    4. Unicast or multicast transmission of video
    5. PAL or NTSC camera format

iv. Camera Control

The operator shall be able to configure any appropriate camera to be PTZ controllable.

v. Recording

The following methods of recording live video shall be supported:

1. User activated
2. Event activated
3. Scheduled
4. Continuous background recording
5. Video motion detection
6. Snapshot

5.3 Tests for CCTV System Equipment

Simulated Functional test to be conducted and will be witnessed by Owner or Owner's representative.

5.4 Power Supply

The bidder shall provide MCBs for distribution of power supply to all instruments and accessories as per their individual requirements.

Power supply to all instrument and control systems shall be done separately and it should be possible to disconnect any instrument without interrupting power supply to any other equipment/device.

6 FIELD INSTRUMENTATION

6.1 General Requirements

6.1.1 Instruments, control devices and other equipment accessories covered under this specification shall be furnished in accordance with I&C specification sheets and drawings enclosed herewith and the requirements of all applicable clauses of this specification.

6.1.2 The Instrumentation and Control equipment shall conform to all applicable codes and standards. All equipment and systems shall also fully comply with the design criteria stated.

6.1.3 The Instrumentation & Control equipment and accessories shall be from the latest proven design for which the performance and high availability have been demonstrated by a considerable record of successful operation in power station service for similar applications. The bidder shall furnish sufficient evidence to fully satisfy the Owner in this regard.

6.1.4 The Bidder shall furnish all Instrumentation & Control equipment and accessories under this specification as per technical specifications, ranges, makes and model numbers approved by the Owner during detailed engineering.

6.1.5 All instruments, devices and accessories furnished by the Bidder as per this specification shall be designed and constructed to perform normally and meet all guarantee when subjected to the environmental and service conditions and other applicable specification documents.

6.1.6 The necessary root valves, impulse piping, drain cocks, gauge zeroing cocks, valve manifolds and all other accessories required for mounting/erection of all local field instruments shall be provided by Bidder as per approved hook up drawings.

6.1.7 Every instrument requiring power supply shall be provided with a pair of easily replaceable glasses cartridge fuse of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.

6.1.8 All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments located outdoor shall conform to IP-65 unless otherwise specified (ATex certified Explosion proof based on hazardous area classifications) and an anti-corrosive paint shall be applied to the field mounted enclosures / instruments. All the field instruments shall also be provided with SS tag nameplate and double compression type nickel-plated brass cable gland. Gaskets, fastener, counter and mating flange shall also be included wherever required with instruments.

6.2 Minimum Requirement of Field Instruments

6.2.1 Following minimum requirement of field instruments shall be fulfilled by Bidder (In addition, Redundancy criteria for instruments shall be as specified elsewhere in specification): -

1) Level Transmitter, Level switches for very high / high / normal / low / very low interlocks (type as per Owner approval).

2) Tapping points/test points shall be provided.

3) All RTDs shall be Duplex.

4) All Field Instruments used in acid or alkaline atmosphere shall be with standard anti-corrosion coating i.e. the combination of polyurethane and epoxy resin baked coating (ANSI/ISA-71.04).

5) All primary instruments installed at "Minus level or Floor" shall be with protection class of IP 68.

6) Transmitters (all types) as on the required basis for monitoring interlocks & controls as per redundancy criteria.

7) 6 no. duplex embedded temperature detectors for various motor stator windings and duplex RTDs for motor/pump bearing temp.

8) All field mounted push button, selector switch etc. shall be as per IEC or NEMA 4X protection.

9) All limit switches shall be conforming to IEC-60947-5-1.

10) Primary Elements: Flow nozzles shall be made of stainless steel, with three sets of pressure taps installed in the pipe wall where required. Installation of flow nozzles and pressure taps shall be made in the pipe.

11) Orifice plates shall be supplied with carrier rings as per process requirement.

12) Instrument and Service Air – Vortex/Swirl type or other suitable type flow meter

13) Electromagnetic flow meter to be considered for slurry/water applications flow measurement. Ultrasonic flow transmitters are acceptable for Low pressure Biogas flow measurement.

14) Coriolis flow meter to be provided for Pure Bio -Gas measurement (Custody purpose).

15) Instruments should be in easy reach of maintenance person, there should be separate platform for unreachable instruments. Easy access should be provided to all the tapping points of instruments used for measurement & control.

16) Pressure Gauges/Indicators shall be provided for all the following services:

(a) Suction and discharge lines of pumps/fans, including on header section if two or more pumps/fans are employed for same service

(b) All input and output lines of process equipment

(c) All applications where pressure transmitters are not envisaged.

17) Level gauges shall be provided for all tanks, and the maximum length of one gauge glass shall not exceed 1 meter. The gauge glasses shall be stacked to cover the complete height of tanks including overflow level. There shall be an overlap of a minimum of 150mm, when more than one level gauge is required.

18) One (1) no. online and one (1) no. offline gas chromatography systems shall be provided.

19) Two (2) nos. of handheld gas analyzer to measure O2, CO2, H2S and CH4.

20) Radar type level transmitters to be provided for Feed tank level measurements. DP based level measurements are acceptable for digestors. Foam detection switch to be considered in digestors.

21) Minimum 4 numbers of temperature transmitters to be provided for Digestor temperature measurement.

22) pH analyzers (redundant) to be provided for all digestor tanks.

23) All instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.

24) Canopy/Enclosure shall be provided for field instruments like transmitters, switches & flow meters, etc. and any other equipment to protect from direct sunlight, lightning & rain.

Field instruments shall be supplied & offered as per data sheets specified below:

6.3 Transmitters, Switches, Gauges and Panel Mounted Instruments

LEVEL TRANSMITTER

S. No.	Description	Specifications	Bidder's data
1	Type	Ultrasonic, Radar, Gauge Pressure type, etc. (Selection shall be made as per process requirement)	
2	Enclosure MOC	Die-cast aluminum/ as per process requirement	
3	Enclosure Class	As per process requirement	
4	Wetted part MOC	SS316 or as per process requirement	
5	Adjustability	Programmable/As per standard	
6	Accuracy	± 0.5% of span or better	
7	Instrument connection	As applicable	
8	Electrical connection	As applicable	
9	Output	4-20mA (preferrable HART compatible)	
10	Display	Local LCD display/As per standard	

FLOW TRANSMITTER

S. No.	Parameter	Value	Bidder's data
1	Type	Electro-magnetic, ultrasonic, differential pressure type, etc. (Selection shall be made as per process requirement)	
2	Enclosure MOC	Die-cast aluminum/ as per process requirement	
3	Enclosure Class	IP-65 for outdoor/as per process requirement	
4	Wetted part MOC	SS316 or as per process requirement	
5	Adjustability	Programmable	
6	Accuracy	± 0.5% of span or better	
7	Instrument connection	As applicable	
8	Electrical connection	As applicable	
9	Output	4-20mA HART, Pulse/Frequency/Switch output (as applicable)	
10	Display	Local LCD display/As per standard	

TEMPERATURE TRANSMITTER

S. No.	Parameter	Value	Bidder's data
1	Type	RTD	
2	Enclosure MOC	Die-cast aluminum/ as per process requirement	
3	Enclosure Class	As per process requirement	
4	Wetted part MOC	SS316 or as per process requirement	
5	Adjustability	Programmable	
6	Accuracy	± 0.5% of span or better	
7	Instrument connection	As applicable	
8	Electrical connection	As applicable	
9	Output	4-20mA (preferrable HART compatible)	
10	Display	Local LCD display/As per standard	

PRESSURE TRANSMITTER

S. No	Parameter	Value	Bidder's data
1	Type	Absolute pressure, Gauge pressure type, etc. (Selection shall be made as per	

		process requirement)	
2	Enclosure MOC	Die-cast aluminum/ as per process requirement	
3	Enclosure Class	As per process requirement	
4	Wetted part MOC	SS316 or as per process requirement	
5	Adjustability	Programmable	
6	Accuracy	± 0.5% of span or better	
7	Instrument connection	As applicable	
8	Electrical connection	As applicable	
9	Output	4-20mA (preferrable HART compatible)	
10	Display	Local LCD display/As per standard	

pH TRANSMITTER

S. No	Parameter	Value	Bidder's data
1	Type	Double junction reference type (Selection shall be made as per process requirement)	
2	Enclosure MOC	Die-cast aluminum/ as per process requirement	
3	Enclosure Class	As per process requirement	
4	Wetted part MOC	SS316 or as per process requirement	
5	Adjustability	Programmable	
6	Accuracy	± 0.5% of span or better	
7	Instrument connection	As applicable	
8	Electrical connection	As applicable	
9	Output	4-20mA (Pulse/Frequency/Switch output HART as applicable)	
10	Display	Local LCD display/ As per standard	

PRESSURE GAUGE

S. No.	Parameter	Value	Bidder's data
1	Type	Diaphragm/Bourdon (As per process requirement)	
2	Enclosure MOC	Die-cast aluminum/ as per process requirement	
3	Enclosure Class	As per process requirement	
4	Wetted part MOC	As per process requirement	
5	Dial Size	4''/6''/standard sizes	
6	Accuracy	1% or better	
7	Instrument connection	As applicable	

TEMPERATURE SENSOR

Sr. No.	Parameter	Value	Bidder's data
A	**RTD Element with Transmitter**		
1	Element	PT 100 (3 Wire)/(4 wire) as per process requirement	
2	No. of Element	Simplex/Duplex	
3	Type	Straight/as per process requirement	
4	Element Diameter	6 mm/standard sizes	
5	Body MOC	As per process requirement	
6	Accuracy Class	1% or better	
7	Process Conn.	As applicable	
8	Output	Ohms/4-20mA (as applicable)	
B	**Thermowell For RTD**		
1	Body MOC	SS316/as per process requirement	
2	Internal diameter	8 mm/standard sizes	
3	Process Medium	As per process	
4	Process Conn	As applicable	

OFFLINE GAS CHROMATOGRAPHY

S. No.	Particulars	Unit	Values	Bidder's data
1	Service/ Piping Class		Natural Gas / Class ANSI 300/ As per process requirement	
2	Flow Rate (Min / Normal I Max)	kg/s	As per process requirement	
3	Pressure (Mainline) Inlet/ Outlet	Bar(g)	As per process requirement	
4	Design Pressure	Bar(g)	As per process	
5	Temperature (Mainline Inlet/ Outlet	Deg. C	As per process	
6	Design Temperature	Deg. C	As per process	
7	Power Supply		24 V DC/as per standard	
8	Housing		As per process requirement	
9	Safety Approval		As per process requirement	

TEMPERATURE GAUGE

S. No.	Parameter	Value	Bidder's data
1	Body	SS316/as per process requirement	
2	Dial size	150 mm/standard sizes	
3	Element Diameter	6 mm/standard sizes	
4	Accuracy	1% or better	
5	Process Conn.	As applicable	
B	**Thermowell For TG**		
1	Body	SS316/as per process requirement	
2	Internal diameter	8 mm/standard sizes	
3	Process Medium	As per process	
4	Process Conn	As applicable	

6.3.1 Junction Boxes

Bidder shall note that the Analog and digital signals shall be wired to different junction boxes.

(i) No. of ways 12/24/36/48/64/72/96/128 with 10% spare terminals.

(ii) Material 4mm thick fibre glass reinforced polyester.

(iii) Type Screwed at all four corners for door. The door handle shall be self-locking with common key. Door gasket shall be of synthetic rubber.

(iv) Mounting clamps and structures etc.	Suitable for mounting on walls, columns, accessories The brackets, bolts, nuts, screws, double compression glands and lugs required for erection shall be of brass, included in Bidders scope of supply. Race ways for routing of cables inside JBs shall be provided.
(v) Type of TB	Rail mounted maxi termi or cage-clamp type suitable for terminal conductor size up to 2.5 mm2. An M6 earthing stud shall be blocks provided.
(vi) Protection class	IP:65 minimum and Explosion/Flame Proof as per area classification. ATEX certified.

6.3.2 Intercom System (EPABX)

The intercom system shall be used for communication within the plant. The connections shall be provided at various locations including different control panels and operator room. It shall be suitable for industrial application and shall be backed up by battery or separate UPS.

Specifications for Intercom/EPABX System:

- Microprocessor based programmable
- Power supply 230VAC, 50Hz
- Ambient – 150C to 450C
- Direct Inward dialling (DID) with voice guidance facility.
- Caller line Identification (CLI) on Analog as well as digital extension.
- Connectivity to computer (with Call Billing Software)
- Dynamic STD locking
- Conferencing facility for specified extensions
- Back-up power supply separate UPS or 12VDC battery
- Cabling – Single pair
- Minimum 4 P&T
- Modular for ease of expansion

Telephone wiring shall be brought to a tag-block at a suitable point in ground floor. Provisions shall be kept for suitable entry-pipe for laying incoming telephone cable.

Unarmoured Telephone Cable:

Telephone cable should be solid annealed tinned electrolytic copper high conductivity conductor insulated and sheathed with PVC compound as per BS: 6746, unarmoured twisted pairs with proper colour code bundled together in concentric layers and wrapped with melinix or PVC tape with nylon ripcord. Ripcord is laid longitudinally under the sheath as an effective means of slitting the sheath to facilitate removal. The lay is chosen so as to minimize cross talk in cable. (Manufactured to standard for indoor telephone wiring, conductor resistance at 20 degrees Celsius: max 98 ohms/Km, conductor diameter: 0.5 mm).

Telephone Junction Boxes (20 & 10 Pair):

Telecommunication distribution enclosure with Hi-technology connectors: The Telephone tag blocks made of thermoplastic polyester as insulation and carrier material for the krone LSA plus contacts in weather resistant, dust & waterproof, wall mounting lockable CRCA sheet, having suitable back mount frames, jumper facility, powder coated with required pair connectors and following technical specification:

Telephone Wiring:

General:

All material shall conform to relevant standard as per BIS and shall carry ISI mark. Provide wiring for telephone on surface of wall or ceiling concealed in slab, wall, under flooring, etc. through existing metallic conduits, rigid PVC conduits, PVC trunking with all necessary hardware material, etc.as specified.

Material:

PVC Telephone Cable:

PVC insulated tinned copper solid conductor with minimum 0.5 mm dia. (Single &Multi pair) properly paired and colour coded shall be terminated on KRONE module with suitable tool.

Saddles:

Saddles fabricated from G I sheet of required gauge (16/18 gauge) either galvanized finish or painted with superior quality enamel black paint, with necessary shearing for mechanical strength, semi-circular shaped with extended piece having suitable holes for fixing on spacer.

MDF:

Manufactured by reputed manufacturer of specified capacity, facility for wall mounting, with door & lock, aluminium frame for fixing of KRONE, duly enclosed in cabinet made from 18 SWG CRCA sheet with powder coating of required colour.

Junction box:

Manufactured by reputed manufacturer of specified capacity, facility for wall mounting, with door & lock, aluminium frame for fixing of krone, duly enclosed in cabinet made from 18 SWG CRCA sheet with powder coating of required colour. The depth of the box should consider the height of KRONE module plus protection magazine.

Over Voltage Protection Magazine:

Manufactured by reputed manufacturer of 10 pair capacity, with 3 pole gas discharge tube should be properly fitted on KRONE module in MDF/Junction box.

Rosette Box:

PVC/Bakelite box with LED indicator, RJ 11 jack, facility for fixing on wall.

Jumper Wire:

Twin twisted PVC insulated with Tinned copper solid conductor minimum 0.5 mm dia.

Location for Telephone Connections:

- Security Terminal: 1 No.
- Weighbridge Terminal: 1 No.
- Central Control Room: 1 No.
- Biogas Purification Plant: 1 No.
- Workshop & Store: 1 No.
- ETP: 1 No.

Other locations where telecommunication is required

7 ERECTION HARDWARE

7.1 General Requirements

7.1.1 This section covers the material requirement for instrument connection to process, instrument process, piping, tubing, supports, transmitter racks and main accessories to be furnished under this specification and the requirements of installation and routing. Impulse lines, fittings and other accessories required for the erection of complete Instrumentation and Control System supplied under various packages of this specification shall be supplied on "as required' basis. Bidder shall offer all necessary items for this section based on his experience on similar plants, plant layout diagrams, installation drawings and other applicable sections of this specification. Based on the good engineering practices, Bidder shall furnish installation drawings during the engineering of the system for Owner's review and approval. The installation of the drawings shall be suitable for his installation of his range of instrumentation.

7.1.2 The Bidder shall furnish, and test all required erection hardware, which is necessary for proper installation and interconnection of the equipment/systems furnished by the Bidder and their integration with main equipment/systems as per the enclosed installation drawings and other applicable clause. The Bidder shall furnish all hardware and accessories to ensure that the equipment/systems furnished form a complete and operational system meeting the intent and requirement of this specification.

7.1.3 All materials furnished shall conform to the latest editions of American National Standard Code for Pressure piping, Power piping, ANSI B311.1, ANSI B16.11, ASME Boiler and Pressure Vessel Codes, IBR and other applicable ASME, ANSI and Indian Standards. Schedule numbers, sizes and dimensions of all carbon steel, stainless steel and alloy seamless steel pipe shall confirm to ANSI B.36.10 and of stainless steel pipe shall confirm to ANSI B 36.19 unless otherwise specified.

7.1.4 Instrument erection hardware which includes all junction boxes, cable trays, cable glands, lugs, cable ties, support, local panels, pneumatic and process hook up hardware, Impulse piping & fittings and other erection materials and accessories required for the system supplied. Installation of cable trays shall be vertical only.

7.1.5 All materials supplied under this section shall be suitable for intended service; process operating conditions and type of instruments used and shall fully conform to the requirements of this specification.

7.1.6 The Bidder is responsible for the performance of the equipment furnished on system basis any shortfall in erection material observed during erection stage shall be compensated by the Bidder at no extra cost.

7.2 Process Connections

The type of instrument source connection shall depend upon the process parameters and the tapping size. The source connection drawings shall be finalized during the engineering stage, Refer Hookup diagram.

7.2.1 Impulse Piping System

Impulse piping system consists of primary impulse pipes/tubes, valves, fittings, valve manifolds and other accessories between the source connection point (source shut-off valve onwards) and all instruments/devices. Impulse pipe span for supporting clamp shall be 1.5 metres. This will also include all piping and valves etc. required for instrument drain and vent connections. The Bidder shall furnish and test all items required for completeness of this specification.

7.2.2 Air Supply Piping

The piping for air supply shall be as specified below (However Bidder shall supply the materials as required basis to complete the system in all respect)

1. Individual Supply Lines and Control Signal Lines:-

Air lines shall be ¼ inch size, connected by SS316 flare less tubing fittings. SS tubing shall be light drawn tampered tubing conforming to ATM B75 shall be annealed soft temper tubing conforming to ASTM B68 or B75. Fittings on the branch line to facilitate connections to the individual supply line shall be SS screwed type.

2. Flexible Hoses:-

Flexible hoses shall be ¼ inch rubber hose with Buna-N liner steel wire braid reinforcement and rubber outer covering complete with ¼ inch brass fittings and shall have swivel male pipe threads. Each hose shall be one meter in length.

3. Pipe Material Specification:-

The piping material shall be carbon steel hot-dipped galvanized inside and outside as per IS-1239 or the equivalent of these standard heavy qualities with screwed ends. The piping threads shall be as per ASA B.2.1

4. Isolating Valves:-

Gate valves as per ASTM B62 inside screw rising stem screwed female ends as per ASA B.2.1 valve bonnet shall be union type and trim shall be stainless steel body rating 150 pounds ASA. Valves sizes shall be ½ inch to 2 inch.

5. Fittings:-

Forged cast steel A234 Gr. WPM galvanized inside and outside; screwed as per ASA B2.1 dimensions as per ASA B16.11, rating 2000 pounds, elbows and soft seats. The size of the fittings shall be ½ inch through 2 inch.

6. Air Filter Regulator Set:-

An instrument Air Filter Regulator Set with mounting assembles shall be provided for each pneumatic device requiring air supply. The filter shall be of size 5 microns and material sintered bronze. The air set shall have a 2 inch size pressure gauge and built in filter housing blow-down valve. Filter regulators shall be suitable for 10 Kg/Sq.cm. maximum inlet pressure. The connection size shall be ¼

inch NPT. A ½ inch instrument air supply isolating valve shall be provided for each pneumatic device requiring air supply.

7.2.3 Process Connections

Following type of source connections shall be provided by the Bidder on equipment/piping for instrumentation purpose.

1. Source valves for pressure and differential pressure measurements as per enclosed instruments source connection details.
2. Threaded/weld able stubs for thermowells of various sizes for temperature elements as per enclosed source connection details.
3. Source valves with socket welded connections for level services as per enclosed instrument source connection details.
4. For control actuators at the master operating spindles/levers of the final control elements.

However, if the source connection details, as illustrated, do not match with the connection ports of the instruments, the same may be altered in consultation with Owner.

7.2.4 Impulse Tubing

High pressure and high temperature services (Water)	Seamless Alloy Steel piping to ASTM A335 GR.P22 (schedule 160 for high pressure & high temperature)
Low pressure and Low temperature services (Water)	Seamless carbon steel piping to STM A106 Gr.B
Low pressure and low temperature services (Air)	ERW carbon steel piping to IS 1239: 1973 Heavy class System
Analysis system	Seamless stainless steel piping to ASTM A312 GR. TP-321

7.2.5 Fittings Double compression type

i)	Material for socket weld fittings	ASTM A105 ASTM A182, Gr. F22 6000/3000 lbs
ii)	Dimensions of fittings	ANSI B16.11

7.2.6 Valves

i)	3-way valves	SS body/Forged CS body stellated internals and SW ends as per requirement for 2500 lb/600 lb ASA ratings.
ii)	3-valve/5- valve manifolds	FAS body/FCS body 316SS stellated internals with NPT(F) SCRD ends for 2500 lb/1500 lb/600 lb ASA ratings.

iii)	2-valve manifolds	FCS body, 316SS stellated internals, NPT(F) SCRD ends.
iv)	Isolation and drain valves	Globe valves with FAS

7.2.7 Condensation vessels body/FCS body, 316SS stellated internals, W ends for 2500 lb/1500 lb/600 lb ASA ratings.

7.2.8 Flexible conduits with fittings Lead coated, paper insulated, heat resistant. flexible metal conduits with necessary fittings

7.3 Guideline for Installation and Routing Of Instrument Piping

7.3.1 General Requirements

The following general erection guidelines have been enumerated here to enable the Bidder to estimate the requirement of instrument piping in plant:-

1. All instrument piping shall be in accordance with good engineering practice. It shall be finalized during engineering stage. Instrument piping shall be complete with fittings, valves and other required accessories.

2. Instrument piping shall not be routed:-
   a) Across equipment removal areas
   b) Below mono-rails and cranes
   c) Above or below removable gratings
   d) Above or below cable trays.

3. Primary Impulse Piping System:

   a) The primary impulse piping system shall include the instrument piping and all required accessories from process tap off point (root valves onwards) up to the respective instruments. From the same source, Tee off for instruments are not allowed. Separate tapping shall be provided for each instrument. The Bidder shall provide the necessary fittings and accessories along with impulse pipes for completeness and arrangements as per the finalized Instrument Installation Diagrams. Special accessories such as reservoirs and other devices shall be installed as required for flow primary element connection as required by the design of instruments, in accordance with the instructions of the instrument manufacturer.
   b) The Bidder shall prepare impulse pipe routing drawings.
   c) Impulse piping shall include a blow-down line and shut-off valve adequate for the duty requirements and for withstanding continuous design pressure and temperature of process medium. For process pressure above 40 Kg/Cm^{2}g, double valves shall be used before connecting to the blow-down header (This arrangement shall be provided for installation for the new transmitter if the existing transmitter has the same arrangement.)
   d) To assure a constant static head the connections from low pressure steam and low pressure liquid filled lines should preferably slope downward continuously towards the instrument as

the instrument is mounted below the source point. If downward slope is not feasible or the instrument is mounted above the source point, the line should slope upward continuously and a "pigtail" installed at the instrument to assure a water seal for temperature protection. Upward sloping liquid lines should be used only if the process pressure is sufficient to assure a head of liquid at the instrument. Horizontal runs should have a slope of not less than 40 mm per meter and must be adequately supported to maintain a constant slope. Vacuum connections to the condenser should always slope upward to the instrument.

4. Primary process piping for steam flow, liquid flow and manometric level measurement systems should preferably slope downward from the primary element connections to the instrument. Primary piping for flue gas and air flow measurement systems should preferably slope upward from the primary element connections to the instrument. If these requirements cannot be met, special venting or drain provisions will be required. Horizontal runs must have a slope of not less than 40 millimetres and must be adequately supported to maintain a constant slope.
5. Primary process piping from the field which enters the instrument enclosure from the bottom shall extend into the enclosure approximately 150 millimetres and be equipped with a socket weld to flare less tubing coupling of stainless steel. This coupling shall be used to connect the field primary process line to the enclosure process line. The field primary process line shall be anchored to the enclosure angle with U-bolts. Holes for supporting U-bolts shall be field or drilled. All impulse piping shall be supported rigidly at an interval not exceeding 1.5 meters so as to prevent excessive sag in piping. Process piping shall not be used for supporting impulse piping.
6. Impulse lines subject to severe sonic pulsations shall be of sufficient length and of suitable configuration to scatter harmful sonic wave energy before it reach the instrument.
7. Impulse piping shall be installed to permit thermal expansion without placing excessive stress on the piping and without affecting the gradient of slope. Long continuous straight runs of piping shall always be avoided. If required, expansion loops shall be provided at least every 2.5 meters to break the continuity.
8. All welded and screwed fittings shall conform to ANSI B16.11. Threads of piping components shall be taper pipe thread in accordance with ANSI B2.1. All threads shall be clean machine cut with all burrs and chips removed. Lubricants shall be of dry filch type. Any one of the following compounds may be used as a pipe thread sealer. Bidder shall supply adequate amount of his preferred sealer for erection purpose. Teflon tape shall not be used as a pipe thread sealer.

9. Instrument Air Piping System:-

Instrument Air shall be made available by the bidder at 3.5 to 7.0 Kg/cm^2 pressure. The instrument air may be arranged as under:-

For the control valves and power cylinders in Owner's scope but controlled by bidder's control system, the instrument air requirement for E/P converter shall be tapped from the nearby instrument air header laid by bidder / already laid existing piping with accessories available near the control valves or damper.

Air supply piping shall be installed at site always with a slope of over 1/100 to prevent accumulation of condensed water within the pipe.
All joints in the instrument air sub-header shall be of screwed type.

10. Signal / Control Air Tubing System:-

Necessary tubes with fittings and accessories for output signal from pneumatic instruments mounted in the field and control signals to final control elements shall be covered under this tubing system.
Valve manifold shall be used, wherever Diff pressure transmitter/ switch have been used for pressure measurement.
Valve manifold shall be used for Diff. Pressure & Flow measurement Transmitters/Switches.

11. Code for Racks and Associated Equipment	ANSI C83.9-1972
12. Code for pressure piping, welding and	ANSI B-31.1 Hydrostatic testing
13. Flexible conduits with fittings	Lead coated, paper insulated, heat resistant flexible metallic conduits with necessary fittings.

7.3.2 Transmitter & Switches Enclosures

In general, process parameter transmitters & switches installed at outdoor location and in areas where they are subjected to splashing oil, water, steam etc., shall be mounted in closed type transmitter rack. For other areas (indoor), open type racks may be used for installation of transmitters and process switches. However the actual requirement shall be finalized during detailed Engineering considering following:-

1. Transmitter/Switches enclosures shall be free standing, enclosed type offering protection against dust, moisture and vermin. Enclosures shall be suitable for outdoor installations.
2. The enclosures shall comprise of Galvanized Sheet mounting plate internally. Also external-mounting brackets in Polyamide or Stainless Steel shall be available and shall be weather proof. Panel thickness shall be 3 mm for instrument supporting faces and back and for remaining sides shall be 2 mm.
3. Instrument piping inside the enclosure shall conform to the specification and in line with typical installation drawings enclosed with the specification.
4. Blow down header shall be provided inside the enclosure as called for.
5. Bulk head connection shall be provided to receive and terminate the impulse pipes from root valves.
6. Instrument tubing, fittings and isolation, drain valves shall be to ANSI code for pressure piping. Piping/tubing shall be subject to hydrostatic tests at 1.5 times maximum system pressure.
7. Support angles shall be provided for valve manifolds, wiring trays etc. Enclosures shall be complete with necessary bulk head fittings, junction boxes, drain header and other accessories as needed on the basis of approved hook up drawings.
8. Sufficient spacing among adjacent transmitters shall be maintained to offer easy accessibility and operational convenience. The enclosure shall be designed with sizes to suit the grouping and to completely include all the hardware for hooking up the transmitters to the process on the basis of

approved installation diagrams. A maximum of Six (6) transmitters are envisaged to be grouped in one enclosure.

9. The field devices like switch devices, limit switches, position transmitters, solenoid valves etc shall be provided with removable type insert & screw type connectors, or terminal heads suitable for easy maintenance and testing of these equipment items.
10. All spare contacts/terminals on relays, control switches, limit switches or similar devices, process switches, duplex RTDs & Duplex T/Cs shall be wired to accessible terminal blocks/JBs for Owner's future connections. All wiring leaving a junction box or enclosure shall leave from terminal blocks and not from other devices in the enclosure. Two (2) pair cables shall be provided for terminating the transmitter to local JBs.
11. Auxiliary equipment such as relays, terminal blocks etc shall be readily accessible and servicemen shall have direct access to the equipment without removal of barriers, cover plates or wiring.
12. All electrical cables shall be conservatively selected for the electrical and environmental conditions of the installation and shall be of the best construction for the service conditions encountered. Oil resistant and proper temperature applicable cable shall be used throughout.
13. A minimum of twenty (20) percent spare terminals shall be provided. Only one wire per terminal shall be used on the outgoing side of these blocks (for cable panel). Any common connections required shall be provided on the panel side of the block. All incoming power terminals are to be clearly identified in a manner distinctly different from all other terminals and grouped in a logical pattern.
14. Each wire is to be identified at both ends corresponding to wire number shown in wiring diagrams.
15. All wire terminations at terminal, shall be made with compression type connections properly sized for the conductor and the terminal. The connector shall be constructed of fine grade high conductivity copper and shall be tin plated. No more than two wires shall be connected to a terminal. Vertical wiring on the panels between the terminal blocks and the devices shall be enclosed in non-metallic raceways or punched metal raceways with removable cover. Horizontal wiring between the raceways and the devices may run exposed. Wiring on the panels shall be formed neatly with wires neatly grouped in packs using non-metallic bends, and with group substantially supported along the panel.
16. Wire stripping shall be done in such a manner that conductor will not be nicked or cut.
17. The entire arrangement of wiring and arrangement of connections/ terminal blocks shall be acceptable of the Owner's Engineer.
18. Switches for temperatures, flow, level, pressure etc. required for unit protection/interlock shall be triplicated.
19. Each instrument shall be provided with nameplate and labels etc.

7.3.3 Local Instruments, Local Boards and Tapping Points

All local gauges as well as sensors and switches for parameters like pressure, temperature, level, flow etc for safe and efficient operation of equipment under the scope of specification, shall be provided

by bidder as approved by Owner. Such equipment shall be listed by the Bidder detailing the items with the respective functions in service. All field mounted instruments shall be mounted in such a way as not to be affected by vibration & environmental conditions. Racks to mount these instruments shall be furnished by bidder complete with requisite erection hardware, tubings and junction boxes with all terminals of the instruments duly wired complete with cable glands. Groupings of instruments, actual number of racks for instruments and its construction shall be to Owners approval.

Transmitters provided shall be mounted in transmitter enclosures to Owner's approval. The junction box for electrical connections shall be outside the transmitter enclosures.

All erection hardware required for complete installation/ implementation of entire instrumentation specified is included in bidders scope. Any change in size, type, and rating or in quantity deemed necessary during engineering shall be supplied within package price with no additional financial implication to Owner.

Bidder's scope includes providing counter flanges on pipe lines/ vessels to suit Owner arranged flanged devices. Counter flanges shall be complete with gaskets, nuts, bolts and other requisite accessories for proper installation.

Separate and independent tapping on equipment/associated piping shall be provided to suit the philosophy of redundant primary sensors. Separate sensors for control and monitoring etc are as decided by Owner. This shall include application such as first stage pressure. Wherever the process value being measured needs to be compensated for temp, pressure variations, the tapping points for such compensating elements shall be provided in requisite number along with the tapping for the process value.

Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Bidder will be intimated about thread standard to be adopted.

The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Bidder.

a) Temperature test pockets with stub and thermowell

b) Pressure test pockets

7.3.4 Size of tapping point stub, number and size of root valves for different types of measurements Size of tapping point stub, number and size of root valves for different types of measurements are as follows:

Sl. No.	Quantity of root valves	Size of stub and root valve	Service Condition
Pressure and Differential Pressure Measurement			
(i)	2	25NB	> 40 bar(g) OR 425degC
(ii)	1	15NB	< 40 bar(g) AND 425degC
Level Measurement			
Level Gauge & Switch			
(i)	2	25NB	> 40 bar(g) OR 425degC
(ii)	1	25NB	< 40 bar(g) AND 425degC
Level transmitter (displacement type)			
(i)	2	40NB	>40 bar(g) OR 425degC
(ii)	1	40NB	<40 bar(g) AND 425degC
Stand pipe for level measuring instrument			
(i)	2	80 NB	>40 bar(g) OR 425degC
(ii)	1	80 NB	< 40 bar(g) AND 425degC
Flow Measurement			
(i)	2	25NB	> 40bar(g) OR 425degC
(ii)	1	25NB	< 40 bar(g) AND 425degC

Note:-

1). Rating of piping / fittings / valves etc. is subjected to the final design pressure & temperature during the detailed engineering, as per ANSI B 31.1.

2). In case temperature is more than 540 deg. C, the material shall be P-91 only.

3). Material shall be compatible with that of the impulse pipe material and design parameter.

4). For DM Plant or DM water services, complete erection Hardware material shall be SS316 only.

5). Proper approach for all root valves shall be provided.

8 INSTRUMENTATION AND CONTROL CABLES

8.1 General

Bidder's scope of supply, laying, erection & commissioning of instrumentation and control cables shall include the following: -

a) Bidder shall supply, lay, erect, terminate all the control, instrumentation, interfacing (coaxial, fibre optic) cables etc.
b) All cables from sensors and contacts in field to the bidder's local junction boxes for field transmitters/sensors/switches etc.
c) All interconnecting cables and prefabs between bidder's supplied local JB, local instrument/transmitters, cabinets, panels and termination cabinets and interconnecting cables between Bidder's panels to equipment / instruments/ Plant Control Room. All field JB's / all field instruments / MCC / SWGR to PLC cabinets in LER / PLC cabinets/Relay cabinets/local control panels /desk etc. All power, Signal & Special cables from Sensor to JB, JB to MCC, JB / Drives to PLC, MCC / SWGR to PLC cabinets wherever one end or two ends are in EPC bidder's scope. Cables shall be supplied, laid, terminated by EPC bidder including preparation of Cable schedule and supply of cable Trays irrespective of other end scope.
d) All cables interconnecting computers and peripherals.
e) All co-axial cables/fibre optic cables and any other special cables for interfacing with other packages via soft link (covering all packages irrespective of scope).
f) All Extension cables.
g) Interfacing cables (Coaxial, fibre optic etc) between Owners supplied control systems/DCS to Bidder's PLC.
h) Preparation of Complete cable schedule, Interconnection diagram & JB schedules shall be in bidder scope.
i) All external field signals for PLC shall be terminated in separate marshalling/ termination cabinets. Under no circumstances, field cabling to be directly terminated in PLC system cabinets.
j) All Instrument cables shall be paired cables.
k) All cables shall be provided with anti-termite, Anti Rodent & moisture resistant properties.
l) All spare contacts/terminals on relays, control switches, limit switches or similar devices, process switches, duplex RTDs & Duplex T/Cs shall be wired to accessible terminal blocks/JBs for Owner's future connections. All wiring leaving a junction box or enclosure shall leave from terminal blocks and not from other devices in the enclosure. Two (2) pair (individual & overall shielded) cables shall be provided for terminating the transmitters & switches i.e. Analog & Binary signals to local JBs. Similarly four (4) pair (individual & overall shielded) cables shall be provided for terminating the Duplex (4 wire) RTD to local JBs. 10% spare pairs or min 1 pair cable (whichever is more) shall be provided with all type of cables.
m) 10% spare pairs or min 1 pair cable (whichever is more) shall be provided with all type of cables.
n) All others cables not included above however required for completeness and operation of plant.

8.2 Specification and Standards

Except where specified otherwise all materials, cables and construction shall conform to the Indian Electricity Act and Rules and the Indian and other international standards with latest revisions and amendments issued up to date.

8.2.1 General

All materials shall be new and of tested quality conforming to applicable National and Manufacturer's Standards and Indian Electricity Rules.
All materials shall be transportable to and suitable for installation at site with ease and without any damage. It shall give continuous reliable operation over long period under worst specified site conditions.
All materials shall be designed to withstand extremes of all magnetic, electrical, mechanical and thermal stresses which may be encountered during normal and abnormal operating conditions.

8.2.2 Cables – Design Criteria

Cables shall be so designed and manufactured that damage does not occur in handling, during transit, storage, installation and operation under any or all the climatic and operating conditions which they may be subjected to. Outer sheath of cables shall have rodent and termite repulsion property.

Cables shall be suitable for laying in conduits, ducts, trenches, trays or for direct burial in ground in both and wet locations.

Cables shall be capable of operating satisfactorily under the power supply voltage and frequency variations as specified in the specification. Current ratings and ratings factors of cables shall not be worse than the ones specified in IS: 3961.

Performance characteristics of cables shall be based on the following conditions of laying:

1. All cables shall be laid in multilayer and touching each other

2.Cables shall be suitable for laying in duct or burying in ground up to a depth of 1.5 meters with uncontrolled back fill and chances of flooding by water.

All instrumentation cables shall be flame retardant low smoke (FRLS) type and fire stop sealing shall be provided in the cable gallery along with fire retarder cable coating compound.

Fillers in multiple conductor cables shall be flame retardant and moisture resistant.

The colour of inner sheath and outer sheath shall be black and sky blue respectively.

All cables shall be provided with marking including manufacturer's name, year of manufacturing, insulation material, conductor sizes, no of pairs, voltage ratings, type of cable, etc, progressive markings to read marking of the length of the cable at each meter interval and "FRLS" at every 5 meter interval.

All external field signals for DCS / PLC shall be terminated in separate marshalling / termination cabinets. Under no circumstances, Field cabling to be directly terminated in DCS / PLC system cabinets. All spare contacts/terminals on relays, control switches, limit switches or similar devices, process switches, duplex RTDs & Duplex T/Cs shall be wired to accessible terminal blocks/JBs for Owner's future connections. All wiring leaving a junction box or enclosure shall leave from terminal blocks and not from other devices in the enclosure. Two (2) pair (individual & overall shielded) cables shall be provided for terminating the transmitters & switches i.e. Analog & Binary signals to local JBs. Similarly four (4) pair (individual & overall shielded) cables shall be provided for terminating the Duplex (4 wire) RTD to local JBs. 10% spare pairs or min 1 pair cable (whichever is more) shall be provided with all type of cables.
Cables for analog signals shall be instrumentation cable of 0.5 sq. mm copper conductor size with individual pair shielding & over all shielding.
Cables for binary signals shall be instrumentation cable of 0.5 sq. mm copper conductor size.
Cable for power supply to each solenoid valves shall be power cable of min. 3C x 2.5 Sq.mm copper conductor size. Specification shall be as mentioned elsewhere in the Electrical part.
Control cable of 1.5 / 2.5 sq. mm shall be multicore having overall shielding and specification similar to Instrumentation cable except insulation and voltage grade which shall be 1100 V and shall confirm to IS 1554.
All instrumentation cables covered in this specification shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and its amendments read along with this specification.

8.2.3 Cable Specifications

Cable shall have the following specification: -

S. No.	Description	Cable N (Overall shielded)	Bidder's data
1.	Voltage Grade and Type	225 V grade multipair annealed tinned copper conductor overall shielded armoured instrumentation	
2	Not Used		
3.	Conductor	Nominal 0.5 Sq. Area concentric lay Annealed tinned high conductivity stranded 7x0.3 mm dia. Electrolytic Copper conductor.	
4.	Insulation	Extruded HR PVC type – C to IS:5831	
5.	Shield	Minimum 0.06mm thick aluminium mylar tape shall be provided on each pair with hundred	

S. No.	Description	Cable N (Overall shielded)	Bidder's data
		percent coverage, 20% overlap and tinned copper drain wire of diameter 0.51 sq.mm with 7 strands (20 AWG).	
6.	Inner sheath	FRLS HR PVC type ST-2 to IS:5831/VDE 0207.	
7.	Armouring	Galvanized steel wire/strip to IS:3975 & IS 1554 Part II	
8.	Outer sheath	FRLS HR PVC type ST-2 to IS:5831/VDE 0207	
9.	Lay	Twisted pair with 20 lay/mt	
10.	Tests for FRLS Properties	1. Flammability Test - The cables shall pass the requirement of IEEE-383 fire propagation test in this regard.	
		2. Smoke generation by Sheath under fire When tested as per ASTM-2843, the cable shall meet the requirement (60%) smoke density.	
		3. Acid gas generation of sheath during fire When tested as per IEC-754-1, the maximum Acid gas should be less Than 20% by weight.	
		4. Oxygen Index Test The oxygen index when tested under ASTMD 2863 shall be minimum 29.	
		5. Water immersion test shall be carried out as per VDE 0815	
		Swedish Chimney Test	
		Other Tests	
		1 Fire resistance test to IS-5831 for 20 minutes. (PVC insulation & sheath of electrical cables)	
		2 Thermal stability at 200 deg. C to IEC-540 for100mts.	
		3 Rodent and termite proof.	
		4 Heat shock test to IEC-502.	
11.	Conductor and Pair :	The wires of pairs shall be coded by base colours on insulation which are repeated in every unit. Base colours of the pairs in a unit shall be as follows:	
		Pair | 1 | 2 | 3 | 4	

S. No.	Description	Cable N (Overall shielded)					Bidder's data
		a) Wire	Blue	Grey	Green	White	
		b)Wire	Red	Yellow	Brown	Black	
		The units shall be coded by colours of rings on the insulation cores as tabulated below in order to distinguish between wires of various units in cables					
		Unit:		**Ring Colour:**	**Ring Group**		
		1		PINK	I		
		2		PINK	II		
		3		PINK	III		
		4		PINK	IIII		
		5		PINK	IIIII		
		6		PINK	IIIIII		
		7		ORANGE	IIIIIII		
		8		ORANGE	IIIIIIII		
12	**Marking**	Progressive sequential marking of the length of the cable at every one meter & progressive markings to read "FRLS" at every 5 meters shall be provided on the outer sheath of all instrumentation cables.					
13	**Electrical Properties at 20 Deg.C**						
a)	a) Conductor resistance of the loop not greater than	78.4 Ohms/Km for 0.5 sq mm. Conductor size					
		24.6 Ohms/Km for 1.5 sq mm. Conductor size.					
b)	Insulation resistance not less than	100 Meg Ohms/Km					
c)	Mutual capacitance at 0.8 KHz not greater than	100 nF/Km					
d)	Test Voltage-cond/cond. And cond/shield	2000 Vrms					

S. No.	Description	Cable N (Overall shielded)	Bidder's data
e)	Characteristic impedance at 0.8 KHz	340 Ohms for 0.5 sq mm. Conductor size.	
		230 Ohms for 1.5 sq mm. Conductor size.	
f)	Image attenuation at 1 KHz	1.2 dB/Km	
g)	Image attenuation at 10 KHz	0.29 dB/100 m	
h)	Cross talk attenuation at 0.8 KHz greater than	70 dB/Km	
i)	Coupling capacitance at 0.8 KHz not greater than	200 pF/100 m	
j)	**High Voltage Test :**	**Duration**	
	Conductor to Conductor :	2000 Vrms, 50 Hz for 1 min.	
	Conductor to Shield	1000 Vrms, 50 Hz for 1 min.	

8.2.4 Cable Specifications

Cables shall have the following specifications: -

Sr.No	Description	Cable M (Individually and Overall shielded)	Bidder's data
1	Voltage Grade and Type	225 V grade multipair annealed tinned copper conductor individual pair and overall shielded armoured instrumentation cable	
2	Conductor	Nominal 0.5 Sq.mm. area concentric lay annealed tinned high conductivity stranded 7 x 0.307 mm dia. Copper conductor.	
3	Insulation	Extruded HR PVC type-C to IS:5831	
4	Shield	Through aluminum mylar tape min 0.06 mm (0.075 mm) with min 20% overlap and 0.51 sq.mm dia tin coated copper drain wire (7 stranded -20 AWG) laid under the contact with aluminum side of the tape.	
5	Inner sheath	FRLS HR PVC type ST-2 to IS:5831/VDE 0207	
6	Armouring	Galvanized steel wire/strip to IS:3975	
7	Outer sheath	FRLS HR PVC type ST-2 to IS:5831/VDE 0207	

Sr.No	Description	Cable M (Individually and Overall shielded)	Bidder's data
8	Test for FRLS properties	"See details as specified in Cable Type N".	
9	Colour Coding & Marking	"See details as specified in Cable Type N".	
10	Electrical Properties	"See details as specified in Cable Type N".	

8.2.5 Specification for Co-axial Cables Cable-C

Co-axial cables are used for high frequency equipments and systems for transmission and reception purposes and computers. Co-axial cable should have minimum following characteristics:-

Construction	:	Solid silica coated, annealed copper conductor.
Di-electric	:	Low loss solid polyethylene foam, semi and spaced construction.
Outer conductor	:	Braided or longitudinal tube of copper or Aluminum giving 100% coverage with slight overlap.
Outer sheath	:	FRLS PVC
Diameter over Di-electric	:	7.24 sq.mm.
Outer diameter	:	10.29 sq.mm.
Nominal impedance	:	75 ohms
Nominal capacitance	:	20.5 pF/ft.
Nominal attenuation	:	8 dB at 1000 MHz Per 100 ft.

8.2.6 Fiber Optic Cable

A	**Fiber:**	
1	Type	Multiple single mode/Multi-Mode Fiber to avoid usage of any repeaters.
2	Core Diameter	62.5 ± 3 microns
3	Cladding Diameter	125 ± 2 microns
4	Fiber Proof test	As per Manufacturer's standard
5	Coating Diameter	As per Manufacturer's standard
6	Number of Fibers/core	Four OR Six (Colour Coded) with min. 100% spare core (Fibers)
7	Standard	As per Manufacturer's standard
B	**Numerical Aperture**	0.275
C	**Bandwidth & Attenuation:**	

1	Bandwidth @ 850 nm	160 MHz-Km min
2	Attenuation @ 850 nm	4.0 dB/Km max
D	**Cable Construction: Optic Fibre cable shall be galvanized corrugated steel taped armoured, fully water blocked with central dielectric material**	
1	Outer Colour	Orange
2	Outer Jacket	Polyethylene 1.0 to 1.5mm thick, Flame retardant & UV resistant.
3	Inner Jacket	Core-locked flame retardant polyethylene
4	Filler / Strength member	As per Manufacturer's standard
5	Central Strength member	Glass reinforced plastic (GRP) and Buckle resistant
E	**Stripping Ability**	All layers easily r emoved with Commercially available tools
F	**Installation:**	
1	Minimum bending radius	As per IEC/EIA & other international standard
2	Maximum Tensile Load	As per IEC/EIA & other international standard
3	Method of laying	Directly laid in cable trays / duct bank / clamped with available structure
4	Pulling	Ordinary cable grips
G	**Storage Temperature**	- 20°C to 60°C
H	**Operating Temperature**	- 20°C to 65°C
I	**Test Specification (EIA – STD – RS – 445 or Equivalent):**	
1	Impact Resistance	50 impacts
2	Crush	440 N/Cm
J	**Moisture Resistance**	Water blocking layer
K	**F.O. Cable Testing**	All Fiber Optic Cables shall be Tested as per IEC/EIA & other international standard using Optical Time Domain Reflector (OTDR) meter

Fibre optic cables routed underground shall be through suitable grade permanently lubricated HDPE protection pipe as per IS49884, IS12235 & TEC.G/CDS-08/01 of suitable size @ 53% fill factor.

8.2.7 Cable laying and Accessories

A) Cable laying

Cables shall be laid strictly in line with cable schedule. Installation of cable trays shall be vertical.

B) Identification tags for cables:

Indelible tags to be provided at all terminations, on both sides of wall or floor crossing, on each conduit/duct/pipe entry/exit, and at every 20 m in cable trench/tray.

C) Cable tray numbering and marking:

To be provided at every 10m and at each end of cable way & branch Connection.

D) Joints of cable shall not be permitted.

Buried cable protection

With concrete slabs; route markers at every 20 meters along the route & at every bend.

E) Road crossings

Cables to pass through buried high density PE pipes encased in RCC. At least 300 mm clearance shall be provided between:

- HT Power & LT Power cables,
- LT Power & LT Control/Instrumentation cables,

Spacing between cables of same voltage grade shall be in accordance with the derating criteria adopted for cable sizing.

F) Segregation (physical isolation to prevent fire jumping)

a) All cable associated with the unit shall be segregated from cables of other units.
b) Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire.

G) Cable clamping

All cables laid on trays shall be neatly dressed up & suitably clamped/tied to the tray. For cables in trefoil formation, trefoil clamps shall be provided.

H) Optical Fiber cables

For cables to existing central control room, bidder shall use the existing cable trays.

FO cables which are buried, shall be buried in a separate trench approximately at 1 meter depth & to be laid in GI / rodent proof HDPE conduits covered with sand, brick, and soil along the pipe line route.

While crossing roads - to be laid in GI / rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete.

While crossing canals/river- to be laid in GI/ rodent proof HDPE conduits within hume pipe.

Bidder shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fiber Optic Card Cage, Fiber Optic Line Driver, Modem (for Optical Fiber Cables), cable glands, Grommets, lugs, termination kits etc. on as required basis.
Bidder shall furnish two completely new sets of cable termination kits like Crimping tools, maxi-termi / wire-wrap tools etc., which are required for maintenance of the system as per the type of termination used.

8.2.8 Conduits

All rigid conduits, couplings and elbows shall be hot dipped galvanized rigid mild steel in accordance with IS :9357 Part-I and Part- II. The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant lead coated steel, water leak, fire and rust proof. The temperature rating of flexible conduit shall be suitable for actual application.

8.2.9 Type and Acceptance Tests for Instrumentation Cables

After completion of manufacture, type and acceptance tests as specified in relevant standards and herein shall be conducted and requisite number of copies of test certificates as per Distribution Schedule shall be furnished.

The Owner may, at his discretion, waive type tests provided type tests reports of tests carried out on identical materials(s)manufactured by the Bidder in India are furnished. The Bidder shall furnish copies of such type test reports with the Bid or indicate when they expect to make these available. After completion of manufacture, following minimum type and acceptance tests as specified in relevant standards and herein shall be conducted and requisite number of copies of test certificates shall be furnished. The Owner may, at his discretion, waive type tests provided type tests reports of tests carried out on identical materials(s)manufactured by the Bidder in India are furnished. The Bidder shall furnish copies of such type test reports with the Bid or indicate when they expect to make these available.

Section XII

List of Forms and Formats

PROFORMA	
PROFORMA-I	BID FORM
PROFORMA-II	STATEMENT OF NON-COMPLIANCE (IF ANY)
PROFORMA-III	PROFORMA LETTER OF AUTHORISATION FOR ATTENDING BID OPENING
PROFORMA-IV	PROFORMA FOR LETTER OF AUTHORITY
PROFORMA-V	TO BE FILLED-UP/SUBMITTED BY THE VENDOR ON ITS LETTER HEAD FOR E-REMITTANCE
PROFORMA-VI	FORMATE OF UNDERTAKING BY BIDDERS TOWARDS SUBMISSION OF AUTHENTIC INFORMATION/DOCUMENTS
PROFORMA-VII	FORM OF BID SECURITY (BANK GUARANTEE FORMAT)
PROFORMA-VIII	UNDERTAKING BY VENDOR ON SUBMISSION OF BANK GUARANTEE
PROFORMA-IX	UNDERTAKING FOR LOCAL CONTENT (TO BE SUBMITTED IN THE LETTER HEAD OF THE BIDDER)
PROFORMA-X	DECLARATION ABOUT BIDDER'S FINANCIAL STANDING
PROFORMA-XI	DECLARATION THAT BIDDER IS NOT UNDER HOLIDAY LIST / DELISTED / BLACKLISTED / DEBARRED IN OIL
PROFORMA-XII	DECLARATION BY THE VENDOR / PARTY FOR CONFIRMATION OF TERM DEPOSIT/ FIXED DEPOSIT FROM THE ISSUING BANK
PROFORMA- XIII	EXHIBIT-I [UNDERTAKING FOR WORKS INVOLVING POSSIBILITY OF SUB-CONTRACTING]
PROFORMA-XIV	EXHIBIT-II [UNDERTAKING TOWARDS COMPLIANCE OF CLAUSE NO. 11.1 OF THE FORWARDING LETTER
PROFORMA-XV	FORMAT FOR INSPECTION CERTIFICATE FROM THIRD PARTY INSPECTION AGENCY
PROFORMA-XVI	DECLARATION FROM BIDDER REGARDING SAFETY MEASURES
BRS	
BRS-1	COMMERCIAL CHECK LIST
BRS-2	TECHNICAL EVALUATION SHEET FOR BEC/BRC
BRS-3	CERTIFICATE OF COMPLIANCE TO FINANCIAL CRITERIA
BRS-4	CERTIFICATE OF ANNUAL TURNOVER & NET WORTH
BRS-5	TECHNICAL PARAMETERS OF EQUIPMENT
BRS-6	GUARANTEED BIOGAS PRODUCTION PER METRIC TON OF VOLATILE SOLID
BRS-7	GUARANTEED ENERGY CONSUMPTION
BRS-8	PLANT DESIGN DETAILS
BRS-9	ODOURISING SYSTEM

BRS-10	PROFORMA FOR FURNISHING DETAILS OF PAST EXPERIENCE IN CBG PROJECTS DURING PAST 5 YEARS
BRS-11	BIDDER'S GENERAL INFORMATION
BRS-12	DRAFT ACTIVITY CHART
BRS-13	FORMAT FOR LIST OF SPARES REQUIRING DURING COMMISSIONING & 10 YEARS O&M PERIOD
BRS -14	FORMAT FOR LIST OF MANDATORY CRITICAL SPARES NEED TO BE MAINTAINED AT SITE
BRS-15	AGREED TERMS AND CONDITIONS
BRS-16	TECHNICAL SPECIFICAITON / PARAMETERS OF EQUIPMENT
BRS -17	APPROACH, METHODOLOGY & WORK PLAN

PROFORMA-I

BID FORM

To
M/s GM(C&P)
OIL INDIA LIMITED
NOIDA-201301

Sub: IFB No. CQI2018P27_Establish a 200 TPD capacity Source Segregated Organic Fraction of Municipal Solid waste-based Biogas/CBG plant for commercial use.

Gentlemen,

Having examined the General and Special Conditions of Contract and the Terms of Reference including all attachments thereto, the receipt of which is hereby duly acknowledged, we the undersigned offer to perform the work/services in conformity with the said conditions of Contract and Terms of Reference for the sum quoted in the Price Bid Format or such other sums as may be ascertained in accordance with the Schedule of Prices attached herewith and made part of this Bid.

We undertake, if our Bid is accepted, to commence the work as per the terms & conditions set out in the subject tender.

If our Bid is accepted, we will submit the Performance Security Deposit as specified in the tender document for the due performance of the Contract.

We agree to abide by this Bid for a period of 120 (One Hundred Twenty) days from the original date of Bid closing and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

Until a formal Contract is prepared and executed, this Bid, together with your written acceptance thereof in your notification of award shall constitute a binding Contract between us.

We understand that you are not bound to accept the lowest or any Bid you may receive.

Dated this _____day of_____20___

Authorized Person's Signature: _____

Name: _____

Designation: _____

Seal of the Bidder: _____

_____

PROFORMA-II

STATEMENT OF NON-COMPLIANCE (IF ANY)

(Only exceptions/deviations to be rendered)

1.0 The Bidder shall furnish detailed statement of exceptions/deviations, if any, to the IFB stipulations, terms and conditions in respect of each Section of Bid Document in the following format:

Section No.	Clause No. (Page)	Non-Compliance	Remarks

Signature of Bidder: _____

Name: _____

NOTE: OIL INDIA LIMITED expects the bidders to fully accept the terms and conditions of the bid document. However, should the bidders still envisage some exceptions/deviations to the terms and conditions of the bid document, the same should be indicated as per above format and submit along with their bids. If the "**Statement of Non-Compliance"** in the above Proforma is left blank (or not submitted along with the Bid), then it would be construed that the bidder has not taken any exception/deviation to the IFB requirements.

PROFORMA-III

PROFORMA LETTER OF AUTHORISATION FOR ATTENDING BID OPEN

To
GM(C&P)
OIL INDIA LIMITED
NOIDA-201301

Sir,

SUB: OIL's IFB No. CQI2018P27

I / We _____ confirm that Mr. (Name and address) as authorised to represent us during bid opening on our behalf with you against IFB No. CQI2018P27 for **Establishing a 200 TPD capacity Source Segregated Organic Fraction of Municipal waste-based Biogas / CBG plant for commercial use.**

Yours Faithfully,

Authorized Person's Signature:
Name:
Signature of the Bidder:
Name:
Date:

PROFORMA -IV

PROFORMA FOR LETTER OF AUTHORITY

To
GM(C&P)
OIL INDIA LIMITED
NOIDA-201301

Dear sir,

SUB: OIL's IFB No. CQI2018P27

We, _____ of confirm that Mr. (Name and Address) is authorized to represent us to Bid, negotiate and conclude the agreement on our behalf with you against IFB No. for **Establishing a 200 TPD capacity Source Segregated Organic Fraction of Municipal waste-based Biogas/CBG plant for commercial use** for any commercial / Legal purpose etc.

We confirm that we shall be bound by all and whatsoever our said representative shall commit.

Yours faithfully,

Signature:
Name & Designation For & on behalf of

Authorized Person's Signature:
Name:

NOTE: This letter of authority shall be on printed letter head of the bidder and shall be signed by a person competent and having the power of attorney (Power of attorney shall be annexed) to bind such Bidder.

PROFORMA-V

[TO BE FILLED-UP / SUBMITTED BY THE VENDOR ON ITS LETTER HEAD FOR E-REMITTANCE]

Name:

FULL Address:

Phone Number:

Mobile Number:

E-mail address:

Fax Number:

Bank Account Number (in which the Bidder wants remittance against invoices):

Bank Name:

Branch:

Address of the Bank:

Bank Code:

IFSC/RTGS Code of the Bank:

NEFT Code of the Bank:

Bank

PAN Number:

GST Registration Number:

_____

Signature of Bidder with

Official Seal

PROFORMA-VI

FORMAT OF UNDERTAKING BY BIDDERS TOWARDS SUBMISSION OF AUTHENTIC INFORMATION/DOCUMENTS

Ref. No. _____ Date: _____

To
GM(C&P)
OIL INDIA LIMITED,
NOIDA 201301

Sub: Undertaking of authenticity of information/documents submitted
Ref: Your Tender No. CQI2018P27

Sir,

With reference to our quotation against your above-referred tender, we hereby undertake that no fraudulent information/documents have been submitted by us.

We take full responsibility for the submission of authentic information/documents against the above cited bid.

We also agree that, during any stage of the tender/contract agreement, in case any of the information/documents submitted by us are found to be false/forged/ fraudulent, OIL has right to reject our bid at any stage including forfeiture of our EMD and/or PBG and/or cancel the award of contract and/or carry out any other penal action on us, as deemed fit.

Yours faithfully,

For (type name of the firm here)
Signature of Authorized Signatory
Name:
Designation:
Phone No.
Place:
Date:

(Affix Seal of the Organization here, if applicable)

_____

PROFORMA-VII

FORM OF BID SECURITY (BANK GUARANTEE FORMAT)

WHEREAS, (Name of Bidder) _____ (hereinafter called "the Bidder") has submitted his bid dated (Date) _____ for the provision of certain services (hereinafter called "the Bid") against OIL INDIA LIMITED, OIL House, Plot No19, Sector- 16A, NOIDA (hereinafter called the Company)'s Tender No. CQI2018P27

WE KNOW ALL MEN by these presents that We (Name of Bank) of (Name of Country) having our registered office at _____ (hereinafter called "the Bank") are bound unto Oil India Ltd (hereinafter called "Company" in the sum of (_____) * for which payment well and truly to be made to Company, the Bank binds itself, its successors and assignees by these presents. SEALED with the common seal of the Bank this _____ day of _____ 2025.

THE CONDITIONS of this obligation are:

1) If the Bidder withdraws his Bid during the period of bid validity specified by the bidder.

2) If the Bidder, having been notified of the acceptance of their Bid by the Company during the period of Bid validity:
   a) Fails or refuses to execute the Form of Agreement in accordance with the Instructions to Bidders, on tender document.
   b) Fails or refuses to furnish the Performance Security in accordance with the Instructions to Bidders on tender documents.

3) If the Bidder furnishes fraudulent document / information in their bid.

We undertake to pay to Company up to the above amount upon receipt of its first written demand, (by way of letter/fax/e-mail) without Company having to substantiate its demand, provided that in its demand Company will note that the amount claimed by it is due to it owing to the occurrence of one or both of the two conditions specifying the occurred condition or conditions.

This guarantee will remain in force up-to and including the date up to (date of expiry of bank guarantee should be minimum 165 days from scheduled Bid Closing Date) any demands in respect thereof should not reach the bank not later than the above date.

The details of the Issuing Bank and Controlling Bank are as under:

A. Issuing Bank:

Bank Fax no & Bank email ID:
Bank Telephone No.
IFSC Code of the Bank:

B. Controlling Office:

Address of the Controlling Office of the BG issuing Bank:
Name of the Contact Person at the Controlling Office with Mobile No. and e-mail address:

DATE:
SIGNATURE & SEAL OF THE GUARANTOR
DESIGNATION
NAME & ADDRESS OF BANK

*** The bank should insert the amount of guarantee in words and figures**
**** Date of expiry of bank guarantee should be minimum 150 days from scheduled Bid Closing Date**

NOTE: The Bank Guarantee issuing bank branch shall ensure the following:

a) The Bank Guarantee issued by the bank shall be routed through SFMS platform as per the following details:

   i. "MT 760/MT 760 COV" for issuance of bank guarantee.
   ii. "MT 760/MT 767 COV" for amendment of bank guarantee.

The above message / intimation shall be sent through SFMS (indicating the Tender Number) by the BG issuing bank branch to HDFC Bank Limited, E-13/29, IFS Code – HDFC0000003; SWIFT Code – HDFCINBBDEL; Branch Address: HDFC Bank Limited, E-13/29, 2nd Floor, Harsha Bhavan, Middle Circle, Connaught Place, New Delhi 110001.

b) Bank Guarantee issued by a Scheduled Bank in India at the request of some other Non-Scheduled Bank of India shall not be acceptable.
c) Further correspondence against BG towards Performance Security must contain the Tender Number.

PROFORMA-VIII

UNDERTAKING BY VENDOR ON SUBMISSION OF BANK GUARANTEE FORM OF PERFORMANCE BANK GUARANTEE

(TO BE FURNISHED BY THE CONTRACTOR IN CASE OF SUBMITTING PERFORMANCE SECURITY IN THE FORM OF BANK GUARANTEE AFTER ISSUE OF LOA)

To
GM(C&P)
Oil India Limited,
OIL House, Plot No. 19, Sector 16A,
Noida-201 301, U.P.

WHEREAS _____ (Name and address of Contractor) (hereinafter called "Contractor") had undertaken, in pursuance of Contact No. _____ to execute (Name of Contract and Brief Description of the Work) _____ (hereinafter called "the Contract").

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee as security for compliance with Contractor's obligations in accordance with the Contract.

AND WHEREAS we (May incorporate the Bank Name) have agreed to give the Contractor such a Bank Guarantee; NOW THEREFORE we hereby affirm that we are Guarantors on behalf of the Contractor, up to a total of (Amount of Guarantee in figures) _____ (in words_____), such amount being payable in the types and proportions of currencies in which the Contract price is payable, and we undertake to pay you, upon your first written demand and without cavil or arguments, any sum or sums within the limits of guarantee sum as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein. We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or the work to be performed thereunder or of any of the Contract documents which may be made between you and the Contractor shall in any way cease us from any liability under this guarantee, and we hereby waive notice of such change, addition or modification.

This guarantee is valid until the _____day of _____

The details of the Issuing Bank and Controlling Bank are as under:

A. Issuing Bank:
BANK FAX NO:

BANK EMAIL ID:
BANK FAX NO:

IFSC CODE OF THE BANK:

B. Controlling Office:

Address of the Controlling Office of the BG issuing Bank:

Name of the Contract Person at the Controlling Office with Mobile No. and e-mail address:

a) Our liability under this Bank Guarantee shall is restricted up to Rs. _____
b) This guarantee shall be valid till _____
c) We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only and only if you serve upon us a written claim or demand on or before_____ (Date of Expiry of BG PLUS one year claim period).
d) At the end of the claim period that is on or after ……. (Date of expiry of the Bank Guarantee Plus Minimum of 1 year claim period shall be stipulated) all your rights under this Guarantee shall stand extinguished and we shall be discharged from all our liabilities under this Guarantee irrespective of receipt of original Bank Guarantee duly discharged, by Bank.

Name of the Contact Person at the Controlling Office with Mobile No. and e-mail address:
SIGNATURE AND SEAL OF THE GUARANTORS_____
Designation_____
Name of the Bank_____
Address _____

Note:

The Bank Guarantee issuing bank branch shall ensure the following:

The Bank Guarantee issued by the bank shall be routed through SFMS platform as per the following details:

i. "MT 760/MT 760 COV" for issuance of bank guarantee.
ii. "MT 760/MT 767 COV" for amendment of bank guarantee.

The above message / intimation shall be sent through SFMS (indicating the Contract Number) by the BG issuing bank branch to HDFC Bank Limited, E-13/29 IFS Code –HDFC0000003; SWIFT Code – HDFCINBB; Branch Address: HDFC Bank Limited, E-13/29, 2nd Floor, Harsha Bhavan, Middle Circle, Connaught Place, New Delhi 110001

a) Bank Guarantee issued by a Scheduled Bank in India at the request of some other Non-Scheduled Bank of India shall not be acceptable.
b) Further correspondence against BG towards Performance Security must contain the Contract Number.

PROFORMA-IX

UNDERTAKING FOR LOCAL CONTENT
(To be submitted in the letter head of the bidder)

Ref. No. _____ Date: _____

To
GM(C&P)
BD Department,
OIL, Noida

SUB: UNDERTAKING FOR LOCAL CONTENT

Dear sir,

We, _____ (Name of the bidder) have submitted Bid No. _____against Tender No. _____dated _____'Establish a 200 TPD capacity Source Segregated Organic Fraction of MSW based Compressed Bio-Gas plant for commercial use'

We hereby undertake that we meet the mandatory minimum local content requirement as mandated by Ministry of Petroleum and Natural Gas, Government of India vide Notification No. FP-20013/2/2017-FP-PNG dated 17.11.2020 (or as amended from time to time). The percentage of Local Content is___%.

For and on behalf of _____
Authorized Signatory _____
Name _____
Designation _____
Contact No. _____

PROFORMA-X

DECLARATION ABOUT BIDDER'S FINANCIAL STANDING

To
GM(C&P)
OIL INDIA LIMITED
NOIDA 201301

Sub: Undertaking/Declaration regarding financial standing

Ref: Tender No. **CQI2018P27**

We, _____ (name of bidder), hereby confirm that:

i. We are neither bankrupt nor undergoing any insolvency resolution process or liquidation or bankruptcy proceeding under any law.
(OR)
ii. No insolvency resolution process or liquidation or bankruptcy proceeding is initiated under any law against us.

Place: _____

Date: _____

(Name & Signature of the authorized signatory of the bidder)

_____

PROFORMA-XI

DECLARATION THAT BIDDER IS NOT UNDER HOLIDAY LIST/DELISTED/BLACKLISTED/DEBARRED IN OIL

To
GM(C&P)
OIL INDIA LIMITED
NOIDA 201301

Sub: Undertaking/Declaration regarding Holiday List, debarment etc.

Ref: Tender No. CQI2018P27

We, _____ (Name of the bidder) hereby declare that neither our company nor any of its allied concerns, partners or associates or directors or proprietors involved in any capacity, are currently put on holiday list / banning list by OIL debarring us / them from carrying on business dealings with OIL.

Place:

Date:

(Name & Signature of the authorized signatory of the bidder)

_____

PROFORMA-XII

Declaration by the vendor / party for confirmation of Term deposit / Fixed Deposit from the issuing bank

To
GM(C&P)
OIL INDIA LIMITED
NOIDA 201301

Sub: **Contract No. .....**

Full address of the issuing bank	:	
Branch Code	:	
Authorised signatory with full name and designation	:	
Phone (Mobile) Numbers of the branch	:	
Email address of the branch	:	
Such fixed/term deposit must be pledged in favour of OIL and it must in the printed form on the physical original FDR in words ''Pledged in favour of Oil India Limited''	:	

Authorised Person's Signature: _____

Name:_____

Designation: _____

Seal of the Bank:

PROFORMA-XIII

EXHIBIT–I

UNDERTAKING FOR WORKS INVOLVING POSSIBILITY OF SUB- CONTRACTIONG (REF. CLAUSE NO. 11.6 OF THE FORWARDING LETTER)

We, M/s _____ , have read the clause regarding restrictions on procurement from a country which shares a land border with India and on sub- contracting to contractors from such-countries, we certify that we are not from such a country/or if from such a country, has been registered with the Competent Authority and will not sub-contract any work to a contractor from such countries unless such contractor is registered with the Competent Authority. We hereby certify that we fulfil all requirements in this regard and are eligible to be considered.

Yours faithfully,
For (type name of the firm here)

Signature of Authorized
Signatory Name:
Designation:
Phone No.
Place:
Date:

(Affix Seal of the Organization here, if applicable)

PROFORMA-XIV

EXHIBIT–II

UNDERTAKING TOWARDS COMPLIANCE OF CLAUSE NO. 11.1 OF THE FORWARDING LETTER

We, M/s _____ have read the clause regarding restrictions on procurement from a country which shares a land border with India, we certify that we are not from such a country/or if from such a country, has been registered with the Competent Authority. We hereby certify that we fulfil all requirements in this regard and is eligible to be considered.

Yours faithfully,
For (type name of the firm here)

Signature of Authorized
Signatory Name:
Designation: Phone No.
Place:
Date:
(Affix Seal of the Organization here, if applicable)

PROFORMA-XV

PROFORMA FOR UNDERTAKING FROM THIRD PARTY INSPECTION AGENCY

(to be submitted on official letter head)

TO
M/s OIL INDIA LIMITED

Sir,

SUB: OIL's Tender No.....

M/s. _____having registered office at_____ intend to participate in the above referred tender of OIL INDIA LIMITED.

The tender conditions stipulates that the bidder shall submit documents pertaining to Bid Evaluation Criteria (BEC), duly verified and certified by designated independent Third-Party Inspection Agency.

In this regard this is to certify that copies of documents pertaining to Bid Evaluation Criteria (BEC)/Bid Rejection Criteria (BRC) submitted to us by the bidder have been verified and certified by us with originals and found to be genuine and authentic. We have signed and stamped on the copies of all the verified and certified documents having ____ nos. pages.

Note: In the event of any requirement, OIL reserves the right to ask the inspection agencies to verify the documents with source, if required at no extra cost to OIL.

Thanking you,

Authorised Person's Signature:_____
Name:_____

PROFORMA-XVI

SAFETY MEASURES (SM)

To

GM(C&P)
OIL INDIA LIMITED
NOIDA-201301

SUB: SAFETY MEASURES

Description of work/service: Establish a 200 TPD Source Segregated Organic Fraction of Municipal Waste based Biogas/CBG plant for commercial use.

Sir,

We hereby confirm that we have fully understood the safety measures to be adopted during execution of the above contract and that the same has been explained to us by the concerned authorities. We also give the following assurances.

a) Only experienced and competent persons shall be engaged by us to carry out work under the said contract.

b) The names of the authorized persons who would be supervising the jobs on day-to-day basis from our end are the following:

i. _____

ii. _____

iii. _____

The above personnel are fully familiar with the nature of jobs assigned and safety precautions required.

c) Due notice would be given for any change of personnel under item(b) above.

d) We hereby accept responsibility for the safety of all the personnel engaged by us and for the safety of the Company's personnel and property involved during the course of our working under this contract. We would ensure that all the provisions under the Oil Mines Regulations, 1984 and other safety rules related to the execution of our work would be strictly followed by our personnel. Any violation pointed out by the Company's Engineers would be rectified forthwith or the work suspended till such time the rectification is completed by us and all expenditure towards this would be on our account.

e) We confirm that all persons engaged by us would be provided with the necessary Safety Gears at our cost.

f) All losses caused due to inadequate safety measures or lack of supervision on our part would be fully compensated by us and the Company will not be responsible for any lapses on our part in this regard.

g) We shall abide by the HSE (Health, Safety & Environmental) points mentioned in the Special Conditions of Contract (SCC):

(Seal)

Yours Faithfully,

Date_____

M/s _____

FOR & ON BEHALF OF CONTRACTOR

BRS-1

COMMERCIAL CHECK LIST

Bidder's Name:_____

TENDER No. CQI2018P27

This Questionnaire duly filled in should be returned along with each copy of Un- priced Bid. Clauses confirmed hereunder should not be repeated in the Bid.

Sl. No.	Description	Bidder's Confirmation
1.	Bidding structure	
2	Bidder's name and address:	
3.	It is noted that deviations to Terms & Conditions shall lead to rejection of offer, as specified in the Tender.	
4.	Ensure and confirm that prices quoted in 'Schedule of Rates', are for complete scope of work as defined in the tender	
5.	Indicate SAC Code Indicate rate of GST applicable.	SAC Code: GST ..... %
6.	EMD Details: EMD No., Issuing bank, amount with currency and Validity	
7.	Confirm to Submit Performance Security as per Tender requirement	
8.	Confirm that the offer shall remain valid for acceptance up to 120 (One Hundred Twenty) days from Bid Due Date / Date of opening of bids.	
9.	Whether Commencement of work and Completion period of contract is complied?	
10.	Whether Integrity Pact Submitted (if applicable)?	

11.	Confirm that quoted prices shall	
	remain firm and fixed until completion of the contract, except as otherwise mentioned in the bid document.	
12.	Confirm that you have submitted all documents as mentioned in the Tender/Annexures	
13.	Confirm acceptance to all terms & conditions of the Tender.	
14.	Confirm that all correspondence must be in English Language only.	
15.	Indicate Name & Contact No. (Telephone/Fax/E-mail) of person signing the bid.	Name: Contact No.: Fax: Email:
16.	Confirm that all Bank charges associated with Bidder's Bank shall be borne by Bidder.	
17.	Please indicate the following: (i) PAN No. (ii) GST Regn. No.	
18	Whether applying for Purchase Preference Policy (Linked with Local Content) (PP-LC)? (Yes/No)	
19.	% of Local Content Categorically specified or not as per PROFROMA-VIII. Note: Bidder should not mention the % of LC as more than XX%, it should be Categorically specified in % wise.	
20.	Restrictions on procurement from a bidder of a country which shares land border with India, Undertakings viz. Exhibit-I, and Exhibit-II, submitted or not if applicable	
21.	Declaration about bidder's financial	

	standing as per APPENDIX-1 submitted or not.	
22.	Declaration about bidder's financial standing as per APPENDIX-2 submitted or not	
23.	Proforma-XV (Third Party Inspection of Documents done) as per BEC Clause 6.2.9	
24	Confirmation that all the information as required in clause 25 under SCC is submitted	

Bidder confirms that in case of conflicting version of various terms & conditions at different places, the confirmation furnished as above shall be considered over- riding and final and any other deviation indicated elsewhere shall be treated as redundant.

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

BRS-2

TECHNICAL EVALUATION SHEET FOR BEC/BRC

Sl. No.	Clause No of BEC/BRC	Description	Bidders Remarks (Complied / Not Complied / Deviation)	Bidder to indicate the following to support the remarks/ compliance	
				Details of documents submitted	Relevant Page No.
1	2.0	**Eligibility Criteria (LC)** The bidder must be incorporated in India and must maintain more than or equal to 20% local content (LC) for the offered services to be eligible to bid against this tender. **Regarding calculation of local content and submission of documents during bidding & execution of contracts, provision of Public Procurement (Preference to Make in India) Order, 2017 of Department for Promotion of Industry and Internal Trade (DPIIT), Govt. of India as revised vide Order No. P-45021/2/2017-PP (BE-II) dated 16th September 2020 (and as amended time to time) with modifications as notified vide MoPNG Order No. FP20013/2/2017-FP-PNG-Part (4) (E-41432) dated 26th April 2022 (including subsequent amendments thereof, if any) shall be applicable.** If such local content is not maintained during execution of contract, OIL reserves the right to invoke the Performance Securities and additional Bank Guarantee submitted by the			

		bidding and supporting companies, in addition to resorting to other options as may be deemed appropriate. Whether or not the bidders want to avail PP-LC benefit against this tender, it is mandatory for them to meet the following at the bidding stage. a) The bidder must provide the specific percentage (%) of local content in their bid, without which the bid is liable for rejection being non-compliant. b) The Bidder shall submit an undertaking from the authorized signatory of bidder having the Power of Attorney along with the bid specifying the LC Percentage and such undertaking shall become a part of the contract, if awarded [Format enclosed]. c) The aforesaid undertaking of the bidder shall also be supported by a certificate from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of other than companies) giving the percentage of local content. d) Bidder to submit a copy of their Certificate of Incorporation/ Registration in India.			

2	**3.1 TECHNICAL CRITERIA**	Shall have prior experience of setting up and operation and maintenance of MSW waste to Biogas/Bio-CNG plant including ETP in last 10 Financial years of following capacity. The said Plant should be in operation at the time of bidding. ➢ One plant of minimum **160 TPD** Feedstock capacity **OR** ➢ Two plants of minimum **100 TPD** Feedstock capacity **OR** ➢ Three plants of minimum **80 TPD** Feedstock capacity **Shall have prior experience of operation and maintenance of MSW to Biogas/Bio-CNG plant including ETP of a minimum capacity of 80 TPD plant for at least 1 (one) year of O&M experience in last 10 Financial years.** **Notes on BEC Clause 3 above:** a) For proof of requisite experience, the following documents must be submitted along with the bid.			

		i. Copy of Concession Agreement or contract document or work order documents showing details of work. AND ii. Completion Certificate showing gross value of the job/service, description of job/service and duration of the contract. OR Bank statement for payment received against invoice (s) raised for the work/TDS certificate.			
3	**FINANCIAL CRITERIA**	4.1.1The bidder must have annual financial turnover from operation of **Rs. 36,28,57,200.00** in any of the preceding three (3) financial years reckoned from the original bid closing date as per the Audited Annual Reports. [Annual Financial Turnover from Operation of the bidder shall mean - "Aggregate value of the realization of amount made from the sale, supply or distribution of goods or on account of services rendered, or both, by the company (bidder) during a financial year" as per the Companies Act, 2013 Section 2 (91).] 4.1.2 The Net Worth of the Bidder must be positive for the financial/accounting year preceding the original Bid closing date. [Net worth shall mean = Share capital + Reserves created out of profits and securities Premium – Aggregate value of accumulated losses (excluding revaluation reserves) – deferred expenditure – Miscellaneous Expenditure to the extent not written off and carried forward Loss - Reserves			

		created out of write back of depreciation and amalgamation] 4.1.3 The minimum requirement of Working Capital of the Bidder is Rs. _____ Crore for the accounting year preceding the original bid closing date. In case the Working Capital is less than above, the bidder can supplement the same through line of credit from a scheduled commercial bank having net worth more than INR 100 crores as per enclosed format. [Working Capital shall mean "Current Assets minus Current liabilities" as per latest year's audited annual Financial Statements.] Note: • The Net worth to be considered against the clause above, should be read in conjunction with the definition of Net worth as mentioned in Section 2 (57) of The Companies Act, 2013. • Attested copies of the bidders audited annual reports/ financial statement for the last Three Financial years have to be attached along with a certificate from a practicing Chartered Accountant on his letterhead confirming annual turnover, net profit, and net worth during these years. 4.2 Notes to Financial Evaluation Criteria 4.2.1 For proof of Annual Financial Turnover & Net worth, any one of the following documents/photocopies must be submitted along with the bid: a. A certificate issued by a practicing Chartered/Cost Accountant (with Membership Number and Firm			

		Registration Number), certifying the Annual turnover & Net worth as per format prescribed in BRS-4. OR b. Audited Balance Sheet along with Profit & Loss account Note: Mention of UDIN (Unique Document Identification Number) is mandatory for all Certificates issued w.e.f. February 1, 2019, by Chartered Accountant in Practice.			
4	**5 COMMERCIAL EVALUATION CRITERIA**	**Compliance to all BEC clauses of Commercial Evaluation Criteria, Price evaluation Criteria, Purchase Preference Clause, Compliance of Competition Act 2002**			

Signature of Authorized Signatory with Seal
Name:
Designation:
Date:
Place:

BRS-3

(TO BE EXECUTED BY THE AUTHORIZED SIGNATORY OF THE BIDDER ON THE OFFICIAL LETTER HEAD OF THE BIDDER)

CERTIFICATE OF COMPLIANCE TO FINANCIAL CRITERIA

Ref.: Note '2' under Clause 3.3 Financial Criteria of BEC-BRC of Tender No. CQI2018P27

I _____ the authorized signatory(s) of _____ (Company or Firm name with address) do hereby solemnly affirm and declare/ undertake as under:

The balance sheet / Financial Statements for the financial year _____ have actually not been audited as on the Original Bid Closing Date.

Yours faithfully,

For (type name of the firm here)

Signature of Authorized Signatory

Name:

Designation:

Phone No.

Place:

Date:

(Affix Seal of the Organization here, if applicable)

Note: This certificate is to be issued only considering the time required for preparation of Financial Statements i.e. if the last date of preceding financial/ accounting year falls within the preceding six months reckoned from the Original Bid Closing Date.

BRS-4

CERTIFICATE OF ANNUAL TURNOVER & NET WORTH

TO BE ISSUED BY PRACTISING **CHARTERED ACCOUNTANT'S FIRM** ON THEIR LETTER HEAD

TO WHOM IT MAY CONCERN

This is to certify that the following financial positions extracted from the audited financial statements of M/s ..... (Name of the Bidder) of the last3 (three)) completed accounting years up to 31st March, 2024 **(as the case may be)** are correct.

YEAR	**TURN OVER** In INR (Rs.) Crores	**NET WORTH** In INR (Rs.) Crores

Place:

Date:

UDIN:

Seal:

Membership Code & Registration No.:
Signature

Signature of Authorized Signatory with Seal
Name:

Designation:

Date:

Place:

BRS-5

TECHNICAL PARAMETERS OF EQUIPMENT

S No	Technical Information to be submitted with the Offer	Reference to Bidder's Offer
1	Description of selected process technology for different sections	
2	Process Flow Diagram	
3	Mass Balance Chart	
4	General Plant Layout	
5	Complete Lists of Mechanical, Electrical, C&I, Other Equipment, Miscellaneous Items of each section of plant, indicating the numbers provided (working +standby), ratings / capacities etc.	
6	List of top 15 major energy consuming equipment / devices along with rated, expected loading consumption, running hours per day etc.	
7	Feedstock Rated Capacity & Maximum Capacity – (Minimum rated capacity of 200 TPD Source Segregated Organic Fraction of Municipal Solid Waste (MSW) and shall be capable of handling SSOF-MSW up to 260 TPD)	

Note: Reference to Bidder's Offer shall indicate Section No., Clause No., Page No. etc in Bidder's Offer, where the respective Technical Information Provided.

Signature of Authorized Signatory with Seal
Name:

Designation:

Date:

Place

BRS-6

BIOGAS PRODUCTION PER METRIC TON OF VOLATILE SOLID – GUARANTEED PARAMETERS & DEMONSTRATED PARAMETERS

S. No.	Description	UOM	Guaranteed Value
A	**Guaranteed Parameters**		
1	***Biogas Production (measured at the inlet of gas purification system) per MT of Volatile Solids in Slurry fed to the hydrolysis/digestors system (biomethanation system)-Refer Note 1 below**	Nm^3	**(Bidder to indicate)**
2	**Methane Recovery (Methane recovery in the purification and upgradation system)**	%	>97
3	**CBG Quality**		
•	CH_4	mole %	≥ 97
•	CO_2	mole %	≤3
•	O_2	mole %	≤0.5
•	H_2S	mg/m^3	≤3.7
•	Total Sulphur (including H2S)	mg/m^3	≤10
•	Moisture	mg/m^3	≤5
4	**CBG Quantity production per MT of Volatile Solids in MSW fed to hydrolysis/digestors system (biomethanation system)**	Tonne	(Bidder to indicate)
B	**Demonstrated Parameters**		
1	**Organics Recovery (Organic recovery from the MSW processing & Pretreatment plant) – Refer Note 4 below**	%	85

Notes:

1) Bidder shall indicate Production of Biogas as guaranteed by him per MT of Volatile Solid in the above table (in any case it shall not less than 425 Nm3 per MT of VS) in his offer, at the time of bidding.
2) Bidder shall prove during the Performance Guarantee Test Run (PGTR) that the Production of Biogas per MT of Volatile Solid is not less than the guaranteed value given by him in the above table at the time of bidding. If it is less, the specified penalties will be imposed on the bidder.
3) During the Operative period of the Plant, production of CBG per MT of VS shall not be less than value demonstrated during the PGTR or the guaranteed value whichever is less.
4) Organics Recovery shall be demonstrated by the bidder during the PGTR.

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

BRS-7

GUARANTEED ENERGY CONSUMPTION

S. No.	Description	Unit	Guaranteed Parameter
1	**Electricity Consumption per day of normal running of plant**	**kWh / day**	
2	**Contract Demand for electrical power connection**	**KVA**	

Note: The bidder will furnish the basis and calculation in support of the quoted guaranteed electrical consumptions and connected load.

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

BRS-8

PLANT DESIGN DETAILS

The bidder is required to furnish the following details for the offered plant.

S.No.	Parameters	Details
1	MSW Capacity handling Tonnes per day (TPD)	
2	Pretreatment handling capacity Tonnes per day (TPD)	
3	Dry waste handling capacity Tonnes per day (TPD)	
4	Wet waste/ organic waste handling capacity Tonnes per day (TPD)	
5	Odour reducing system details for input feed	
6	Organic Extractor Capacity Tonnes per Hour	
7	**Digester details:**	
i	No. of digesters	
ii	Volume of each digester	
iii	Digester technology with HRT and SRT	
iv	Double Membrane Gas Holding Capacity and Capacity of blower	
v	Slurry homogeneous system details: such as Agitator and/or High flow pumps (Number & capacity)	
vi	Slurry Heating System details: Electrical water heater in Wattage, **OR** Boiler Capacity	
8	Estimated Biogas at the outlet of Digester in Nm^3 and percentage Methane content	
9	Estimated Biogas used for heating purpose in Nm^3	
10	Estimated Biogas at the inlet of purification in Nm^3	

11	Purification System details for raw Biogas: i. H_2S removal ii. CO_2 removal iii Moisture removal iv. Methane purity in purified biogas	
12	Compressor system details if required: i. Compressor output ii. Compressor efficiency	
13	CBG pressure at injection point	
14	Marker Gas addition system before CBG injection	
15	Sludge drying system details i. Dryer type ii. Baghouse capacity iii. Dried product solid concentration iv. Time period required for drying	
16	Compost produced (FOM/LFOM/PROM): i. Capacity of storage tank, if required	
17	Centrate processing capacity in ETP: i. ETP designed capacity	
18	Total water requirement: i. Processing water ii. Domestic water iii. Recycled water	

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

BRS-9

ODOURISING SYSTEM

S.No.	Technical Parameters	Unit
1	Technology Type	
2	Type of Odourant	
3	H_2S Efficiency (%)	
4	Gas Flow rate (SCMH)	
5	Storage Tank Capacity (Litres)	
6	Quantity of Storage Tank	
7	Odorant Storage Tank Capacity (Litres)	
8	Maximum positive pressure (kg/cm^2)	
9	Design Pressure (Kg/cm2)	
10	Type of Scrubber	
11	Injection Pump	
12	Operating Temperature (°C) / Design	
13	Power Supply	
14	Flow Signal	
15	First Fill of Odourant	

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

BRS-10

PERFORMA FOR FURNISHING DETAILS OF PAST EXPERIENCE IN CBG PROJECTS DURING PAST 5 YEARS

Sl. No.	Description	
1	Name of works & Owner's address, contact person with telephone numbers.	
2	Detailed scope of work.	
3	Type of plant & machines used (only for major components).	
4	Capacity of the of CBG Project	
5	Whether O&M is being looked after? Please indicate period of O&M contract.	
6	Commissioning time as per contract.	
7	Actual commissioning time.	
8	If delayed, then reasons for delay.	
9	Period of successful operation.	
10	Compensation	
11	Additional information, if any.	

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

BRS-11

BIDDERS GENERAL INFORMATION

To
Oil India Ltd
Plot No 19, Sector-16,
NOIDA-201203

Sub:

1. Name of the bidder ----------

2. Status of Firm/ Company: Proprietorship Firm / Partnership Firm/
   [Mark √] Company (Private or public)

3. Number of years in the business ----------

4. Registered Office Address: ----------

   ----

4. Operational Address: ----------
   [If different from above] ----------
   ----

6. Telephone No. & Fax No.: ----------

7. E-mail ID & Website: ----------

8. Licensed capacity to manufacture:

Description of equipment	Size Capacity	Licensed Capacity	No. of units manufactured		
			Current Year	Last Year	Second Last Year

9. Plant Details:

a) Location
b) Description

10. Type of equipment manufactured/supplied/installed during last 4 years.

Name of Equipment	Capacity/size/ Model	Nos. manufactured / supplied/ installed	Project to which supplies have been made	No. of orders in hand

11. Describe Quality Control Organization, if any, and give the organization chart.

a) Are goods offered subject to batch test, random sampling, or full 100% test for Quality check?
b) Are tests carried out by factory employees or by a separate testing agency?
c) Are independent quality Control Organization checks made and certificates issued?

12. ISO Certification [If any] [If 'Yes', Please Furnish Details]:

13. Names of buyers to whom similar equipment have been supplied, installed and commissioned in the past to which reference could be made by us regarding the bidder's technical and delivery ability.

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

BRS-12

DRAFT ACTIVITY CHART

S.No.	Name of the activity	Duration

If required add more Rows

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

BRS-13

FORMAT FOR LIST OF SPARES REQUIRED DURING COMMISSIONING & 10 YEARS O&M PERIOD

S. No.	LIST OF SPARES	Quantity

If required add more Rows

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

BRS-14

FORMAT FOR LIST OF MANDATORY CRITICAL SPARES NEED TO BE MAINTAINED AT SITE

S.No.	LIST OF SPARES	Quantity

If required add more Rows

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

BRS -15

AGREED TERMS AND CONDITIONS

Bidder must accept and comply with the following provisions as given in the Tender Document in toto, failing which offer will be rejected:

i.	Firm price	
ii.	EMD / Bid Security/Bid Bond	
Iii.	Period of validity of Bid	
iv.	Price Schedule	
v.	Performance Bank Guarantee / Security deposit	
vi.	Delivery / Completion Schedule	
vii.	Scope of work	
viii.	Guarantee of material / work	
ix.	Price Discount clauses	
x.	Tax liability	
xi.	Arbitration / Resolution of Dispute Clause	
xii.	Force Majeure	
xiii.	Applicable Laws	
xiv.	Specifications	
	Integrity Pact	

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

BRS -16

TECHNICAL SPECIFICAITON / PARAMETERS OF EQUIPMENT

We are giving below the list of major facilities / Equipment as specified in Section VII of Scope of Work. However, if required you can add more items in the list.

All the required details should be provided in a separate table/ sheet for each item.

Technical specification & General Information to be submitted

S.No.	Particulars	To provide details	Reference
1.	Weighbridge		
2.	Infeed Bunkers Dry MSW & Wet MSW		
3.	Bag Opener + Oversize Remover		
4.	Iron Separator		
5.	Wind Shifter		
6.	Sorting Station		
7.	Organic Extraction System		
8.	Grit Removal System		
9.	Digester Feed pumps		
10.	Digesters with biogas holder		
11.	Bio-Gas Desulphurization System		
12.	Bio-Gas Purification System		
13.	Odouring System		
14.	Solar -enhanced Composting facility		
15.	Effluent Treatment (ETP)		
16.	Miscellaneous plants and Facilities		

Signature of Authorized Signatory with Seal

Name:
Designation:
Date:
Place:

BRS -17

APPROACH, METHODOLOGY & WORKPLAN

Bidder should prepare the Approach, Methodology & Workplan and mention below or attach with this sheet

Note for Bidder

The methodology and work plan proposed by the bidder shall include but not limited to the following:

The eligible bidder shall make a detailed presentation OIL on the approach and Methodology to be adopted for carrying out the segregation and processing of waste to CBG.

The bidder shall also present to OIL about the robustness of work plan to ensure quality and timely completion of assignment.

a. Quality of approach and methodology proposed for this project. The bidder shall separately mention the following:

i. Approach and methodology proposed for taking up this assignment.
ii. Bidder's global resources to be utilized for various activities of the scope of work.
iii. Plan and methodology to be followed for having one to one discussion with working committee.

b. Robustness of the Work plan to ensure quality and timely completion of assignment bidder should indicate the following:

i. Organogram for this assignment including support staff
ii. Responsibility of each team member
iii. Fortnightly schedule and status update of the progress
iv. Mechanism of getting inputs / information available elsewhere
v. Methodology of taking input from internal/external experts, if required
vi. Any other details that the bidder may like to mention

Signature of Authorized Signatory with Seal

Name:

Designation:

Date:

Place:

Section XIII

List of Annexures

Annexure	Particulars
ANNEXURE -1	FORMAT OF PRE-BID MEETING
ANNEXURE -2	INTEGRITY PACT
ANNEXURE -3	LIST OF APPROVED BANKS
ANNEXURE -4	HSE POLICY
ANNEXURE -5	FORMAT FOR HINDRANCE REGISTER
ANNEXURE -6	GA DRAWING OF THE PROJECT LAYOUT
ANNEXURE -7	FORM OF BID SECURITY (BANK GAURANTEE FORMAT)
ANNEXURE -8	FORMAT OF PERFORMANCE BANK GUARANTEE for EPC
ANNEXURE -9	FORMAT OF PERFORMANCE BANK GUARANTEE during O & M
ANNEXURE -10	AGREEMENT FORM

ANNEXURE- 1

Format for Pre-bid Queries

To

ED(BD)
BD Department,
Oil India Limited,
Plot No. 19, Sector 16A,
Noida- 201301,
Uttar Pradesh, India.

Sub: Tender No.: CQI2018P27

Dear Sir

Having examined the General and Special Conditions of Contract and the Terms of Reference including all attachments thereto, the receipt of which is hereby duly acknowledged, we have some queries and the same are submitted as per the format provided in the tender documents.

S. No.	Clause No.	Existing provision	Clarification Required	Suggested text for the amendment	Rationale for the Clarification or amendment

Signature _____
Name _____
Designation _____
Office Stamp _____

ANNEXURE- 2

INTEGRITY PACT (IP)

Between

Oil India Limited (OIL) hereinafter referred to as "The Principal"

And

(Name of the bidder) ..... hereinafter referred to as "The Bidder"

Preamble:

The Principal intends to award, under laid down organizational procedures, contract/s for Establish a plant of 200 TPD Source Segregated Organic Fraction of Municipal Solid Waste Compressed Bio Gas Plant at Sambalpur, Odisha for commercial use. The principal values full compliance with all relevant laws and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder/s and Contractor/s.

In order to achieve these goals, the principal cooperates with the renowned international Non-Governmental Organization "Transparency International" (TI). Following TI's national and international experience, the principal will appoint an external independent Monitor who will monitor the tender process for compliance with the principles mentioned above.

Section: 1 Commitments of the Principal

(1) The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:

a) No employee of the Principal, personally or through family members, will in connection with the tender for, or during execution of a contract, demand, take a promise for or accept, for him/herself or third person, any material or immaterial benefit which he/she is not legally entitled to.

b) The Principal will, during the tender process treat all Bidders with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidders the same information and will not provide to any Bidder confidential/additional information through which the Bidder could obtain an advantage in relation to the tender process.

c) The Principal will exclude from the process all known prejudiced persons.

(2) If the Principal obtains information on the conduct of any of its employees which is a criminal offence under the relevant Anti-Corruption Laws of India, or if there be a substantive suspicion in this regard, the Principal will inform the Chief Vigilance Officers and in addition can initiate disciplinary actions.

Section: 2 Commitments of the Bidder

(1) The Bidder commits itself to take all measures necessary to prevent corruption. During his participation in the tender process, the Bidder commits himself to observe the following principles:

i. The Bidder will not, directly or through any other person or firm, offer, promise or give to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material or immaterial benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during subsequent contract execution, if awarded.

ii. The Bidder will not enter with other Bidders into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, Subsidiary contracts, submission or non- submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.

iii. The Bidder(s) will not commit any offence under the relevant Anticorruption Laws of India, further, the Bidder(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

iv. The Bidder will, when presenting his bid, disclose any and all payments he has made, is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.

v. Bidders to disclose any transgressions with any other public/government organization that may impinge on the anti-corruption principle. The date of such transgression, for the purpose of disclosure by the bidders in this regard, would be the date on which cognizance of the said transgression was taken by the competent authority. The period for which such transgressions (s) is/are to be reported by the bidders shall be the last three years to be reckoned from date of bid submission. The transgression (s), for which cognizance was taken even before the said period of three years, but are pending conclusion, shall also be reported by the bidders.

vi. The Bidder(s) of foreign origin shall disclose the name and address of the Agents/ representatives in India, if any. Similarly, the Bidder(s) of Indian Nationality shall furnish the name and address of the foreign principals, if any.

Further, all the payments made to the Indian agent/ representative have to be in India Rupees only.

vii. Bidders not to pass any information provided by Principal as part of business relationship to others and not to commit any offence under PC/ IPC Act;

(2) The Bidder will not instigate third persons to commit offences outlined above or be an accessory to such offences.

(3) The Bidder signing Integrity Pact shall not approach the Courts while representing the matters to IEMs and he/she will await their decision in the matter.

Section: 3 Disqualification from tender process and exclusion from future Contracts

If the Bidder, before contract award has committed a transgression through a violation of Section 2 or in any other form such as to put his reliability or risibility as Bidder into question, the Principal is entitled to disqualify the Bidder from the tender process, for such reason.

1. If the Bidder has committed a transgression through a violation of Section 2 such as to put his reliability or credibility into question, the Principal is entitled also to exclude the Bidder from future contract award processes. The imposition and duration of the exclusion will be determined by the severity of the transgression. The severity will be determined by the circumstances of the case, in particular the number of transgressions, the position of the transgressions within the company hierarchy of the Bidder and the amount of the damage. The exclusion will be imposed for a minimum of 6 months and maximum of 2 years.

2. The Bidder accepts and undertakes to respect and uphold the Principal's Absolute right to resort to and impose such exclusion and further accepts and undertakes not to challenge or question such exclusion on any ground, including the lack of any hearing before the decision to resort to such exclusion is taken. This undertaking is given freely and after obtaining independent legal advice.

3. If the Bidder can prove that he has restored/recouped the Damage caused by him and has installed a suitable corruption prevention system, the Principal may revoke the exclusion prematurely.

4. A transgression is considered to have occurred if in light of available evidence, no reasonable doubt is possible.

5. Integrity Pact, in respect of a particular contract, shall be operative from the date Integrity Pact is signed by both the parties or as mentioned in Section 9 - Pact Duration whichever is later. Any violation of the same would entail disqualification of the bidders and exclusion from future business dealings.

Section: 4 Compensation for Damages

1. If the Principal has disqualified the Bidder from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover from the Bidder liquidated damages equivalent to Earnest Money Deposit / Bid Security.

2. If bidder agrees and undertakes to pay the said amounts without protest or demur subject only to condition that if the Bidder can prove and establish that the exclusion of the Bidder from the tender process has caused no damage or less damage than the amount or the liquidated damages, the Bidder shall compensate the Principal only to the extent of the damage in the amount proved.

Section: 5 Previous transgression

1. The Bidder declares that no previous transgression occurred in the last 3 years with any other company in any country conforming to the TI approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.

2. If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process for such reason.

Section: 6 Equal treatment of all Bidders/Contractor/Subcontractors

1. The Principal will enter into Pacts on identical terms with all bidders.

2. The Bidder undertake(s) to procure from all subcontractors a commitment in conformity with this Integrity Pact. The Bidder shall be responsible for any violation(s) of the provisions laid down in this agreement/Pact by any of its sub- contractors/sub- vendors.

3. The Principal will disqualify from the tender process all bidders who do not sign this Pact or violate its provisions.

Section: 7 Criminal charges against violating Bidders/Contractors/ Subcontractors

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor, which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the Vigilance Office.

Section: 8 External Independent Monitor/Monitors

1. The Principal appoints competent and credible Independent External Monitor (IEM) for this Pact.

2. The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the Chairperson of the Board of the Principal.

3. The Bidder accepts that the Monitor has the right to access without restriction to all Project documentation of the Principal including that provided by the Bidder. The Bidder will also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractors. The Monitor is under contractual obligation to treat the information and documents of the Bidder/Contractor/Subcontractor with confidentiality.

4. The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the Project provided such meetings could have an impact on the contractual relations between the Principal and the Bidder. The parties offer the Monitor the option to participate in such meetings.

5. As soon as the Monitor notices, or believes to notice, a violation of this agreement, he will so inform the Management of the Principal and request the Management to discontinue or heal the violation, or to take other relevant action. The monitor can in this regard submit non-binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action. However, the Independent External Monitor shall give an opportunity to the bidder to present its case before making its recommendations to the Principal.

6. The Monitor will submit a written report to the Chairperson of the Board of the Principal within 8 to 10 weeks from the date of reference or intimation to him by the 'Principal' and, should the occasion arise, submit proposals for correcting problematic situations.

7. If the Monitor has reported to the Chairperson of the Board a Substantiated suspicion of an

offence under relevant Anti-Corruption Laws of India, and the Chairperson has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Vigilance Office, the Monitor may also transmit this information directly to the Central Vigilance Commissioner, Government of India.

8. The word 'Monitor' would include both singular and plural.

9. In case of any complaints referred under IP Program, the role of IEMs is advisory and the advice of IEM is non-binding on the Organization. However, as IEMs are invariably persons with rich experience who have retired as senior functionaries of the government, their advice would help in proper implementation of the IP.

Section: 9 Pact Duration

This Pact begins when both parties have legally signed it. It expires for the Contractor 12 months after the last payment under the respective contract, and for all other Bidders 6 months after the contract has been awarded.

If any claim is made/ lodged during this time, the same shall be binding and continue to be valid despite the lapse of this pact as specified above, unless it is discharged/determined by Chairperson of the Principal.

Section: 10 Other provisions

1. This agreement is subject to Indian Law. Place of performance and jurisdiction is the Registered Office of the Principal. The Arbitration clause provided in the main tender document / contract shall not be applicable for any issue / dispute arising under Integrity Pact.

2. Changes and supplements as well as termination notices need to be made in writing. Side agreements have not been made.

3. If case of a joint venture, all the partners of the joint venture should sign the Integrity Pact. In case of sub-contracting, the principal contractor shall take the responsibility of the adoption of IP by the sub-contractor. It is to be ensured that all sub-contractors also sign the IP. In case of sub-contractors, the IP will be a tri-partite arrangement to be signed by the Organization, the contractor, and the sub-contractor.

4. Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intensions.

.....	.....
For the Principal	For the Bidder/Contractor

Witness 1: .....

Place
Date

ANNEXURE- 3

LIST OF APPROVED BANKS

Submission of Bid Security in the form of Electronic Bank Guarantee (e-BG):

Sl. No.	Bank Name	Sl. No.	Bank Name
1	AU Small Finance Bank	**12**	IDFC First Bank
2	Axis Bank limited	**13**	Indian Bank
3	Bank Of Baroda	**14**	Indian Overseas Bank
4	Bank of India	**15**	IndusInd Bank
5	Canara Bank	**16**	Karur Vysya Bank
6	City Union Bank	**17**	Kotak Mahindra Bank
7	Federal Bank	**18**	Punjab National Bank
8	HDFC Bank	**19**	RBL Bank
9	HSBC Bank	**20**	State Bank of India
10	ICICI Bank	**21**	South Indian Bank
11	IDBI Bank	**22**	Yes Bank

ANNEXURE- 4

HSE POLICY

Annexure to Ref No: S&E/G/53/1332. Dated 30.09.2021

HEALTH, SAFETY & ENVIRONMENT (HSE) POINTS

The Contractor shall adhere to following points while performing the works under this contract.

A. General / Common:

1. The Contractor shall be solely responsible to comply all the statutory norms as applicable while executing the job. It will be solely the Contractor's responsibility to fulfill all the legal formalities with respect to the Health, Safety and Environmental aspects of the entire job (namely: the person employed by him, the equipment, the environment, etc.) under the jurisdiction of the district of that state where it is operating. Ensure that all sub-contractors hired by him comply with the same requirement as the Contractor himself and shall be liable for ensuring compliance of all HSE laws by the sub-contractors. It will be the responsibility of the Contractor/his Supervisor/representative to ensure strict adherence to all HSE measures and statutory Rules during operation in OIL's installations and safety of workers engaged by him. The crew members will not refuse to follow any instruction given by representative of OIL.

2. Contractor's arrangements for health and safety management shall be consistent with those for the company (OIL).

3. A Contractor employee must, while at work, take reasonable care for the health and safety of people who are at the employee's place of work and who may be affected by the employee's Actor omissions at work.

4. The Contractor shall ensure complete safety of the personnel engaged by him, and of all the equipment, they will handle and must take full responsibility for their safety.

5. Every person deployed by the Contractor must use appropriate PPEs (Personal Protective Equipment) to be provided by the Contractor. The Contractor shall provide Personnel Protective Equipment as per the hazard identified and risk assessed for the job and conforming to statutory requirement and company's PPE schedule. Safety appliances like protective footwear, Safety Helmet and Full Body harness, Fall Prevention Devises (FPD) shall conform to relevant IS codes. Necessary supportive document shall have to be available at site as proof. If the Contractor fails to provide the safety items as mentioned above to the working personnel, the Contractor may request to the Company (OIL) for providing the same. In case of exigency OIL will provide the safety items if available. However in turn, OIL will recover the actual cost of the items by deducting from Contractor's Bill. However, it will be the Contractor's sole responsibility to ensure that the persons engaged by him in the mines use the proper PPE

while at work. Contractor employees should be trained in the proper use and maintenance of PPE. In absence of appropriate PPEs, the representative of OIL has the right to stop the work which will be binding for the Contractor. Moreover, the accountability towards any delay in work/ penalty due non-adherence to PPE shall be binding to the Contractor.

6. The Contractor should frame a mutually agreed bridging document between OIL & the Contractor for all issues not envisaged under the terms and conditions of the contract with the roles and responsibilities clearly defined.

7. The Contractor has to keep a register of the persons employed by him/her. The Contractor's supervisor shall take and maintain attendance of his men every day for the work, punctually.

8. Soft copy of the Standard Operating Procedures (SOPs) related to scope of work shall be handed over to the representative of OIL by Contractor including an assessment of risk, wherever possible and safe methods to deal with it/them. Printout of copy (spiral binding) of the SOP mentioned above is to be kept with all working teams at all times. The SOP clearly stating the risk arising to men, machineries & material from the mining operation / other operations to be done by the Contractor and how it is to be managed. However; in case of any doubts, the Contractor shall reconfirm the same from the Engineer in Charge (OIL).

9. Contractor has to ensure that all work is carried out in accordance with the Statute and the SOP for the job. For the purpose, he may deploy adequate qualified and competent personnel for carrying out the job in a safe manner. The work which is not covered under SOP, the Contractor shall develop it and submit to the representatives of OIL.

10. In case of deviation of SOP or non-availability of SOP, Job Safety Analysis (JSA) shall be carried out before commencement of the work.

11. Necessary cold and hot work permits including excavation clearance and permission for working at height, Confined Space Entry as applicable are to be obtained by the competent person of the Contractor from the site representative of OIL before start of the job(s). Work Permit System should be inline as per guidelines issued by HSE Department.

12. The Contractor’s personnel should be aware about the existing as well as probable hazards and ensure their training to tackle such untoward events by the Contractor. If the Company (OIL) arranges any safety awareness program / training for the working personnel at site (company employee, Contractor worker, etc.) the Contractor will not have any objection to any such training.

13. After receipt of the work order the Contractor shall have to submit authorized list of Contract Personnel, who will be engaged for the jobs including name of the Contractor’s competent persons and every contact details. No person shall be engaged in any job in a mine unless his competency has been assessed and approved by the OIL Engineer In Charge.

14. The Contractor shall not engage minor laborer below eighteen (18) years of age under any circumstances.

15. The Contractor should prevent the frequent change of his deployed employees as far as practicable. The Contractor shall not employ or terminate his worker without the knowledge of the OIL engineer in charge. However, if OIL Engineer in Charge found any person not appropriate with respect to the job, the Contractor has to remove the person and replace a suitable person within the timeline as per the terms of the Contract.

16. OIL will communicate all information to the Contractor or his authorized representative only.

17. The Contractor shall have to report all incidents including near miss to the representative of OIL who shall be supervising the Contractor's work.

18. Any compensation arising out of the job carried out by the Contractor whether related to pollution, Safety or Health will be paid by the Contractor only.

19. Any compensation arising due to accident of the Contractor's personnel while carrying out the job, will be payable by the Contractor and their medical treatment/ facilities in case of accidents should be provided by the same Contractor. The Contractor's personnel should be aware about the existing as well as probable hazards and ensure their training to tackle such untoward events by the Contractor.

20. Contractor shall keep a reasonable degree of order by disposing of accumulated rubbish and excess material. Disposal of solid wastes generated by the Contractor shall be in accordance with the company's Procedure for Solid Waste Management. The Contractor Personnel have to take every possible care to keep the environment clean and free from pollution.

21. The Contractor have to ensure the quality and reliability of all the tools, equipment and instruments they use. The supporting documents relevant to prove the above should be submitted. Defective tools shall be immediately removed.

22. Contractor's Supervisor/ Contractor's personnel needs to be aware about the site specific emergency response plan (which includes display of emergency contact nos., establish telephone communication, layout of working area, use of fire extinguisher, emergency exit, assembly point).

23. All Lifting equipment of the Contractor like Crane etc. shall have to be duly calibrated. Calibration Certificate of this equipment shall have to be submitted to the representatives of OIL and a copy of the same to be made available at site.

24. Necessary sign-board / warning signals like caution, "hot work" in progress, emergency telephone numbers, no entry without permission etc. should be used while working on tanks. The said signals / sipn-boards shall have to be arranged by the Contractor and shall be in line with the circular of signboards issued by HSE Department, Oil India Limited.

25. Barricading of area to be done with reflecting tapes as applicable during work.
26. The First-Aid box should be provided by the Contractor and the same has to be kept ready to use at the site throughout the working hours.
27. The availability of First-Aid Fire Fighting equipment should be ensured by the Contractor at all working hours.
28. Smoking is prohibited in all Company restricted areas except in authorized smoking areas/ shelters. Carrying of matches and lighters into the Hazardous Area is prohibited. Cellular phones shall not be used in operating areas / hazardous areas unless they have been classified as 'intrinsically safe' for use in that atmosphere. Consumption of alcohol and possession of non- prescribed drug in Company work site is strictly prohibited.
29. The Contractor personnel should understand the implication of the known hazards related to the work undertaken by them and the necessity of having an emergency plan approved by OIL to counter them, if anything goes wrong.
30. In case Contractor is found non-compliant of HSE laws as required and all the above mentioned general HSE points, company will have the right for directing the Contractor to take action to comply with the requirements, and for further non- compliance, the Contractor will be penalized as per the terms of the Contract.
31. When there is a significant risk to health, environment or safety of a person or place arising because of a non-compliance of HSE Measures Company will have the right to direct the Contractor to cease work until the non-compliance is corrected.
32. Considering the ongoing Covid-19 pandemic, those who are engaged in the above operations should follow the Covid-19 Protocol as per the prevailing Government Guidelines.
33. Any requirement arise by the Statutory Authorities during the period of contract shall be applicable and binding for the Contractor.

B. Additional Points in case of Areas/ Installations under Mines

1. As per DGMS circular & Gazette Notification for maintenance of register as required by the Mines Act1952 and Mines Rules, 1955, the forms A, B, D and E have been updated and modified. The above-mentioned forms need to be maintained as per the new format.
2. The Contractor shall submit to DGMS returns indicating — Name of his firm, Registration number, Name and address of person heading the firm, Nature of work, type of deployment work persons, Number of work persons deployed, how many work hold VT Certificate, how many work persons undergone IME and type of medical coverage given to the work persons.

3. The return shall be submitted quarterly (by 10th of April, July, October & January) for contracts of more than one year. However, for contracts of less than one year, returns shall be submitted monthly.

4. The Contractor shall report all near misses, minor and reportable accident to the Engineer In Charge and maintain the record of near misses as per OIL's practice, and accidents in the Form — J for Reportable accident and Form — K for Minor Accidents as per The Mines Rules 1955 in consultation with the Engineer In Charge.

5. The Contractor engaged for any electrical installation, maintenance, repairs etc., should possess a valid electrical Contractor license issued by the State Electricity Licensing Board and engage adequate number of competent electrical personnel. All the Competent persons shall have appropriate Work Permit/ Supervisory License issued by State Electricity Licensing Board. It shall be included in Terms and Conditions of contract agreement/NIT (Notice Inviting Tender) and shall be ensured by the OIL Engineer in charge.

6. Statutory forms to be maintained in respect to Mines Act, 1952, Mines Rules 1955, Oil Mines Regulations 2017, the Environment (Protection) Act-1986 and other applicable laws.

7. The Contractor, wherever applicable, shall obtain necessary hazardous waste authorization from the State Pollution Control Board for storage, handling and disposal of hazardous waste.

8. The health check-up of Contractor's personnel is to be done by the Contractor in OIL empaneled Hospital and the reports and statutory forms as applicable to be vetted from the OIL authorized Medical Officer. The frequency of periodic medical examinations should be every five years for the employees up to 45 years of age and every three years for employees of 45 years of age and above. Initial Medical Examination should be in line with the standard followed by OIL.

9. All persons deployed by the Contractor for working in a mine must undergo Mines Vocational Training, initial medical examination and Periodic Medical Examination (if required). They should be issued cards stating the name of the Contractor and the work and its validity period, indicating status of MVT, IME & PME.

10. Necessary facilities for monitoring the levels of parameters in respect of Methane, Oxygen, Hydrogen Sulphide and Carbon Monoxide should be provided at mines. Portable multi-gas detector (LEL/02/CO/H2S) and FLP tool, torch light etc. to be made available at site.

11. The Contactor personnel shall arrange daily meeting and monthly pit level meeting headed by the OIL Engineer and maintain records accordingly. Safety Briefing, Evacuation plan in case of emergency and how to inform (in case of emergency) to be discussed during the Tool Box meeting.

ANNEXURE- 5

FORMAT FOR HINDRANCE REGISTER

Description of Project: ..... **Contract No. & Date: .....**

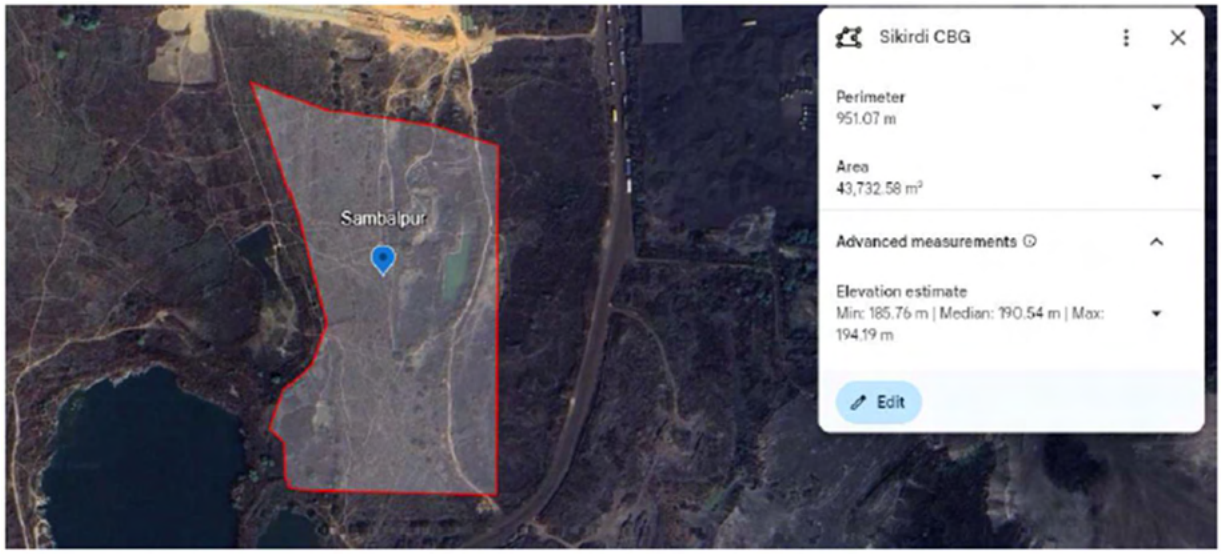
Contractor's Name: ..... **Scheduled Completion Date: .....**

S. No.	Nature of Hindrance	Items of work that could not be executed because of this hindrance	Date of start of Hindrance	Date of Removal of Hindrance	Period of Hindrance	Overlapping period, if any	Net Hindrance days	Remarks

Signature of Contractor's Representative	Signature of Engineer-in-charge	Signature of HoD

ANNEXURE – 6

INDICATIVE GA DRAWING OF THE PROJECT LAYOUT



Proposed Plant Location at Mouza-Sikirdi, Tahsil: Sambalpur Sadar, Sambalpur District

Note: The actual proposed plant boundary demarcation will be updated later.

The Bidder should enclose the following drawings with the bid:

i. Project layout

Signature _____
Name _____
Designation _____
Office Stamp _____

ANNEXURE – 7

FORM OF BID SECURITY (BANK GUARANTEE FORMAT)

FORM OF BID SECURITY (BANK GUARANTEE)

WHEREAS, (Name of Bidder)_____(hereinafter called "the Bidder") has submitted his bid dated (Date) for the provision of certain services (hereinafter called "the Bid") against OIL INDIA LIMITED, OIL House, Plot No19, Sector- 16A, NOIDA (hereinafter called the Company)'s Tender No. .

WE KNOW ALL MEN by these presents that We (Name of Bank) of (Name of Country) having our registered office at (hereinafter called "the Bank") are bound unto Oil India Ltd (hereinafter called "Company" in the sum of (___) * for which payment well and truly to be made to Company, the Bank binds itself, its successors and assignees by these presents.

SEALED with the common seal of the Bank this____day of _, 2024.

THE CONDITIONS of this obligation are:

(1) If the Bidder withdraws his Bid during the period of bid validity specified by the bidder

(2) If the Bidder, having been notified of the acceptance of their Bid by the Company during the period of Bid validity:

(a) fails or refuses to execute the Form of Agreement in accordance with the Instructions to Bidders, on tender document;
(b) fails or refuses to furnish the Performance Security in accordance with the Instructions to Bidders on tender documents.

(3) if the Bidder furnish fraudulent document / information in their bid.

We undertake to pay to Company up to the above amount upon receipt of its first written demand, (by way of letter/fax/e-mail) without Company having to substantiate its demand, provided that in its demand Company will note that the amount claimed by it is due to it owing to the occurrence of one or both of the two conditions specifying the occurred condition or conditions.

This guarantee will remain in force up-to and including the date up to (date of expiry of bank guarantee should be minimum 165 days from scheduled Bid Closing Date) any demands in respect thereof should not reach the bank not later than the above date.

The details of the Issuing Bank and Controlling Bank are as under:

A. Issuing Bank:
Bank Fax no & Bank email id: Bank Telephone No.

IFSC Code of the Bank:

B. Controlling Office:
Address of the Controlling Office of the BG issuing Bank:
Name of the Contact Person at the Controlling Office
with Mobile No. and e-mail address:

SIGNATURE & SEAL OF THE GUARANTOR

DESIGNATION

DATE:

NAME & ADDRESS OF BANK

***The bank should insert the amount of guarantee in words and figures**

****Date of expiry of bank guarantee should be minimum 165 days from scheduled Bid Closing Date**

NOTE: The Bank Guarantee issuing bank branch shall ensure the following:

a) The Bank Guarantee issued by the bank shall be routed through SFMS platform as per the following details:

   i. "MT 760/MT 760 COV" for issuance of bank guarantee.

   ii. "MT 760/MT 767 COV" for amendment of bank guarantee.

The above message / intimation shall be sent through SFMS (indicating the Tender Number) by the BG issuing bank branch to HDFC Bank Limited, E-13/29 IFS Code – HDFC0000003; SWIFT Code – HDFCINBBDEL; Branch Address: HDFC Bank Limited, E-13/29, 2nd Floor, Harsha Bhavan, Middle Circle, Connaught Place, New Delhi 110001

b) Bank Guarantee issued by a Scheduled Bank in India at the request of some other Non-Scheduled Bank of India shall not be acceptable.

c) Further correspondence against BG towards Performance Security must contain the Tender Number.

ANNEXURE – 8

FORMAT OF PERFORMANCE BANK GUARANTEE for EPC

(TO BE FURNISHED BY THE CONTRACTOR IN CASE OF SUBMITTING PERFORMANCE SECURITY IN THE FORM OF BANK GUARANTEE AFTER ISSUE OF LOA)

To
ED (BD)
Oil India Limited,
OIL House, Plot No. 19, Sector 16A,
Noida-201 301, U.P.

WHEREAS _____ (Name and address of Contractor) (hereinafter called "Contractor") had undertaken, in pursuance of Contact No. _____ to execute (Name of Contract and Brief Description of the Work) (hereinafter called "the Contract").

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee as security for compliance with Contractor's obligations in accordance with the Contract.

AND WHEREAS we (May incorporate the Bank Name) have agreed to give the Contractor such a Bank Guarantee; NOW THEREFORE we hereby affirm that we are Guarantors on behalf of the Contractor, up to a total of (Amount of Guarantee in figures)

(in words), such amount being payable in the types and proportions of currencies in which the Contract price is payable, and we undertake to pay you, upon your first written demand and without cavil or arguments, any sum or sums within the limits of guarantee sum as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein. We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or the work to be performed thereunder or of any of the Contract documents which may be made between you and the Contractor shall in any way cease us from any liability under this guarantee, and we hereby waive notice of such change, addition or modification.

This guarantee is valid until the day of

The details of the Issuing Bank and Controlling Bank are as under:

A. Issuing Bank: BANK FAX NO:
   BANK EMAIL ID: BANK TELEPHNE NO:
   IFSC CODE OF THE BANK:

B. Controlling Office:
Address of the Controlling Office of the BG issuing Bank:
Name of the Contract Person at the Controlling Office with Mobile No. and e-mail address:

Notwithstanding anything contained herein:

a) Our liability underthis Bank Guarantee is restricted up to Rs. _____

b) This guarantee shall be valid till .....

c) We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only and only if you serve upon us a written claim or demand on or before ..... (Date of Expiry of BG PLUS one year claim period).

d) At the end of the claim period that is on or after ..... (Date of expiry of the Bank Guarantee Plus Minimum of 1 year claim period shall be stipulated) all your rights under this Guarantee shall stand extinguished and we shall be discharged from all our liabilities under this Guarantee irrespective of receipt of original Bank Guarantee duly discharged, by Bank.

Name of the Contact Person at the Controlling Office with Mobile No. and e-mail address:

SIGNATURE AND SEAL OF THE GUARANTORS
Designation
Name of the Bank
Address

Note: The Bank Guarantee issuing bank branch shall ensure the following:

The Bank Guarantee issued by the bank shall be routed through SFMS platform as per the following details:

i. "MT 760/MT 760 COV" for issuance of bank guarantee.
ii. "MT 760/MT 767 COV" for amendment of bank guarantee.

The above message / intimation shall be sent through SFMS (indicating the Contract Number) by the BG issuing bank branch to HDFC Bank Limited, E-13/29, IFS Code –HDFC0000003; SWIFT Code – HDFCINBB; Branch Address: HDFC Bank Limited, E- 13/29, 2nd Floor, Harsha Bhavan, Middle Circle, Connaught Place, New Delhi 110001

a) Bank Guarantee issued by a Scheduled Bank in India at the request of some other Non-Scheduled Bank of India shall not be acceptable.

b) Further correspondence against BG towards Performance Security must contain the Contract Number.

ANNEXURE – 9

FORMAT OF PERFORMANCE BANK GUARANTEE DURING O & M

(TO BE FURNISHED BY THE CONTRACTOR IN CASE OF SUBMITTING PERFORMANCE SECURITY IN THE FORM OF BANK GUARANTEE AFTER ISSUE OF LOA)

To
ED (BD)
Oil India Limited,
OIL House, Plot No. 19, Sector 16A,
Noida-201 301, U.P.

WHEREAS _____ (Name and address of Contractor) (hereinafter called "Contractor") had undertaken, in pursuance of Contact No. _____ to execute (Name of Contract and Brief Description of the Work) (hereinafter called "the Contract").

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee as security for compliance with Contractor's obligations in accordance with the Contract.

AND WHEREAS we (May incorporate the Bank Name) have agreed to give the Contractor such a Bank Guarantee; NOW THEREFORE we hereby affirm that we are Guarantors on behalf of the Contractor, up to a total of (Amount of Guarantee in figures)

(in words), such amount being payable in the types and proportions of currencies in which the Contract price is payable, and we undertake to pay you, upon your first written demand and without cavil or arguments, any sum or sums within the limits of guarantee sum as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein. We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or the work to be performed thereunder or of any of the Contract documents which may be made between you and the Contractor shall in any way cease us from any liability under this guarantee, and we hereby waive notice of such change, addition or modification.

This guarantee is valid until the day of _____

The details of the Issuing Bank and Controlling Bank are as under:

A. Issuing Bank: BANK FAX NO:
BANK EMAIL ID: BANK TELEPHNE NO:
IFSC CODE OF THE BANK:

B. Controlling Office:
Address of the Controlling Office of the BG issuing Bank:
Name of the Contract Person at the Controlling Office with Mobile No. and e-mail address:

Notwithstanding anything contained herein:

a) Our liability under this Bank Guarantee is restricted up to Rs. _____

b) This guarantee shall be valid till .....

c) We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only and only if you serve upon us a written claim or demand on or before ..... (Date of Expiry of BG PLUS one year claim period).

d) At the end of the claim period that is on or after ..... (Date of expiry of the Bank Guarantee Plus Minimum of 1 year claim period shall be stipulated) all your rights under this Guarantee shall stand extinguished and we shall be discharged from all our liabilities under this Guarantee irrespective of receipt of original Bank Guarantee duly discharged, by Bank.

Name of the Contact Person at the Controlling Office with Mobile No. and e-mail address:

SIGNATURE AND SEAL OF THE GUARANTORS
Designation
Name of the Bank
Address

Note: The Bank Guarantee issuing bank branch shall ensure the following:

The Bank Guarantee issued by the bank shall be routed through SFMS platform as per the following details:

iii. "MT 760/MT 760 COV" for issuance of bank guarantee.
iv. "MT 760/MT 767 COV" for amendment of bank guarantee.

The above message / intimation shall be sent through SFMS (indicating the Contract Number) by the BG issuing bank branch to HDFC Bank Limited, E-13/29, IFS Code –HDFC0000003; SWIFT Code – HDFCINBB; Branch Address: HDFC Bank Limited, E- 13/29, 2nd Floor, Harsha Bhavan, Middle Circle, Connaught Place, New Delhi 110001

a) Bank Guarantee issued by a Scheduled Bank in India at the request of some other Non-Scheduled Bank of India shall not be acceptable.

b) Further correspondence against BG towards Performance Security must contain the Contract Number.

ANNEXURE – 10

AGREEMENT FORM

[Only for acceptance; not to be filled and submitted. Shall be executed during Formal Agreement.]

This Agreement is made on _____ day of _____ between (Name of Company) of (Mailing address of Company) , hereinafter called the "Company" which expression unless repugnant to the context shall include executors, administrators and assignees on the one part, and M/s. _____(Name and address of Contractor) hereinafter called the "Contractor" which expression unless repugnant to the context shall include executors, administrators and assignees on the other part,

WHEREAS the Company desires that Services _____(brief description of services) should be provided by the Contractor as detailed hereinafter or as Company may requires;

WHEREAS Contractor engaged themselves in the business of offering such services represents that they have adequate res and equipment, material etc. in good working order and fully trained personnel capable of efficiently undertaking the operations and is ready, willing and able to carry out the said services for the Company as per SOW attached herewith for this purpose;

WHEREAS Company had issued a firm Letter of Award No. _____dated_____ based on Offer No. _____ dated _____ submitted by the Contractor against Company's IFB No. and the Contractor accepted the same vide; and

WHEREAS, the Contractor has furnished to Company the performance security in the form of _____for Rs _____ (being 7.5% of Annualized Contract value).

All these aforesaid documents shall be deemed to form and be read and construed as part of this agreement/contract. However, should there be any dispute arising out of interpretation of this contract in regard to the terms and conditions with those mentioned in Company's tender document and subsequent letters including the Letter of Intent and Contractor's offer and their subsequent letters, the terms and conditions attached hereto shall prevail. Changes, additions or deletions to the terms of the contract shall be authorized solely by an amendment to the contract executed in the same manner as this contract.

NOW WHEREAS, in consideration of the mutual covenants and agreements hereinafter contained, it is hereby agreed as follows -

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract referred to.

2. In addition to the documents above, the following Sections and Annexures attached herewith shall be deemed to form and be read and construed as part of this agreement viz.:

a) Schedule of Work, quantities, Units & Rates.
b) General Terms & Conditions (GTC).
c) Special Terms & Conditions (STC).
d) Additional Terms & Conditions (ATC).

3. In consideration of the payments to be made by the Company to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Company to provide the Services and to remedy defects therein in conformity in all respect with the provisions of this Contract.

4. The Company hereby covenants to pay the Contractor in consideration of the provision of the Services and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of this Contract at the times and in the manner prescribed by this Contract.

IN WITNESS WHEREOF the parties hereto have set their respective hands and seals to this Agreement on the day, year first written above.

Signed, Sealed and Delivered,

For and on behalf of Company	For and on behalf of Contractor
(Oil India Limited)	(M/s.)
Signature:	Signature:
Name:	Name
Status:	Status:
In Presence of:	In Presence of:
1.	1.
2.	2.

OIL INDIA LIMITED
(A Government of India Enterprise)

DESCRIPTION OF WORK/SERVICE: EPCOM of 200 TPD Source Segregated Organic Fraction of Municipal Solid Waste (SSOF-MSW) based Compressed Biogas (CBG) Plant for Commercial use at Sambalpur, Odisha on Domestic Competitive Bidding Basis.

PRICE BID FORMAT/FINANCIAL DOCUMENT

NAME OF BIDDER	
Bidder's GST No.	
SAC Code	

Item No.	Description of Services (Refer SOQ for detailed description of services)	UOM	Estimated Total Quantity	Rate (Rs.) to be quoted Excluding GST	Applicable GST Rate in %	Applicable GST (CGST+SGST/ CGST+UTGST/ IGST/Not Applicable)	Amount (Rs.) Excluding GST	Amount (Rs.) Including GST
			A	B	C		D = A * B	E = D+(D*C%)
A. EPC PART								
10	Design & Egineerng	LSM	1				0.00	0.00
20	Civil Works: Site Development including	LSM	1				0.00	0.00
30	Civil Works: Boundary Wall with Main Gat	LSM	1				0.00	0.00
40	Civil Works: Internal Roads with Pathway	LSM	1				0.00	0.00
50	Civil Works: 2-Wheeler Parking, Car Park	LSM	1				0.00	0.00
60	Civil Works: Internal Sewerage / Effluen	LSM	1				0.00	0.00
70	Civil Works: Plantation / Gardening / La	LSM	1				0.00	0.00
80	Civil Works: Any Other (Please add, if a	LSM	1				0.00	0.00
90	Civil Works: Digester	LSM	1				0.00	0.00
100	Civil Works: Digestate Sump	LSM	1				0.00	0.00

110	Civil Works: Centrate Sump (Decanter Cen	LSM	1				0.00	0.00
120	Civil Works: Effluent Treatment Plant (E	LSM	1				0.00	0.00
130	Civil Works: Potable Water Storage Tank	LSM	1				0.00	0.00
140	Civil Works: Fire Water Tank	LSM	1				0.00	0.00
150	Civil Works: Any Other (Please add, if a	LSM	1				0.00	0.00
160	Civil Works: Mixed and Wet MSW Receiving	LSM	1				0.00	0.00
170	Civil Works: Bio-Gas Purification System	LSM	1				0.00	0.00
180	Civil Works: CBG Compressors	LSM	1				0.00	0.00
190	Civil Works: Digestate Dewatering System	LSM	1				0.00	0.00
200	Civil Works: Solar-Enhanced Composting F	LSM	1				0.00	0.00
210	Civil Works: Compost Screening, Bagging	LSM	1				0.00	0.00
220	Civil Works: Effluent Treatment Plant (E	LSM	1				0.00	0.00
230	Civil Works: Security Terminal	LSM	1				0.00	0.00
240	Civil Works: Weighbridge Terminal	LSM	1				0.00	0.00
250	Civil Works: HT Sub-station	LSM	1				0.00	0.00
260	Civil Works: Workshop & Store	LSM	1				0.00	0.00
270	Civil Works: Laboratory	LSM	1				0.00	0.00
280	Civil Works: Pump House for Fire Fightin	LSM	1				0.00	0.00
290	Civil Works: Any Other (Please add, if a	LSM	1				0.00	0.00

300	Mechanical Works: Infeed Bunker for Wet	LSM	1				0.00	0.00
310	Mechanical Works: Organic Extraction Sys	LSM	1				0.00	0.00
320	Mechanical Works: Grit Removal System	NO	1				0.00	0.00
330	Mechanical Works: Conveyors: Chain Belt,	NO	1				0.00	0.00
340	Mechanical Works: Digester Feed Pump	NO	1				0.00	0.00
350	Mechanical Works: Mixer	NO	1				0.00	0.00
360	Mechanical Works: Pressure Door, Manhole	NO	1				0.00	0.00
370	Mechanical Works: Biogas Holder with Sup	NO	1				0.00	0.00
380	Mechanical Works: Dual Fuel Hot Water Ge	NO	1				0.00	0.00
390	Mechanical Works: Dual Fuel Hot Water Ge	NO	1				0.00	0.00
400	Mechanical Works: Hydraulic Separator, D	NO	1				0.00	0.00
410	Mechanical Works: Hot Water Recirculatio	NO	1				0.00	0.00
420	Mechanical Works: Biogas Accessories inc	NO	1				0.00	0.00
430	Mechanical Works: Biogas Flaring System	NO	1				0.00	0.00
440	Mechanical Works: Bio-Gas Desulphurizati	LOT	1				0.00	0.00
450	Mechanical Works: Bio-Gas Purification S	LOT	1				0.00	0.00
460	Mechanical Works: CBG Compressor	LOT	1				0.00	0.00
470	Mechanical Works: Cascade System	LOT	1				0.00	0.00
480	Mechanical Works: CBG metering system	NO	1				0.00	0.00

490	Mechanical Works: Digestate Transfer Pum	NO	1				0.00	0.00
500	Mechanical Works: Digestate Sump: Air Bl	NO	1				0.00	0.00
510	Mechanical Works: Press Screw Separator	NO	1				0.00	0.00
520	Mechanical Works: Press Screw Separator	NO	1				0.00	0.00
530	Mechanical Works: Air Blower/Mixer for C	NO	1				0.00	0.00
540	Mechanical Works: Digestate Dewatering E	NO	1				0.00	0.00
550	Mechanical Works: Digestate Dewatering E	NO	1				0.00	0.00
560	Mechanical Works: Dewatering Polyelectro	NO	1				0.00	0.00
570	Mechanical Works: Solar-Enhanced Compost	NO	1				0.00	0.00
580	Mechanical Works: Compost Screening Plan	NO	1				0.00	0.00
590	Mechanical Works: Compost Bagging Unit	NO	1				0.00	0.00
600	Mechanical Works: Effluent Treatment Pla	LOT	1				0.00	0.00
610	Mechanical Works: Conveyors: Chain Belt,	LOT	1				0.00	0.00
620	Mechanical Works: Electronic Weighbridge	NO	1				0.00	0.00
630	Mechanical Works: Potable Water Transfer	NO	1				0.00	0.00
640	Mechanical Works: Fire Hydrant Pump: Ele	NO	1				0.00	0.00
650	Mechanical Works: Fire Hydrant Pump: Die	NO	1				0.00	0.00
660	Mechanical Works: Jockey Pump	NO	1				0.00	0.00
670	Mechanical Works: Odour Control System i	LOT	1				0.00	0.00

680	Mechanical Works: Air Compressor for Ins	LOT	1				0.00	0.00
690	Mechanical Works: Laboratory Equipment	LSM	1				0.00	0.00
700	Mechanical Works: Plant Cleaning Equipme	LOT	1				0.00	0.00
710	Mechanical Works: Skid Steer Loader	NO	1				0.00	0.00
720	Mechanical Works: Tractor	NO	1				0.00	0.00
730	Mechanical Works: 2-Wheeled Hydraulic Tr	NO	1				0.00	0.00
740	Mechanical Works: Truck mounted Sewer Su	NO	1				0.00	0.00
750	Mechanical Works: Emergency Response Veh	NO	1				0.00	0.00
760	Mechanical Works: Piping, Appurtenances	NO	1				0.00	0.00
780	Mechanical Works: Fire Fighting System i	LOT	1				0.00	0.00
790	Mechanical Works: Any Other (Please add,	LOT	1				0.00	0.00
800	Elec &Inst Works: HT Works including	LOT	1				0.00	0.00
810	Elec &Inst Works: LT Works including	LOT	1				0.00	0.00
820	Elec & Inst Works: Earthing Works in	LOT	1				0.00	0.00
830	Elec & Inst Works: Lighting Works St	LOT	1				0.00	0.00
840	Elec & Inst Works: Miscellaneous Wor	LOT	1				0.00	0.00
850	Elec & Inst Works: Safety Equipment	LOT	1				0.00	0.00
860	Elec & Inst Works: Emergency Diesel	LOT	1				0.00	0.00
870	Elec & Inst Works: Field Instruments	LOT	1				0.00	0.00

890	Elec & Inst Works: PLC & SCADA based	LOT	1				0.00	0.00
900	Elec & Inst Works: IT Works includi	LOT	1				0.00	0.00
910	Elec & Inst Works: Any Other (Please add	LOT	1				0.00	0.00
						Total Estimated Cost (Rs.)	0.00	0.00
				B. Operation & Maintenance				
10	O&M of the Plant Year-1	LSM	1				0.00	0.00
20	O&M of the Plant Year-2	LSM	1				0.00	0.00
30	O&M of the Plant Year-3	LSM	1				0.00	0.00
40	O&M of the Plant Year-4	LSM	1				0.00	0.00
50	O&M of the Plant Year-5	LSM	1				0.00	0.00
60	O&M of the Plant Year-6	LSM	1				0.00	0.00
70	O&M of the Plant Year-7	LSM	1				0.00	0.00
80	O&M of the Plant Year-8	LSM	1				0.00	0.00
90	O&M of the Plant Year-9	LSM	1				0.00	0.00
100	O&M of the Plant Year-10	LSM	1				0.00	0.00
						Total Estimated Cost (Rs.)	**0.00**	**0.00**
						Total Estimated Contract Cost (Rs.)	**0.00**	**0.00**
						The above cost should be maintained under "Total Bid Value" in the E-Tender Portal.		

NOTE:

1. The price/rate(s) quoted by the Bidders will be inclusive of all taxes except GST (i.e. IGST or CGST and SGST/UTGST as applicable in case of interstate supply or intra state supply respectively and Cess on GST, if applicable) on the final services. However, GST rate (including cess) to be provided in the respective places in the Price Bid.
2. Bidders are required to quote for all the items as per Price Bid Format/BOQ. In case the bidder does not quote against any of the line items, the total bid value shall be considered as inclusive of the cost of the service/item.
3. OIL will prefer to deal with registered bidder under GST. Therefore, bidders are requested to get themselves registered under GST, if not registered yet. However, in case any unregistered bidder is submitting their bid, their prices will be loaded with applicable GST while evaluation of bid.
4. Price Bid uploaded without giving any of the details of the taxes (Including rates and amounts) will be considered as inclusive of all taxes including GST. When a bidder mentions taxes as extra without specifying the rates & amount, the offer will be loaded with maximum value towards taxes received against the tender for comparison purposes. If the bidder emerges as lowest bidder after such loading, in the event of order on that bidder, taxes mentioned by OIL on the Purchase Order/Contracts will be binding on the bidder.
5. Input Tax Credit on GST (Goods & Service Tax) for this service is NOT available to OIL & the bids will be evaluated based on total price including GST.
6. Bidder may seek benefits under Public Procurement Policy for PP: LC.
7. Refer to GCC & SCC for detail of GST.
8. Refer to SOR & SOW for Item detail Description.

Appendix - 4 Technical Datasheet - Process & Mechanical

Table of Contents

1 WEIGHBRIDGE 4
1.1 Data Sheet - Weighbridge 4
2 INFEED BUNKER 15
2.1 Datasheet - Infeed Bunker 15
3 BAG OPENER + OVERSIZE REMOVER 17
3.1 Datasheet - Bag opener + Oversize Remover 17
4 IRON SEPARATOR 19
4.1 Datasheet - Iron Separator 19
5 WIND SIFTER 21
5.1 Datasheet - Wind Sifter 21
6 ORGANIC EXTRACTION SYSTEM 23
6.1 Datasheet - Organic Extraction system 23
7 GRIT REMOVAL SYSTEM 25
7.1 Datasheet - Grit Removal system 25
8 BIO-METHANIZATION SYSTEM 26
8.1 Datasheet - Buffer Tanks 27
9 BUFFER TANK FEED PUMP 28
9.1 Datasheet - Buffer Tank Feed Pump 28
10 ANAEROBIC DIGESTER 30
10.1 Datasheet - Anaerobic Digester 30
11 DIGESTER FEED PUMPS 36
11.1 Datasheet - Digester Feed Pumps 36
12 BIO-GAS HOLDERS 40
12.1 Datasheet - Biogas Holder 40
13 BIO-GAS FLARING SYSTEM 45
13.1 Datasheet - Bio-Gas Flaring System 45
14 BIO-GAS PURIFICATION AND UPGRADATION SYSTEM 51
14.1 Datasheet - Bio-Gas Purification and Upgradation System 51
15 ODOUR CONTROL SYSTEM 60
15.1 Datasheet - CBG Odourising System 60
16 COMPRESSED BIO-GAS (CBG) SYSTEM 63
16.1 Datasheet - Compressed Biogas System 63

17 DIGESTATE DEWATERING SYSTEM 70
17.1 Datasheet - Solid Liquid Separator (SLS) 70
17.2 Datasheet - Digestate Transfer Pumps 77
17.3 Datasheet - Digestate Sump 78
17.4 Datasheet - Sludge Dewatering Equipment Feed Pumps 80
17.5 Datasheet - Sludge Dewatering Equipment 81
17.6 Datasheet - Centrate Storage Sump 83
17.7 Datasheet - Dewatering Equipment Feed Pumps 84
17.8 Datasheet - Dewatering Equipment 86

18 COMPOSTING FACILITY 88
18.1 Solar-Enhanced Green House Type Composting Facility 88
18.2 Datasheet - Green House 89
18.3 Datasheet - Solar Composting Machine 90
18.4 Compost Screening Plant 92
18.5 Datasheet - Composting and Bagging Unit 93

19 EFFLUENT TREATMENT PLANT (ETP) 101
19.1 Design Requirement 101

20 CONVEYORS 101
20.1 Datasheet - Belt Conveyor 101
20.2 Chain Conveyor 109

21 LAB EQUIPMENT 114
21.1 Datasheet - Lab Equipment 114

1 WEIGHBRIDGE

1.1 Data Sheet - Weighbridge

1.1.1 The below datasheet/table outlines the minimum requirements for the Weighbridge system. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Weighbridge system complete and efficient shall also fall under the bidder's scope of work.

1.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Weigh bridge System (Full set)		Pit less type of microprocessor-based Road Weigh Bridge	
B.	Quantity & Capacity	Nos.	Weighbridge - Quantity 1 No. (with a provision of space to install 1 no. in future by the Owner) Capacity - 50 Tonnes Platform Dimensions - 3m x 12m Type of trucks / trailers for weighment: All types (up to 35 MT)	
C.	Maintenance Tools & tackles kit	Set	1 set to be supplied in a separate steel toolbox.	
D.	Included accessories	-	• Mounting plate kits including bolts, earthing lugs, etc., • 1 No. of OEWS (24" LED monitor) with data logging and analytics software. • 1 No. of A4 colour laser printer, Anti-virus software, Adobe acrobat, MS office professional, Mouse and keyboard. • 1 No. of Operator / engineering control desk • 1 No. of Operator chair	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
			• 1 No. of Printer table • 1 Set of lightning arrester with earthing cables • 1 set. of Hooters • 1 set of sensor cables. (All the sensors shall be supplied with sufficient cable length) • 1 UPS system	
2.	**Codes & Standards**			
I.	**Mechanical**			
A.	Weigh Bridges - Specification	-	IS 1436	
B.	Standard units of weights and measure	-	Legal Metrology Act, 2009	
C.	Metrological regulation for load cells	-	OIML R 60	
D.	Weights of classes E1, E2, E3, F1, F2, M1, M2 and M3 - Part 1: Metrological and technical requirements	-	RS OIML R 111-1	
E.	Hot rolled Medium and High Tensile Structural steel	-	IS 2062	
II.	**Electrical**			
A.	Degrees of Protection provided by Enclosures	-	IEC 60529	
B.	Uninterruptible Power Systems (UPS)	-	IEC 62040	
C.	Extruded Solid Dielectric Insulated Power Cables for rated voltages from 1kV up to 30 kV.	-	IEC 60502	
D.	Thermal Insulation and Classification of Electrical Insulations	-	IEC 60085	
E.	Low Voltage Electrical Installations	-	IEC 60364	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
III.	**Control and Instrumentation**			
A.	Automatic null balancing electrical measuring instruments	-	ANSI C 39.4	
B.	Safety requirements for electrical and electronic measuring and controlling instrumentation	-	ANSI C 39.5	
C.	Compatibility of analogue signals for electronic industrial process instruments	-	ISA-S 50.1: ANSI MC 12.1	
D.	Dynamic response testing of process control instrumentation	-	ANSI MC 4.1: ISA-S26	
E.	Surge withstand capability (SWC) tests	-	ANSI C 37.90A, IEEE Std. 472. IEC – 60254.1	
F.	Printed circuit boards	-	IPC TM-650, IEC326 C	
G.	Edge socket connectors	-	IEC 130-11	
H.	Requirements and methods of testing of wire wrap terminations	-	DIN 41611 Part-2	
I.	Dimensions of attachment plugs & receptacles	-	ANSI C73-1973	
J.	Types of enclosures	-	NEMA Std. ICS-6-110.15 through 110.22 (Type 4 to 13) or equivalent IEC standard	
K.	Racks, panels, and associated equipment	-	EIA: RS-310-B (ANSI C83.9)	
L.	Protection Class for Enclosure, Cabinets, Control Panels and Desks	-	IEC 60529	
IV.	**Cables**			

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
A.	Colour coding of single or multi-pair cables	-	VDE 0815	
B.	Guide for design and installation of cable systems in power generating stations (insulation, jacket materials)	-	IEEE Std. 422	
C.	Requirements of vertical tray flame test	-	IEEE 383	
D.	Standard specification for tinned soft or annealed copper wire for electrical purpose	-	ASTM B-33 – 81	
E.	Oxygen index and temperature index test	-	ASTM D-2863	
F.	Smoke generation test	-	ASTMD-2843 and ASTME-662	
G.	Acid gas generation test	-	IEC-754-1	
H.	Standard for Control, Thermocouple Extension and Instrumentation cable	-	NEMAWC57, ICEA S-73-532	
V.	**Cable Trays, Conduits**			
A.	Guide for the design and installation of cable systems in power generating station (cable trays, support systems, conduits)	-	IEEE Std. 422, NEMA VE-1, NFPA-70-19	
B.	Guide for the design and installation of cable systems in power generating station (Cable trays, support systems, conduits) Test Standards	-	NEMA VE-1	
C.	Galvanising of Carbon steel cable trays	-	ASTM A-386-78	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
3.	**Design Requirement**			
A.	Type of Service (outdoor or indoor)	-	Outdoor	
B.	Weighing Capacity - Gross	MT	Capacity - 50 Tonnes Platform Dimensions - 3m x 12m	
C.	No. of trucks / trailers for weighment	-	Minimum 200 trucks / tractor trailers per day	
D.	Type of trucks / trailers for weighment	-	All types (up to 35 MT)	
E.	Maximum safe overload protection Without electrical damage	-	150% of rated capacity	
F.	Maximum load for mechanical damage	-	300% of rated capacity	
G.	Load cells type	-	Rocker pin (Compression type) / Shear beam type/ equivalent	
H.	Load cells protection	-	IP 68 and tested by a national test house and also have overload parameters	
I.	Number of Load cells per weigh bridge	Nos.	6 nos. (min) of Load cells or as per OEM's recommendation. Each with rating of maximum safe overload capacity. Suitable compensation must be built for temperature variation.	
J.	Minimum capacity of each load cell	-	2 X Capacity of weigh scale / number of load cells	
K.	Accuracy	%	Corresponding to OIML accuracy class C3	
L.	Repeatability		< ±0.010 % FSO	
M.	Minimum Graduation (Resolution)	kg	10	
N.	Load cell: Rated output	mV/V	1 to 3 mV/V or better	
O.	Combined Error	%	0.05% of rated output (maximum)	
P.	Hysteresis	%	0.05% of rated output (maximum)	
Q.	Slide Load Allowed	%	10% of rated load	
R.	Creep a) After 0.5 hours	%	0.03% of rated output (maximum)	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
	b) After 4 hours		0.05% of rated output (maximum)	
S.	Zero Balance	%	±1% of rated output	
T.	Max. Temp. Range	°C	-2 to 70	
U.	Compensated Range	°C	10 to 50 (min.)	
V.	Enclosure	-	IP 67/DIN 40050; completely waterproof; insensitive to vibration; lightning protected as per Indian Electricity Rules; welded stainless steel housing	
W.	System Interface	-	The Weigh Bridge Microprocessor based control system shall be interfaced with the Owner's control system. Consider Modbus RS485 output from weigh bridge control system Also consider Analog hardwired output from weigh bridge control system.	
X.	Relative Humidity	%	As per the site data	
Y.	Rated Voltage	V	As per the site data	
Z.	Operating Frequency	Hz	As per the site data	
AA.	Sound pressure level Lp (distance: <1m)	dB	≤ 85	
4.	**Constructional & Operational Features, Mountings & Fixtures**			
A.	Technology	-	Microcontroller based control system shall be capable of communicating remotely with backlit LCD display for local weight indication.	
B.	Platform MOC	-	Anti-skid steel	
C.	Visual display unit	-	Yes, based on SMT technology to be provided in weight indicator.	
D.	Totaliser	-	Yes, minimum 6-digit type to be provided in the weight indicator.	
E.	Weighing equipment	-	Desk top type and compact should be suitable for dusty, hot,	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
			humid conditions without an air conditioner.	
F.	Digital weight indicator	-	At least 20 mm high character display for backlit LCD display.	
G.	Display modes	-	Weight and 16 mm for messages with a) Indicate weight b) Indicate calibration – Calibration to be checked automatically every 5 minutes.	
H.	Display of keyboard entered values	-	*	
I.	Protection	-	From electromagnetic and radio interference	
J.	Auto calibration	-	Calibrations check facility to be provided	
K.	Digital filtering system	-	To ensure correct weighment when weighing oscillatory loads	
L.	Annunciators	-	To indicate over capacity	
M.	Front panel controls	-	For balance, lamp test, semi auto tare, cancel tare and key board enable	
N.	Automatic, manual tare and zero facility	-	To be provided in digital weight indicator Provision for interfacing with a PC	
O.	Weighment & printouts	-	Name of the contractor Date and Time Serial Number Product Code Customer Code Truck Registration Number First (Gross) Weight (i) Second (Tare) Weight (ii) Net (pay load) Weight (iii) LxBxH (m) Weigh slip after every weighment (i.e.) I & II weighments. Real time clock required to provide date	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
			and time to printer. Facility for totalising the different material received.	
P.	Weighbridge local Control Room.	-	Non-Air-conditioned	
Q.	Side post and post marking at entry and exit of weigh platform	-	Yes.	
R.	Operation, Monitoring and control of weigh bridge	-	Microprocessor based control system in weigh bridge control room consist of Processor, I/O modules, redundant communication modules, power supply modules, ethernet switches, relays, patch cords, communication cables, etc.	
S.	Test weight for calibration	-	Provided by bidder	
T.	Software	-	Supply and installation of Software for weighing, indicating and recording with perpetual license	
U.	Panel	-	1) A fully wired panel for housing all the electronics and located in the weigh bridge control room. 2) All the Standalone Panel shall be provided with Base frame and Anti vibration pad	
V.	Features for weigh electronic system (panel mounted)	-	Having the following minimum features but not limited to Analogue to digital converter enabling flicker free display Automatic Zero span calibration Auto balance Diagnostics load cell connectors Large LCD 10" graphical display Weight indicator Interface with PC	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
			Accepting digital input and providing digital output Providing Analog output	
W.	To avoid vibration and distortion	-	Weigh bridge shall be supplied with arrangement and arresters to restrict the platform motion in longitudinal and lateral directions.	
X.	Load cell	-	SS 304, IP 68 protection or higher, hermetically sealed through electro-plasma welding, Compression load cell, built in surge protection.	
Y.	Positioning of Vehicles	-	Supply of Sensing equipment (design & equipment details to be provided by bidder).	
Z.	UPS system	-	UPS with Battery & stabilizer for the complete control system and instrumentation with sufficient capacity.	
AA.	Battery Backup duration	-	1 hour at nominal load.	
BB.	Earthing	-	Yes Supply of earthing cables as required for the complete system is in Bidder scope up to Electrical and Electronic earth pit is in Bidder scope	
CC.	Earthing material	-	Galvanised steel / Aluminium cables	
DD.	Earth resistivity of the system	ohm	> 1	
EE.	Material of Construction for: Main Beam Cross Beam Transverse Beam Chequered Plate	-	Mid Steel as per IS 2062 Gr B or better	
FF.	Heavy duty guide rails with Crash barrier on	-	Yes. Surface mounted.	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
	both sides of weighbridge			
GG.	Guide rail - Coating	-	Epoxy yellow paint for visibility and corrosion resistance.	
HH.	Data backup	-	The system should maintain backup data in a specified path, either on a network or local system, to be used during failures or breakdowns. Backup data should also be provided on removable storage devices such as CDs and USB drives for manual backup operations. There should be provisions for recovering the software and database from these backups to ensure uninterrupted operation. The system must be capable of storing weigh records for a minimum period of 12 months, with the necessary hardware facilities built into the computer to support this requirement.	
5.	**Testing & Inspection**		In addition to full visual examination, System shall meet the listed following requirements.	
A.	Zero Load Test	-	Yes	
B.	Electronic Weighbridges Accuracy Test	-	Yes	
C.	Graduations of Notches Test	-	Yes	
D.	Balance Range Test	-	Yes	
E.	Span Test	-	Yes	
F.	Corner Test	-	Yes	
G.	Linearity and Hysteresis Test	-	Yes	
H.	Repeatability Test	-	Yes	

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
I.	Temperature Variation Test	-	Yes	
J.	Electrical Interference Test	-	Yes	
K.	Material Test Certificate	-	Yes	
L.	Shop Test Certificates	-	Yes	
M.	Performance Test Certificates	-	Yes	
6.	Performance Guarantees		Weigh bridge along with its control shall be guaranteed for the rated capacity and accuracy for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
A.	Weighing capacity	MT	*	
B.	Accuracy	kg	Corresponding to OIML accuracy class C3	
7.	**Surface Preparation and Painting**		Painting shall be suitable for protecting the equipment as per the site condition.	
A.	Service life	-	25 years (minimum)	
B.	Equipment/ structures which are exposed to atmosphere	-	C4 category as per ISO 12944-2.	
C.	Equipment/structures which are covered by sheeting /brickwork	-	C3 category as per ISO 12944-2.	
8.	**Drawings & Documents to be submitted during detailed engineering stage**			

Sl. No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
A.	GA drawing of weigh bridge with all the mountings & accessories	-	Yes	
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	
D.	Materials test Certificates	-	Yes	
E.	Test certificates / reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

1.1.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope. The Weigh bridge should be stamped and approved from Weights & Measures department of the state.

2 INFEED BUNKER

2.1 Datasheet - Infeed Bunker

2.1.1 The below datasheet/table outlines the minimum requirements for the Infeed Bunker (SSOF-MSW) system. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Infeed Bunker (SSOF-MSW) system complete and efficient shall also fall under the bidder's scope of work.

2.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Infeed Bunker Complete with the required accessories, supports etc.	
2.	Input Material	-	Input SSOF-MSW to the plant	
3.	Quantity of Input Material	TPD	200 (min.)	
4.	Bulk Density of Input Material	kg/m^3	250 – 500 for Process Design (Volume design) 500 – 1000 for Mechanical Design (Strength design)	
5.	Processing Time	Hr./day	16 (max.)	
6.	No. of Units to be provided	-	*	
7.	Throughput Rate of each Unit	TPD	*	
8.	Storage Time of each unit	Minutes	*	
9.	Volume of each Unit	m^3	*	
10.	Dimension of each Unit	-	*	
11.	Material of Construction:			
A	Support Legs, Base Frame	-	Stainless Steel AISI 304	
B	Body and Side Plates etc.	-	Stainless Steel AISI 304	
C	Screws	-	Stainless Steel AISI 304	
12.	Drawings & Documents to be submitted during detailed engineering stage			
A	GA drawing with all the mountings & accessories	-	Yes	

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
B	Technical Data Sheets	-	Yes	
C	Manufacturer's standard quality plan	-	Yes	
D	Materials test Certificates	-	Yes	
E	Test certificates / reports for various shop test conducted	-	Yes	
F	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

2.1.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

3 BAG OPENER + OVERSIZE REMOVER

3.1 Datasheet - Bag opener + Oversize Remover

3.1.1 The below datasheet/table outlines the minimum requirements for the Bag opener + Oversize Remover system. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Bag opener + Oversize Remover complete and efficient shall also fall under the bidder's scope of work.

3.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sr. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Bag Opener including Support Construction, Infeed Bunker, Chain Belt Conveyor, Oversize Remover, Interconnecting Conveyors, Staircase & Maintenance Platform, Electrical	

Sr. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
			cum Control Panel with Profibus/Profinet Interface and all other Accessories etc. complete.	
2.	Input Material	-	SSOF-MSW	
3.	Quantity of Input Material	TPD	200 (min.)	
4.	Bulk Density of Input Material	kg/m^3	250 – 500 for Process Design (Volume design) 500 – 1000 for Mechanical Design (Strength design)	
5.	Processing Time	hr/day	16 (max.)	
6.	No. of Units to be provided	Nos.	*	
7.	Type of each unit	-	Single Shaft, slow speed	
8.	Throughput Rate of each Unit	TPH	*	
9.	Material of Construction	-	*	
A	Infeed Hopper	-	Structural Steel S235 as per EN 10025	
B	Body and Side Plates etc.	-	Structural Steel S235 as per EN 10025	
C	Roller	-	Structural Steel S235 as per EN 10025	
D	Rotor Knives / Counter Knives	-	As per EN 10029 std.	
10.	Drawings & Documents to be submitted during detailed engineering stage			
A	GA drawing with all the mountings & accessories	-	Yes	
B	Technical Data Sheets	-	Yes	

Sr. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
C	Manufacturer's standard quality plan	-	Yes	
D	Materials test Certificates	-	Yes	
E	Test certificates / reports for various shop test conducted	-	Yes	
F	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

3.1.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

4 IRON SEPARATOR

4.1 Datasheet - Iron Separator

4.1.1 The below datasheet/table outlines the minimum requirements for the Iron Separator system. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Iron Separator system complete and efficient shall also fall under the bidder's scope of work.

4.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Iron Separator comprising Permanent Magnet, Conveyor,	

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
			Chute, Support Frame and all other Accessories etc. complete.	
2.	Input Material	-	Output of Bag Opener	
3.	Quantity of Input Material	TPD	200 (min.)	
4.	Bulk Density of Input Material	kg/m^3	250 – 500 for Process Design (Volume design) 500 – 1000 for Mechanical Design (Strength design)	
5.	Processing Time	hr/day	16 (max.)	
6.	No. of Units to be provided	No.	*	
7.	Type of each unit	-	Over-belt Permanent Magnet Type	
8.	Throughput Rate of each Unit	TPH	*	
9.	Orientation	-	*	
10.	Direction of Metal Extraction	-	*	
11.	Separation Efficiency	-	95% (min.) of incoming Feed	
12.	Material of Construction:	-		
A	Infeed Hopper	-	Structural Steel S235 as per EN 10025	
B	Body and Side Plates etc.	-	Structural Steel S235 as per EN 10025	
13.	Drawings & Documents to be submitted during detailed engineering stage			
A	GA drawing with all the mountings & accessories	-	Yes	
B	Technical Data Sheets	-	Yes	
C	Manufacturer's standard quality plan	-	Yes	
D	Materials test Certificates	-	Yes	

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
E	Test certificates / reports for various shop test conducted	-	Yes	
F	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

4.1.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

5 WIND SIFTER

5.1 Datasheet - Wind Sifter

5.1.1 The below datasheet/table outlines the minimum requirements for the Wind Sifter. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Wind Sifter complete and efficient shall also fall under the bidder's scope of work.

5.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Wind Sifter comprising Infeed Conveyor, 1st & 2nd Splitter Drums, Expansion Chamber, Light Fraction Discharge Conveyor, Air Nozzles, Recirculation Fans, Air Ducts, Air Diverter Valves, Dust Filter, Staircase & Maintenance Platform and all other Accessories etc. complete	
2.	Input Material	-	Overflow Fraction from Screen	
3.	Quantity of Input Material	TPD	120 (min.)	

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
4.	Bulk Density of Input Material	kg/m^3	*	
5.	Processing Time	hr/day	16 (max.)	
6.	No. of Units to be provided	No.	*	
7.	Type of each unit	-	Double Drum Separator	
8.	Throughput Rate of each Unit	TPH	*	
9.	Material of Construction:	-		
A	Support Legs, Base Frame	-	Structural Steel S235 as per EN 10025	
B	Body and Side Plates etc.	-	Structural Steel S235 as per EN 10025	
C	Splitter Drums	-	Structural Steel S235 as per EN 10025	
D	Expansion Chamber	-	Structural Steel S235 as per EN 10025	
10.	Drawings & Documents to be submitted during detailed engineering stage			
A	GA drawing with all the mountings & accessories	-	Yes	
B	Technical Data Sheets	-	Yes	
C	Manufacturer's standard quality plan	-	Yes	
D	Materials test Certificates	-	Yes	
E	Test certificates / reports for various shop test conducted	-	Yes	

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
F	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

5.1.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

6 ORGANIC EXTRACTION SYSTEM

6.1 Datasheet - Organic Extraction system

6.1.1 The below datasheet/table outlines the minimum requirements for the Organic Extraction system However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Organic Extraction system complete and efficient shall also fall under the bidder's scope of work.

6.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Organic Extraction System comprising Organic Extractor, Organic Slurry (Substrate) Transfer Pump, Iron Separator, Reject Wind Sifter, Screw Press, Interconnecting Belt & Screw Conveyors, Staircase & Maintenance Platform, Electrical cum Control Panel with Profibus/Profinet Interface and all other Accessories etc. complete	
2.	Input Material	-	SSOF-MSW	

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
3.	Quantity of Input Material	TPD	*	
4.	Bulk Density of Input Material	kg/m^3	250 – 500 for Process Design (Volume design) 500 – 1000 for Mechanical Design (Strength design)	
5.	Processing Time	hr/day	16 (max.)	
6.	No. of Units to be provided	No.	*	
7.	Throughput Rate of each unit	TPH	*	
8.	Material of Construction:			
A	Organic Extractor:			
•	Body/ Protection Material	-	Stainless Steel AISI 304	
•	Hammer Knives	-	Tempered Steel as per EN10025	
•	Screen Elements	-	Stainless Steel AISI 304	
B	Iron Separator:			
•	Support Legs, Base Frame	-	Structural Steel S235 as per EN 10025	
•	Body and Side Plates etc.	-	Structural Steel S235 as per EN 10025	
C	Wind Sifter:			
•	Body	-	Stainless Steel AISI 304	
•	Construction Parts	-	Stainless Steel AISI 304	
D	Screw Press:			
•	Body	-	Stainless Steel AISI 304	
•	Screw	-	Stainless Steel AISI 304	
•	Other Construction Parts /Guards	-	Stainless Steel AISI 304	
E	Screw Conveyors:			
•	Body	-	Stainless Steel AISI 304	
•	Screw	-	Stainless Steel AISI 304	
9.	Drawings & Documents to be submitted during detailed engineering stage			
A	GA drawing with all the mountings & accessories	-	Yes	

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
B	Technical Data Sheets	-	Yes	
C	Manufacturer's standard quality plan	-	Yes	
D	Materials test Certificates	-	Yes	
E	Test certificates / reports for various shop test conducted	-	Yes	
F	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

6.1.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

7 GRIT REMOVAL SYSTEM

7.1 Datasheet - Grit Removal system

7.1.1 The below datasheet/table outlines the minimum requirements for the Grit Removal system However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Grit Removal system complete and efficient shall also fall under the bidder's scope of work.

7.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Grit Removal System including Grit Extraction System, Grit Washing	
2.	Input Material	-	Organic Slurry from Organic Extraction System	

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
3.	Quantity of Input Material	m^3/day	*	
4.	Processing Time	hr/day	16 (max.)	
5.	No. of Units to be provided	-	*	
6.	Throughput Rate of each unit	-	*	
7.	Drawings & Documents to be submitted during detailed engineering stage			
A	GA drawing with all the mountings & accessories	-	Yes	
B	Technical Data Sheets	-	Yes	
C	Manufacturer's standard quality plan	-	Yes	
D	Materials test Certificates	-	Yes	
E	Test certificates / reports for various shop test conducted	-	Yes	
F	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

7.1.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

8 BIO-METHANIZATION SYSTEM

The de-gritted Organic Slurry from Grit Removal System shall be taken to the Bio-methanization System consisting of Buffer Tank followed by Anaerobic Digesters. The Bio-methanization consists of

Buffer Tank, Buffer Tank Feed Pumps, Digester, Digester Feed Pumps, Bio-Gas Holders and Bio-Gas Flaring System.

8.1 Datasheet - Buffer Tanks

8.1.1 The below datasheet/table outlines the minimum requirements for the Buffer Tanks. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Buffer Tanks complete and efficient shall also fall under the bidder's scope of work.

8.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	Input Material	-	De-gritted Organic Slurry (Substrate) from Grit Removal System	
2.	Quantity of Input Material	m^3/day	*	
3.	Dry Solids in Input Material	%	*	
4.	Hydraulic Retention Time	days	1 (minimum)	
5.	No. of Tanks	No.	1 (minimum)	
6.	Dimension (Length*Width) of each Tank	-	As per bidder's design	
7.	Liquid Depth of each tank	-	As per bidder's design	
8.	Free Board of each tank	m	0.50 (min.)	
9.	Volume of each Tank	-	As per bidder's design	
10.	Material of Construction:			
	Tank	-	RCC M30 with Polyurethane Coating of 1150 – 1300-micron DFT or Glass-Fused-to-Steel (Glass-Lined-Steel)	
	Staircase, Walkway/Platform	-	RCC M30 or Structural Steel	

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
11.	Drawings & Documents to be submitted during detailed engineering stage			
A	GA drawing with all the mountings & accessories	-	Yes	
B	Technical Data Sheets	-	Yes	
C	Manufacturer's standard quality plan	-	Yes	
D	Materials test Certificates	-	Yes	
E	Test certificates / reports for various shop test conducted	-	Yes	
F	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

8.1.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

9 BUFFER TANK FEED PUMP

9.1 Datasheet - Buffer Tank Feed Pump

9.1.1 The below datasheet/table outlines the minimum requirements for the Buffer Tank Feed Pump. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Buffer Tank Feed Pump complete and efficient shall also fall under the bidder's scope of work.

9.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Pump including Base Frame, Helical Gear Motor, Temperature Control Unit for the Stator and all other Accessories complete	
2.	Input Material	-	De-gritted Organic Slurry (Substrate) from Grit Removal System	
3.	Quantity of Input Material	m^3/day	*	
4.	Dry Solids in Input Material	%	*	
5.	Pumping Time	hours	16 (max.)	
6.	No. of Units	-	As per bidder's design including Store Standby) (min.)	
7.	Type	-	Positive displacement types of eccentric Screw Pump	
8.	Capacity of each Pump	-	*	
9.	Discharge Pressure of each Pump	-	*	
10.	Material of Construction:			
11.	Base Frame	-	Structural Steel as per IS 2062	
12.	Body	-	Cast Iron	
13.	Rotor, Shaft	- -	SS 316	
14.	Stator		NBR, self-aligned	
15.	Drawings & Documents to be submitted during detailed engineering stage			
A	GA drawing with all the mountings & accessories	-	Yes	

Sl. No.	Description	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
B	Technical Data Sheets	-	Yes	
C	Manufacturer's standard quality plan	-	Yes	
D	Materials test Certificates	-	Yes	
E	Test certificates / reports for various shop test conducted	-	Yes	
F	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

9.1.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

10 ANAEROBIC DIGESTER

10.1 Datasheet - Anaerobic Digester

10.1.1 The below datasheet/table outlines the minimum requirements for the Anaerobic Digester. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Anaerobic Digester complete and efficient shall also fall under the bidder's scope of work.

10.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply			
A.	AD system (full set including all major and minor components)	-	CSTR type - RCC / Steel construction	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
B.	Quantity	Nos.	≥2 (as per the design capacity)	
C.	Maintenance tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	
D.	Included accessories	-	• Multiple Side Wall mounted Agitators / Single Top Mounted Vertical agitator with Explosion proof motor-VFD driven and necessary supporting frame. • Digestor top mounted biogas holders / Standalone biogas holders • Blowers for biogas holder • Level transmitter. • Pressure transmitter. • Pressure vacuum relief valve. • Over pressure & under pressure device. • Temperature transmitter. • Tank heating coils & control arrangement. • Inspection glasses. • Necessary nozzle provisions. • Manholes. • Stairs and platforms.	
2.	**Design Requirement**			
A.	Type of service	-	Outdoor	
B.	Input Material		De-gritted Organic Slurry from Grit Removal System	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
C.	AD technology	-	CSTR	
D.	Feedstock supply	-	Similar Type Only	
E.	Tank shape	-	Cylindrical	
F.	Organic fed	-	Biomass slurry from buffer tanks	
G.	Temperature Range	-	Thermophilic / Mesophilic	
H.	pH monitored	-	Yes	
I.	Agitator System	-	Multiple Side Wall mounted Agitators / Single Top Mounted vertical agitator (and hydraulic gas mix system if required)	
J.	Effective Mixing Volume	m^3	*	
K.	Total Tank Volume	m^3	*	
L.	Hydraulic Residence Time	Days	Minimum 3 days excluding Bottom dead storage and Top Free Board – For Hydrolysis Tanks Minimum 27 days excluding Bottom dead storage and Top Free Board – For digestors (if separate Hydrolysis tanks are provided) Minimum 30 days excluding Bottom dead storage and Top Free Board – For digestors (if no separate Hydrolysis tanks are not provided)	
M.	Organic Loading Rate		*	
N.	Dry matter content	%	*	
O.	Density of Slurry	kg/m^3	*	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
P.	pH level of slurry		*	
Q.	Temperature	°C	*	
3.	**Mixer/Agitator Details**	-	Refer Agitator datasheet.	
4.	**Heating Coil**			
A.	Placement of the coil (Inside or outside)	-	Inside	
B.	Material (Pipe, Plate, Elbow, Fastener, Clamp etc.,)	-	≥ Stainless steel 1.4571	
C.	Dimension (OD x thk)	mm	*	
D.	Coil Length	m	* (As per the design)	
5.	**External elements**			
A.	Insulation and cladding (wall)	-	Yes	
B.	Nozzles & Flanges	-	Yes, Bidder to provide a list for main nozzles with size	
C.	Stairs with rails for roof inspection	-	Yes	
D.	Platform on roof for access to a different element (agitation system, valves, inspection windows, sensors)	-	Yes	
E.	Biogas holder on top (double membrane	-	Yes	
F.	Bull's eye A. Lighting for bull eye B. Lens camera for bull eye	-	Yes	
G.	Monitoring Island, Submerged level	-	Yes	
H.	Thermowell Analog Thermometer	-	Yes	
I.	Max Level watchdog	-	Yes	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
J.	Liquid Level sensor	-	Yes	
6.	**Material of Construction**			
A.	Tank		• RCC M30 + Internal PU Coating of 1150–1300-micron DFT in Bio-Gas Storage Area (For RCC Digestors / Hydrolysis tanks); • Glass-Fused-to-Steel (Glass-Lined-Steel) (For Steel Digestors / Hydrolysis tanks)	•
B.	Staircase, Walkway / Platform		RCC M30 or Structural Steel	
C.	• Mixer • Mixer Propeller • Mixer Guidepost • Mixer Mounting Bracket • Mixer Service Box		• Structural Steel S235 as per EN 10025 • Stainless Steel AISI 304 • Stainless Steel AISI 304 • Stainless Steel AISI 304	•
D.	Heating Coil in each tank		Stainless steel 1.4571	
E.	Manholes, Nozzles		Stainless Steel AISI 304	
7.	**Assembly Dimension**			
A.	Tank Diameter	m	*	
B.	Liquid Depth	m	*	
C.	Min. operating liquid depth	m	*	
D.	Free Board	m	*	
E.	Total Tank height	m	*	
F.	Gas storage height	m	*	
G.	Gas storage volume	m^3	*	
8.	**Testing & Inspection**			

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	
9.	**Performance Guarantees**	-	Digester along with its components shall be guaranteed for the rated capacity against the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
10.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
11.	**Drawings & Documents to be submitted during detailed engineering stage**			
A.	GA drawing of anaerobic digester, agitator with all the mountings & accessories	-	Yes	
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	
D.	Materials test Certificates	-	Yes	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
E.	Test certificates / reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

10.1.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

11 DIGESTER FEED PUMPS

11.1 Datasheet - Digester Feed Pumps

11.1.1 The below datasheet/table outlines the minimum requirements for the Digester Feed Pumps. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Digester Feed Pumps complete and efficient shall also fall under the bidder's scope of work.

11.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Pumps	-	Progressive Cavity Pump (Flooded Suction)	
B.	Quantity	Nos.	*As per the design and 1No. redundancy	
C.	Maintenance tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	
D.	Included accessories	-	Yes	
2.	**Design Requirement**			

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
A.	Type of Service (outdoor or indoor)	-	*	
B.	Location/Application	-	*Based on the design Slurry application 1. Feeding pumps for digester tank 2. Discharging pumps for digester tank 3. Recirculation pumps for digester tank 4. Feeding pumps for liquid digestate tank 5. Discharging pumps for liquid digestate tank 6. Feeding pumps for solid liquid separators	
C.	Solid size	mm	*	
D.	Solid content in slurry	%	*	
E.	Capacity (Flow rate)	m^3/h	*	
F.	Suction pressure	-	Flooded	
G.	Operating temperature	°C	*	
H.	Design Temperature	°C	60	
I.	Discharge pressure	bar	*	
J.	Viscosity	Cps	*	
K.	Density	Kg/m^3	*	
L.	Differential Pressure	bar	*	
M.	Net Positive Suction Head	mLC	*	
N.	Vol./Mech./Overall Efficiency	%	*	
O.	Sound Power Level (1.5 m height from the equipment)	dBA	<85	
P.	Direction of Rotation from DE	-	*	
3.	**Motor**			
A.	Type		Squirrel Cage Induction	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
B.	Make & Model		*	
C.	Efficiency Class		≥IE-2	
D.	Voltage and frequency	V & Hz	As per site condition	
E.	Motor Pole		*	
F.	Operating power	kW	*	
G.	Rated Power	kW	*	
H.	Rotation Speed	RPM	≤ 150 (to avoid excess wear caused by abrasive material such as sand, glass etc)	
I.	Gear transmission Ratio			
J.	Motor Enclosure		≥IP 55	
K.	Insulation Class		≥F - Temp. rise limited to Class B	
L.	Area Classification		*	
M.	Lubrication	-	*	
N.	VFD	-	* As per design	
4.	**Material of Construction**			
A.	Pump Housing	-	Cast Iron	
B.	Rotating Parts	-	≥SS304	
C.	Rotor	-	≥SS304	
D.	Stator	-	*	
E.	Shaft Seal	-	*	
F.	O " Rings	-	*	
G.	Lantern	-	Cast Iron	
H.	Base Plate	-	Mild Steel	
5.	**Pump Construction**			
A.	Suction Flange	-	*	
B.	Discharge Flange	-	*	
C.	Suction Orientation	-	*	
D.	Discharge Orientation	-	*	
E.	Joint Type	-	*	
F.	Specific Standards	-	*	
G.	Special Certifications	-	*	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
6.	**Assembly**			
A.	Construction	-	Block Construction	
B.	Coupling Type	-	Block with Plug-in Shaft	
C.	Coupling Guard	-	*	
7.	**Assembly Dimension**			
A.	Length	m	*	
B.	Width	m	*	
C.	Height	m	*	
D.	Weight	kg	*	
8.	**Accessories**			
A.	Dry Running Protection	-	Yes	
B.	Over Pressure Protector	-	Yes	
C.	Control Panel	-	Yes	
D.	Pressure Relief Valve	-	Yes	
9.	**Protection**			
A.	Earthing	-	Yes	
10.	**Testing & Inspection**			
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	
11.	**Performance Guarantees**	-	Pumping system along with its control shall be guaranteed for the rated capacity against the rated speed of motions and for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
			made good at the bidder's cost.	
12.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
13.	**Drawings & Documents to be submitted during detailed engineering stage**			
A.	Technical Data Sheets	-	Yes	
B.	Manufacturer's standard quality plan	-	Yes	
C.	Materials test Certificates	-	Yes	
D.	Test certificates / reports for various shop test conducted	-	Yes	
E.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

12 BIO-GAS HOLDERS

12.1 Datasheet - Biogas Holder

12.1.1 The below datasheet/table outlines the minimum requirements for the Biogas Holder. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Biogas Holder complete and efficient shall also fall under the bidder's scope of work.

12.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Raw Biogas Holder (Full set)	-	Double membrane (Air membrane & Gas membrane) – Tank Top mounted or Standalone as applicable	
B.	Location	-	Hydrolysis Tanks / Digester tanks and / or Stand-Alone Storage (As per bidder's selection and design)	
C.	Quantity	Nos.	*	
D.	Maintenance Tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	
E.	Included accessories	-	• Blowers with motor. • UPS system. • LT-Ultrasonic • Inspection window • Over pressure & Under pressure valve. • Air regulating valve. • Centre pillar with supporting accessories.	
2.	**Standards & Codes**			
A.	Glass fibre reinforced polyester resin with steel frame	-	IS 12986 (Part 1)	
B.	Testing method for rubber and plastics coated fabrics	-	IS 7016	
3.	**Design Requirement**			
A.	Type of Service (outdoor or indoor)	-	Outdoor	
B.	External Form	-	Semi-spherical	
C.	Storage Capacity	m^3	*	
D.	Working pressure	mBar	*	
E.	Duration of Storage	Hours	4	
F.	Support system	-	PP support mesh. Webbing with flanges.	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
G.	Surface resistance	Ohm	*	
H.	Bleeder resistance	Ohm	*	
I.	UV resistance	-	*	
J.	Flame Retardant	mm/min	*	
4.	**Air Membrane (outer layer)**			
A.	Fabric Type	-	• PVDF lacquer polyester fabric with PVC coating on both sides. • The fabric will have flame retardancy certification: DIN 4102 class B1. • All welds should be entirely carried out by HF (High Frequency) welding.	
B.	Fabric protectivity	-	• UV Resistant • Microbial Resistant • Abrasion Resistant • Flame Retardant	
C.	Tear Strength	N	*	
D.	Tensile Strength	N/5cm	*	
5.	**Gas Membrane (Inner layer)**			
A.	Fabric Type	-	• PVDF lacquer polyester fabric with PVC coating on both sides. • The fabric will have flame retardancy certification: DIN 4102 class B1. • All welds should be entirely carried out by HF welding.	
B.	Fabric protectivity	-	• Microbial Resistant • Abrasion Resistant • Flame Retardant • H_2S and NH_3 resistance	
C.	Permeability	$cm^3/m^2/day$	*	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
D.	H_2S and NH_3 resistance	ppm	*	
E.	Tear Strength	N	*	
F.	Tensile Strength	N/5cm	*	
6.	**Protection & Control**			
A.	Ultrasonic Level Transmitter	-	Yes	
B.	Inspection Window	-	Yes	
C.	Pressure Sensor	-	Yes	
7.	**Air delivery system (Air Blower)**			
A.	Air Blowers	-	For filling outer membrane with Flame proof motor.	
B.	Quantity	Nos.	2 (1W + 1S) for each balloon	
C.	Capacity	m^3/h	* (as per the design)	
D.	Pressure	mbar	*	
E.	Motor power	kW	*	
F.	Voltage & Frequency	V & Hz	*As per plant data	
G.	Protection	-	≥ IP55	
H.	Non-return valve	-	Yes	
I.	Flexible hose pipe to connect the air delivery system to the gasholder	-	Yes	
J.	UPS Supply with battery backup	-	Yes	
K.	Battery Backup duration	-	*As per the design	
L.	Mechanical PVRV	-	Yes	
8.	**Air Compressor**		Yes	
A.	Air compressor	-	Flame proof	
B.	Quantity	Nos.	2 (1W + 1S) for each balloon	
C.	UPS Supply with battery backup	-	Yes	
9.	**Material of Construction**			
A.	Anchoring system - Flanges	-	≥ Laser cut flanges of SS 304	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
B.	Anchoring system - Anchors	-	≥ SS 316	
C.	Protection & Control - Air Regulating Valve between air membrane and gas membrane	-	Body: Aluminium Flanges: ≥ SS 304	
D.	Gas Over & Under-Pressure Valve	-	SS 316	
10.	**Assembly Dimension**			
A.	Diameter	m	* (Corresponding to tank diameter)	
B.	Inner Membrane Height	m	*	
C.	Outer Membrane Height	m	*	
D.	Weight	kg	*	
11.	**Testing & Inspection**			
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	
12.	**Performance Guarantees**	-	Biogas holder along with its components shall be guaranteed for the rated capacity against the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
13.	**Drawings & Documents to be submitted during**			

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
	detailed engineering stage			
A.	GA drawing of raw biogas holder with all the mountings & accessories	-	Yes	
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	
D.	Materials test Certificates	-	Yes	
E.	Test certificates / reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

12.1.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

13 BIO-GAS FLARING SYSTEM

13.1 Datasheet - Bio-Gas Flaring System

13.1.1 The below datasheet/table outlines the minimum requirements for the Bio-Gas Flaring System. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Bio-Gas Flaring System complete and efficient shall also fall under the bidder's scope of work.

13.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Biogas flaring unit (Full set including automation)	-	Closed Biogas Flaring System (Elevated flaring). The minimum stack height shall be as per prevailing norms issued by State Pollution Control Board / Central Pollution Control Board with respect to Emissions Discharge from time to time.	
B.	Quantity	No.	1	
C.	Maintenance Tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	
D.	Included accessories	-	• Main Flare Burner. • Pilot Burner with Pilot Line. • Flame arrestors for main line & pilot line. • HT electrode to spark the gas. • Temperature Sensors. • Ignition System. • Gas Train with Accessories. • Interconnecting Piping. • Valves and Instrumentation. • PLC based automation system. • Hooter. • Ladder with cage. • Necessary accessories	
2.	**Design Requirement**			
A.	Type of Service (outdoor or indoor)	-	Outdoor	
B.	Type		Auto Ignition	
C.	Design Flow Rate	m^3/h	150% of the Design Bio-Gas Flow (min.)	
D.	Working Flow Rate	m^3/h	*	
E.	Design Pressure	mBar	*	
F.	Working Pressure	mBar	*	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
G.	Flare Stack Total Height	m	*	
H.	Combustion Temperature	°C	*	
I.	Control Panel		Weatherproof	
3.	**Flare Burner**			
A.	Make & Model	-	*	
B.	Type	-	Aspirated Type	
C.	Quantity	Nos.	*	
D.	Flow Rate	kg/h	*	
E.	Working Pressure	bar(g)	*	
F.	Line size	NB	*	
G.	Ignition	-	Pilot burner	
4.	**Pilot Burner & Accessories**			
A.	Make & Model	-	*	
B.	Type	-	Aspirator	
C.	Quantity	Nos.	*	
D.	Location	-	Integrated with Flare Burner	
E.	Flow Rate	kg/h	*	
F.	Working Pressure	bar(g)	*	
G.	Line size	NB	*	
H.	Ignition	-	Spark electrode	
I.	Flame sensing	-	Thermocouple.	
J.	Operation	-	Automatic.	
5.	**Flame Arrestor-Main line**			
A.	Make & Model	-	*	
B.	Type	-	Anti-flash back element	
C.	Flow Rate	kg/h	*	
D.	Working Pressure	bar(g)	*	
E.	Line size	NB	*	
F.	End connection	-	*	
G.	Quantity	Nos	*	
6.	**Flame Arrestor-Pilot line**			
A.	Make & Model	-	*	
B.	Type	-	Anti-flash back element	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
C.	Flow Rate	kg/h	*	
D.	Working Pressure	bar(g)	*	
E.	Line size	NB	*	
F.	End connection	-	*	
G.	Quantity	Nos	*	
7.	**Ignition System**			
A.	Make & Model	-	*	
B.	Ignition Electrode	-	Ceramic Electrode	
C.	HT Transformer	-	Yes	
D.	Primary voltage	V	*	
E.	Output voltage	V	*	
F.	Max. current	A	*	
G.	HV Transformer Box	-	Weatherproof Structure Mounted	
H.	Location	-	On Structure	
8.	**Control Valve Assembly (Gas Skid)**			
A.	Butterfly Valve	-	Yes	
B.	Electric Actuated Butterfly Valve (FLAME PROOF)	-	Yes	
C.	Pressure Guage	-	Yes	
D.	Pilot Burner Gas Line	-	Yes	
E.	Pilot Solenoid Valve (Flame proof)	-	Yes	
F.	Drain Valve	-	Yes	
G.	Pressure Switch (Flame proof)	-	Yes	
H.	Pressure Relief Valve	-	*	
9.	**Moisture Separator**			
A.	Make & Model	-	*	
B.	Type	-	Cylindrical-Impingement	
A.	Size	-	*	
B.	Pressure Side Connection	-	Flange End	
C.	Inlet connection size	DN	*	
D.	Drain connection size	DN	*	

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
10.	**Derrick Structure**			
A.	Make & Model	-		
B.	Derrick Structure Height	m	*	
C.	Access	-	Ladder with cage.	
11.	**Local Control Panel**			
A.	Make	-	*	
B.	Indication Lamps	-	For flare on/trip, main, pilot valve open/close, Ignition on and fail, power on, Biogas Pressure low alarm and hooter.	
C.	Push Button	-	Flare manual start/stop, Reset, Ignition on/off	
D.	Selectors Switch	-	Flare system Auto/manual selection	
E.	Temperature Indicator/ Controller	-	Temperature controller with set point	
F.	Thermocouple Cable	-	As per flare height	
G.	Panel Protection	-	Weatherproof	
12.	**Protection**			
A.	Earthing	-	Yes	
13.	**Material of Construction**			
A.	Flare Burner Assembly	-	≥SS 316	
B.	Pilot Burner	-	≥SS 316	
C.	Main Gas Line Pipe	-	≥SS 304	
D.	Control Valve Assembly (Gas Skid)	-	≥SS 304	
E.	Pilot Gas Line	-	≥SS 304	
F.	Flare tip with shroud	-	SS 304 / SS 316	
G.	Moisture separator	-	SS 304	
14.	**Flare Burner Material of Construction**			
A.	Flare Pipe	-	≥SS 304	
B.	Burner	-	≥SS 316	
C.	Wind shield	-	≥SS 316	
D.	Mounting Flange	-	≥SS 304	
15.	**Flame Arrester**			

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
A.	Casing	-	≥ SS304	
B.	Element	-	≥ SS316	
C.	Gaskets	-	Teflon	
D.	Flanges	-	≥ SS304	
E.	End Connection	-	Flanged End-ANSI B16.5, 150#	
F.	Nut & Bolts	-	≥SS 304	
16.	**Derrick Structure**		≥Mild Steel Epoxy Painted	
A.	Ladder with the cage	-	Mild Steel Epoxy Painted	
B.	Platform	-	Mild Steel Epoxy Painted	
C.	MOC	-	Mild Steel Epoxy Painted	
D.	Painting	-	Epoxy Painting to all MS parts	
17.	**Assembly Dimension**			
A.	Length	m	*	
B.	Width	m	*	
C.	Height	m	*	
D.	Weight	kg	*	
18.	**Testing & Inspection**			
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	
19.	**Performance Guarantees**	-	Flare system along with its control shall be guaranteed for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
20.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
21.	**Drawings & Documents to be submitted during detailed engineering stage**			

S.No.	Particulars	Unit	Data (Data marked thus * shall be as per the bidder design)	Vendor Data (Duly filled in by the Bidder)
A.	GA drawing of flaring system with all the mountings & accessories	-	Yes	
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	
D.	Materials test Certificates	-	Yes	
E.	Test certificates / reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

13.1.3 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

14 BIO-GAS PURIFICATION AND UPGRADATION SYSTEM

14.1 Datasheet - Bio-Gas Purification and Upgradation System

14.1.1 The below datasheet/table outlines the minimum requirements for the Bio-Gas Purification and Upgradation System. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Bio-Gas Purification and Upgradation System complete and efficient shall also fall under the bidder's scope of work.

14.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sr. No.	Description	Unit	Remark
1	Design Bio-Gas Flow	Nm^3/hr	130% of Raw Bio Gas Produced
2	Type of Bio-Gas Purification Technology	---	As per bidder's design
3	Scope of Supply:		

	• Bio-Gas Feed Blowers. • Biogas purification System for removal of Hydrogen Sulphide (H_2S) and Carbon Dioxide (CO_2) and moisture. • High-Pressure Compressors (Discharge Pressure: xx bar) if required • CBG injection system at the terminal point within plant boundary for feeding compressed Biogas into CGD network at desired pressure up to 45 bar (g) along with Odorizing system as per **BRS-9** for mixing in CBG. • Interconnecting Piping, Valves, Instruments and all other Accessories etc. complete.

All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Biogas purification and upgradation system	-	Full system including chemicals and accessories	
B.	Quantity	No.	1 Full set.	
C.	Maintenance Tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	
D.	Included Accessories	-	• Complete instrumentation package, • Pneumatically Actuated change over valves, • Pneumatic Air Compressor, • Emergency Stop Switches on Big Electric Motors, • Chiller (Water/Air Cooled), Cooling Tower with Water Pumps, • Control panel PLC base with RS 485 connectivity option to DCS, • Spare Module for PLC, Rotameter, • Intermediate Buffer Balloon	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
2.	**Codes & Standards**			
I.	**Mechanical**			
A.	Pressure Vessel Design	-	ASME Sec VIII Div. 1	
B.	Piping Design	-	ASME B31.3	
C.	Shell-and-Tube Heat Exchanger	-	TEMA (Tubular Exchanger Manufacturers Association)	
D.	Blowers and Compressors	-	API 617 or ISO 10439	
E.	Storage Tanks	-	API 650 or IS 803	
II.	**Electrical**			
A.	Degrees of Protection (Enclosures)	-	IEC 60529 (IP Ratings)	
B.	Explosion Protection	-	IEC 60079 (ATEX for Hazardous Areas)	
C.	Electrical Installations	-	IEC 60364	
D.	Motor Efficiency	-	IEC 60034 / IE3 or better	
E.	Low-Voltage Switchgear	-	IEC 61439	
F.	Lightning Protection	-	IEC 62305	
G.	Cables for Power and Instrumentation	-	IEC 60228 / IS 7098	
III.	**Instrumentation and Control**			
A.	Gas Composition Analysers	-	ISO 6974 / ISO 6975	
B.	Pressure and Temperature Sensors	-	IEC 60770	
C.	Safety Instrumented Systems	-	IEC 61511	
D.	SCADA and Automation	-	IEC 62264	
IV.	**Environmental and Safety**			
A.	Noise Emission Standards	-	ISO 3744 (< 85 dB at 1 m distance)	
B.	Environmental Compliance	-	ISO 14001	
C.	Hazardous Waste Management	-	IS 4576	
D.	Venting and Flaring	-	API 521	
3.	**Membrane Requirements for CO2 Removal- Design Requirement**			
A.	Membrane	-	Placed in container	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
B.	Membrane Modules	-	Hollow fibre or spiral-wound membranes	
C.	Material of Construction	-	Stainless Steel (AISI 304/316) for components in contact with gas	
D.	Membrane Modules (Three Stages) along with heat exchanger and filtration system	-	Yes	
E.	Assembly membrane container includes	-	Ventilator, Heater, Flow switch LEL detector	
F.	Material of Construction	-	Stainless Steel (AISI 304/316) for components in contact with gas	
G.	Methane purity	%	≥97	
H.	Methane Recovery	%	≥99	
I.	Material (Pipes, Valves)		AISI 304/316	
J.	Pressure control valve biomethane	-	≥ SS316	
K.	Biogas booster Compressor	Nos.	yes	
L.	Online Gas Monitoring System with Analyser for H_2S, CO_2, CH_4 & O_2	-	Yes	
M.	Pressure control valve biomethane	-	*	
N.	Pressure control valve off gas	-	*	
O.	Pressure safety valves	-	*	
P.	3-way valves and other valves	-	*	
Q.	Rotary Valve skid	-	*	
R.	Raw Biogas Flow Transmitter	Nos	1	
S.	Product Gas Flow Transmitter	Nos	1	
T.	Pressure transmitters	-	*	
U.	Temperature transmitters	-	*	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
V.	Online Dew Point meter	Nos	1	
W.	Control and Automation	-	PLC + software placed in membrane container, Separate room for control cabinet (ventilated), Installation and programming control system, Wiring, Touch screen for monitoring, Remote control and monitoring (via internet connection)	
X.	Pressure regulators calibration	-	*	
Y.	Calibration piping	-	*	
Z.	Calibration accessories	-	Yes	
AA.	H_2S Removal system	-	H_2S removal Vessels, H_2S removal media	
BB.	Raw Biogas Suction Pot	Nos	*	
CC.	Dehumidification Unit	-	Yes	
DD.	Roots Blower with VFD & FLP motor	-	Yes	
EE.	Vacuum Pumps with Starter & FLP motor	-	Yes	
FF.	Surge Vessel	Nos.	*	
GG.	Heat Exchanger with moisture separator	-	*	
HH.	Chilled water Dryer with moisture separator	-	Double-effect type	
II.	Cooling tower fan	Nos.	1	
JJ.	Cooling water circulation pump	-	*	
KK.	Chemicals recycle pumps	-	*	
LL.	Biogas Dryer with interconnected piping and valves	-	Twin Tower	
MM.	Tanks (HDPE)	-	Suitably sized tanks for Scrubber tank, Regenerator tank, Chemical mixing tank, water wash tank, Buffer tank	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
NN.	Fine Filters	Nos	*	
OO.	Particulate Filter	-	2x100% considered	
PP.	Connecting piping and wiring	-	*	
QQ.	**Inlet (Raw) Biogas Specification**			
	• Gas Flow Rate	m^3/h	*	
	• Gas Pressure	bar (g)	*	
	• Methane (CH4)	%	*	
	• Carbon Dioxide (CO2)	%	*	
	• Hydrogen Sulphide (H2S)	PPM	*	
	• Moisture (H2O)		Saturated	
	• Nitrogen (N2)	%	*	
	• Oxygen (O2)	%	*	
RR.	**Outlet (Purified) Biogas Specification**			
	• Gas Flow Rate	m^3/h	*	
	• Gas Pressure	bar (g)	*	
	• Methane (CH4)	%	≥97	
	• Carbon Dioxide (CO2)	%	*	
	• Hydrogen Sulphide (H2S)	PPM	*	
	• Moisture (H2O)	-	Dew point (–) 65 °C	
	• Nitrogen (N2)	%	*	
	• Oxygen (O2)	%	*	
SS.	Pressure control valve off gas	-	≥ SS316	
TT.	Pressure safety valves	-	≥ SS316	
UU.	3-way valves and other valves	-	≥ SS316	
VV.	Connecting piping and wiring (inside container)	-	≥ SS316	
WW.	Compressor Type	-	*	
XX.	Capacity of compressor	m^3/h	*	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
4.	**H2S Removal Unit**			
A.	Type	-	Chemical Scrubbers (with NaOH or proprietary chemicals)/ activated carbon/ Iron Oxide-Based Scrubbers/ Biological Scrubbers	
B.	Usage	-	Individually or in combination depending on the specific requirements	
C.	Design Code	-	Non-ASME	
D.	H_2S Loading Capacity	kg H_2S/kg	*	
E.	H_2S scrubbing system with regenerative system.	-	A complete set up to scrub the gas of H_2S. This includes a scrubber, regenerator, ejector, filtration unit for sulphur filtration, intermediate storage tanks, pumps, plumbing and electricals.	
F.	MOC	-	Fiber Reinforced Plastic (FRP)/ Polypropylene (PP)/ Stainless Steel 304	
G.	Tanks	-	HDPE, suitably sized tanks for Scrubber tank, Regenerator tank, Chemical mixing tank, water wash tank.	
H.	Interconnecting piping	-	HDPE & CPVC	
I.	Operating Temperature	°C	As per the site condition	
J.	Operating Pressure	bar	As per the site condition	
K.	Operating pH	-	*	
L.	Weight	kg	*	
A.	Gas distributors	-	≥ SS316	
B.	Pressure relief valves	-	≥ SS316	
C.	Sample Ports	-	≥ SS316	
M.	Reactor Type for biological scrubbers	-	Fixed film or packed bed	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
N.	Auxiliary Equipment for biological scrubbers	-	Nutrient dosing pumps, Blowers, Recirculating pumps, pH adjustment system	
O.	pH control systems	-	*	
P.	Weight	kg	*	
5.	**Moisture Removal Unit**			
A.	Type	-	Chiller-Based Units/Adsorption-Based Dryers/Compression-Expansion Systems	
B.	Usage	-	Individually or in combination depending on the specific requirements	
C.	Dew Point Reduction	°C	As per the site condition	
D.	Moisture removal efficiency	%	≥90	
E.	Media type (Adsorption)	-	Silica Gel, Molecular Sieves	
F.	Feed gas blower Type	-	*	
G.	MOC for blower	-	*	
H.	Blower Capacity	m^3/h	*	
I.	Ignition Protection Class	-	*	
J.	Motor Protection Class	-	IP 55	
K.	Back Drive Control	-	VFD	
L.	Operating Pressure	bar	*	
M.	Biogas cooler	-	Shell and tube heat exchanger	
N.	Biogas flow meter	-	*	
O.	Biogas dryer	-	*	
P.	Desiccant Type	-	Activated Alumina & Mol. Sieve	
Q.	MOC Internal	-	Stainless Steel	
R.	Moisture Shell	-	Carbon Steel	
S.	Auxiliary Equipment	-	Condensate Collection Trays, Mist Eliminators, Dew Point Sensor.	
T.	ATEX-certified	-	Yes	
6.	**General Requirements**			

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
A.	Control Systems		Centralized PLC/SCADA system for process automation and monitoring	
B.	Safety Equipment		• Explosion-proof designs for all components. • Safety relief valves and flame arrestors in case of gas leaks	
C.	Maintenance Tools		• Spare parts for all critical components. • Maintenance kits with tools and lubricants for regular servicing	
7.	**Assembly Dimension**			
A.	Platform Length	m	*	
B.	Platform Width	m	*	
C.	Overall Weight	Kg.	*	
D.	Control room size required (L x W x H)	m	*	
8.	**Testing & Inspection**			
A.	Material Test Certificate		Yes	
B.	Performance Test Certificates		Yes	
C.	Calibration Certificate		Yes	
D.	FAT/SAT		Yes	
9.	**Performance Guarantees**		Purification and Upgradation system along with its control shall be guaranteed for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance,	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
			the deficiency shall be made good at the bidder's cost.	
10.	**Surface Preparation and Painting**		Painting shall be suitable for protecting the equipment as per the site condition	
11.	**Drawings & Documents to be submitted during detailed engineering stage**			
A.	Technical Data Sheets		Yes	
B.	Manufacturer's standard quality plan		Yes	
C.	Materials test Certificates		Yes	
D.	Test certificates / reports for various shop test conducted		Yes	
E.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)		Yes	

All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

15 ODOUR CONTROL SYSTEM

15.1 Datasheet - CBG Odourising System

15.1.1 The below datasheet/table outlines the minimum requirements for the CBG Odourising System. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the CBG Odourising System complete and efficient shall also fall under the bidder's scope of work.

15.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Odouriser	-	Complete odorizing system	
B.	Quantity	Nos.	*	
C.	Maintenance tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	
D.	Included accessories	-	• Chemical injection pump - pneumatic pump • Level gauge and transmitter • Rotameter • Electronic unit controller • Pressure gauge • Pressure regulator • Flame arrester • Vero meter • Odorant filter • Odorant storage tank • Flame control panel • Scrubber	
2.	**Design Requirement**			
A.	Odorant injection rate	mg/smc	*	
B.	Operating pressure	bar	*	
C.	Pump displacement	cc/stroke	*	
D.	Odorant density	g/cc	*	
E.	Odorant storage tank capacity	L	250	
F.	Scrubber material	-	*	
G.	Tubing outer diameter	mm	*	
H.	Pump quantity	Nos.	*	
3.	**Materials of Construction for Valves and fittings**			
A.	Odorant injection connection material	-	SS 316	
B.	Reducing union	-	SS 316	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
C.	Ball valve (for biogas line)	-	SS 316	
D.	Female connector	-	SS 316	
E.	Male branch tee	-	SS 316	
F.	Equal tee	-	SS 316	
G.	Ball valve (for instrument air line)	-	SS 316	
H.	Flange	-	SS 316	
I.	Tubes and fittings	-	SS 316	
J.	Pump material	-	SS 316	
4.	**Assembly Dimension**			
	Length	m	*	
	Width	m	*	
	Height	m	*	
	Weight	kg	*	
5.	**Performance Guarantee**	-	Odorizing system along with its control shall be guaranteed for the rated capacity for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
6.	**Drawings to be submitted**			
A.	GA drawing of the odorizing system with all the mountings & accessories	-	Yes	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	
D.	Materials test Certificates	-	Yes	
E.	Test certificates / reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

16 COMPRESSED BIO-GAS (CBG) SYSTEM

16.1 Datasheet - Compressed Biogas System

16.1.1 The below datasheet/table outlines the minimum requirements for the Compressed Biogas System. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Compressed Biogas System complete and efficient shall also fall under the bidder's scope of work.

16.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Compressor system (Full set)	-	Positive displacement compressor mounted on skid	
B.	Quantity (with redundancy)	Nos.	*	
C.	Maintenance tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
D.	Included accessories	-	• Frame oil lubrication • Closed cooling water system incl. air/water cooled heat exchanger • Pulsation dampener on suction side • Pulsation dampener on discharge side • Suction strainer • Non-return valve • Bypass Valves • Safety valves • Instrumentation and control cabinet • Gas piping • Frequency converter • CO2 flooding system • Compressor enclosure	
2.	**Codes & Standards**			
A.	Compressor design, materials manufacture, inspection and testing	-	≥ISO 13631	
B.	Design of compressor pulsation dampener	-	≥API 618	
C.	Design of cooling system for lubricating oil	-	≥ISO 10438-3	
D.	Design of compressor foundation	-	≥BS CP 2012-1	
E.	RTD (temperature measuring)	-	≥EN 60751	
F.	Pressure and differential pressure instruments	-	≥EN 837	
G.	Plant piping	-	≥ASME B31.3	
H.	Pipe flanges and pipe fittings	-	≥ANSI B 16.5	
I.	Injection of CBG into CGD pipeline network	-	≥OISD-STD-226	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
J.	For compression, storing, handling and refuelling of CBG in cascades	-	≥OISD-STD-179	
K.	Cascading and storage	-	Gas cylinder rules, 2016 (PESO)	
3.	**Design Requirement**			
A.	Type of service (outdoor or indoor)	-	*	
B.	Type	-	Reciprocating	
C.	Make	-	*	
D.	Fluid Properties	-	CH_4: ≥ 97 % Other impurities: ≤ 3%	
E.	Flow Rate	Sm^3/hr	*	
F.	Service	-	Continuous (24 hrs/day)	
G.	Capacity flow variation	(%)	-/+ 5 (as per ISO1217)	
H.	Turndown ratio	%	*	
I.	Suction pressure	Bar(g)	*	
J.	Outlet pressure	Bar(g)	50	
K.	Suction/Discharge temperature	°C	*	
L.	Cooling type (water-cooled or air-cooled)	-	*	
M.	Drive	-	Direct-driven, VFD	
N.	No. of stages	Nos.	*	
O.	No. of cylinders	Nos.	*	
P.	Compressor motor rating	kW	*	
Q.	Blower rating	kW	*	
R.	Electrical motor	-	Flame proof induction motor	
S.	Noise level	dB	<85 (at 1m)	
T.	Speed	RPM	*	
U.	Oil for lubrication	-	*	
V.	Oil at the outlet	ppm	*	
W.	Lubrication type	-	Forced-feed (oil pump)	
X.	Auxiliary oil pump driver	-	Electric motor	
Y.	Suction gas strainer	-	≥SS (150 micron)	
Z.	Enclosures	-	*	
4.	**Piping**		Refer piping material specification	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
5.	**Material of Construction**			
A.	Crank shaft	-	Forget Alloy Steel	
B.	Piston	-	Alloy Steel	
C.	Blower Shaft	-	Forging EN 24	
D.	Rotor	-	FG 260	
6.	**Compressor Skid**			
A.	Compressor skid (metal frame)	-	* According to the weights of compressor and its auxiliaries and such that the skid is compatible with the foundation	
B.	Compressor skid foundation	-	Block foundation (concrete foundation)	
C.	Non-return valve	Nos.	* (at the final discharge)	
D.	Ball valve	Nos.	*	
E.	Blow off valve	Nos.	*	
F.	Isolating valve	Nos.	* (at inlet and outlet for maintenance & emergency, shall be both manual and automatic)	
G.	Pressure gauge quantity	Nos.	*	
H.	Over pressure limit	%	30	
I.	Temperature sensor quantity	Nos.	*	
J.	Lead type for RTD	-	3-wire RTD (simplex)	
K.	Material of RTD	-	Pt 100 (complying IEC 751 standard)	
L.	Mass flow meter quantity	Nos.	* (at inlet and outlet)	
M.	Gas detector	Nos.	*	
N.	Gas detector type	-	IR absorption with < 5 sec response time	
O.	Flame detector	Nos.	*	
P.	Flame detector type	-	UV/IR with spectral range over 185-260 nm.	
Q.	Spark arrester	Nos.	At the vent line	
7.	**Instrumentation**			
A.	Temperature sensor type	-	RTD	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
B.	Pressure and differential pressure	-	At compressor inlet and outlet	
C.	Mass Flow meter	-	Yes (Coriolis type)	
D.	Pressure and Temperature Indication on gauge panel	-	Yes (both suction and final discharge)	
E.	Pressure and Temperature transmitter at each stage	-	Yes (both suction and discharge)	
F.	Oil Pressure Indicator	-	Yes	
G.	Bull's eye type crankcase oil level indicator	-	Yes	
H.	Pressure gauge at gas recovery vessel	-	Yes	
I.	Vibration switch for compressor	-	Yes	
J.	Safety relief valve on each stage	-	Yes	
8.	**Controls**			
A.	Fault control of Low Lube oil pressure	-	Yes	
B.	Fault control of High discharge gas temperature at each stage	-	Yes	
C.	Fault control of High discharge gas pressure at outlet	-	Yes	
D.	Fault control of Low and High gas suction pressure	-	Yes	
E.	Fault control of High vibration	-	Yes	
9.	**Motor Details**			
A.	Motor Power	kW	*	
B.	Motor Type	-	Electrical	
C.	Motor Energy Efficiency class	-	≥ IE2	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
D.	Protection class	-	≥ IP 55	
E.	Rated Speed	RPM	*	
F.	Noise level (measured at 1m distance)	dB	< 85	
G.	Design Temperature	°C	*	
H.	Operating Temperature	°C	As per the site condition	
I.	Installation height	m	As per the site condition	
J.	Relative Humidity	%	As per the site condition	
K.	Operating Hour	-	* (based on the design)	
L.	Max. DMC (Deviation from Mean Current)	%	≤ 14	
M.	Insulation	-	Class F (Thermal Sensor PTC-set @150°C)	
N.	Explosion Protection	-	Yes (Ex d II B T 3 Motor)	
O.	ATEX certification	-	Yes	
P.	Soft start	-	Yes	
Q.	Line Filter	-	Yes	
R.	Direct Link Inductor	-	Yes	
S.	VFD control	-	* Yes (based on the design & application)	
T.	Operating Voltage & Frequency	V & Hz	As per the site condition	
10.	**Electrical Control Panel**			
A.	PLC based Panel with HMI	-	Yes	
B.	24V DC control circuit	-	Yes	
C.	Emergency stop button	-	Yes	
D.	Overload, fault Accept/Test/Reset push button	-	Yes	
E.	Indicating lamp	-	Yes	
F.	Alarm & Trip	-	Yes (for High discharge gas pressure, Low lubricating oil pressure, Low cooling water pressure/flow, Low gas suction pressure, High gas discharge temperature)	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
11.	**Testing & Inspection**			
A.	Mechanical Test run	-	Yes, before initial operation	
B.	Compressor capacity test	-	Yes	
C.	Compressor discharge pressure test	-	Yes	
D.	Compressor discharge temperature test	-	Yes	
E.	Compressor biogas quality	-	Yes	
F.	Power consumption	-	Yes	
G.	Noise	-	Yes	
H.	Vibration	-	Yes	
I.	Suction strainer, separator	-	Visual inspection	
J.	Pistons and crank gear	-	Visual inspection	
K.	Valves leakage rate test	-	Yes, according to ISO 5208 Ball valve: Rate A Other valves: Rate AA	
L.	Material test certificates	-	Yes	
M.	Shop test certificates	-	Yes	
N.	Performance test certificates	-	Yes	
12.	**Performance Guarantees**	-	Compressors along with its control shall be guaranteed for the rated capacity for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
13.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
14.	**Drawings to be submitted**			

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
A.	GA drawing of the compressor with all the mountings & accessories	-	Yes	
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	
D.	Materials test Certificates	-	Yes	
E.	Test certificates / reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

17 DIGESTATE DEWATERING SYSTEM

Digestate from Digesters shall be pumped to the Digestate Dewatering System where it shall be separated into Solid (Dewatered Sludge) and Liquid (Centrate/Filtrate) phases in two (2) stages. The Dewatered Sludge shall be then transported to the Composting Facility to produce Compost whereas the Centrate/Filtrate shall be pumped to the Effluent Treatment Plant (ETP) for further treatment.

17.1 Datasheet - Solid Liquid Separator (SLS)

17.1.1 The below datasheet/table outlines the minimum requirements for the Double Stage SLS system. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Double Stage SLS system complete and efficient shall also fall under the bidder's scope of work.

17.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	SLS System	-	Double Stage SLS for dewatering the sludge.	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
			(Screw Press machine followed by Decanter or Volute Press or Belt Filter Press)	
B.	Quantity	Nos.	* As per the Design	
C.	Maintenance Tools & tackles kit	set	1 set to be supplied in a separate steel toolbox.	
D.	Included accessories	-	1. Control panel. 1. Motors. 2. VFD driven motor suitable to respective application.	
Screw Press Requirement				
2.	**Design Requirement**			
A.	Type of Service (outdoor or indoor)	-	Indoor	
B.	Fluid type	-	Slurry/Digestate	
C.	Capacity	m^3/hr	*As per design.	
D.	Dry matter TS content	%	*As per design.	
E.	Presence of Corrosive/Toxic Components	-	*	
F.	Installation height	m	* (based on the design)	
G.	Solid-liquid separation efficiency	%	*	
H.	Noise level (measured at 1m distance)	dB	< 85	
I.	Design Temperature	°C	0 - 60	
J.	Operating Temperature	°C	As per the site condition	
K.	Relative Humidity	%	As per the site condition	
L.	Operating Hour	h	* (based on the design)	
M.	Explosion Protection	-	* (based on the design)	
N.	ATEX-certified	-	* (based on the design)	
O.	Operating Voltage & Frequency	V & Hz	As per site condition	
P.	Solenoid Valve	-	Yes	
3.	**Motor Details**			
A.	Screw press Gear Motor	kW	*	
B.	Flocculation Gear motor	kW	*	
C.	Motor energy efficiency class	-	≥ IE3	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
D.	Rated Speed	RPM	*	
E.	Protection class	-	≥ IP 55	
F.	VFD - Drive control	-	*	
G.	Motor - Insulation Class	-	≥ F Temp. rise limited to Class B	
4.	**Dewatering Zone - MOC**			
A.	Fixed plate	-	≥ SS316	
B.	Movable Rings	-	≥ SS316	
5.	**Thickening Zone - MOC**			
A.	Fixed plate	-	≥ SS316	
B.	Movable Rings	-	≥ SS316	
C.	Screw Shaft	-	≥ SS316	
6.	**Assembly Dimension**			
A.	Length	m	*	
B.	Width	m	*	
C.	Height	m	*	
D.	Weight without motor	kg	*	
E.	Weight with motor	kg	*	
7.	**Screen**			
A.	Cleaning system	-	Yes	
8.	**Automatic Showering System for cleaning**		Yes	
A.	No. of Nozzle	Nos.	*	
B.	Each nozzle capacity	LPM	*	
9.	**Flanges and Connections**			
E.	Inlet digestate flange	-	Yes	
F.	Outlet liquid digestate flange	-	Yes	
G.	Outlet solid cake opening	-	Yes	
H.	Rinsing water inlet flange	-	Yes	
Decanter Requirements				
10.	**Design Requirement**			
A.	Type of Service (outdoor or indoor)	-	Indoor	
B.	Fluid type	-	Slurry/Digestate	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
C.	Capacity	m^3/hr	*As per design.	
D.	Solid content in fluid	%	*As per design.	
E.	Max. density of compact wet cake	kg/m^3	*	
F.	Presence of Corrosive/Toxic Components	-	*	
G.	Installation height	m	* (based on the design)	
H.	Solid-liquid separation efficiency	%	*	
I.	Noise level (measured at 1m distance)	dB	< 85	
J.	Design Temperature	°C	0 - 60	
K.	Operating Temperature	°C	As per the site condition	
L.	Relative Humidity	%	As per the site condition	
M.	Operating Hour	-	* (based on the design)	
N.	Explosion Protection	-	*	
O.	ATEX-certified	-	*	
P.	Operating Voltage & Frequency	V & Hz	As per the site condition	
11.	**Decanter Inlet Design Parameter**			
A.	Flow	m^3/h	*	
B.	pH	-	*	
C.	TSS	%	*	
D.	DS	%	*	
E.	Temperature	°C	*	
12.	**Decanter Outlet Design Parameter**			
A.	Flow	m^3/h	*	
B.	pH	-	*	
C.	TSS	%	≤ 1	
D.	TS	%	*	
E.	DS	%	*	
F.	Temperature	°C		
13.	**Bowl**			
A.	Maximum main speed	RPM	*	
B.	Bowl length	m	*	
C.	Bowl diameter	m	*	
D.	Conical Beach angle	degree	*	
E.	Solids discharge type	-	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
F.	Solids transportation aids, cylindrical section	-	*	
G.	Solids transportation aids, taper section	-	*	
H.	Material - hubs	-	≥ AL 111 2377 (Duplex stainless steel)	
I.	Material - bowl shell	-	≥ AL 111 2349 (AISI 316)	
J.	Material - bolts	-	≥ A4-80 (AISI 316)	
K.	Material - seals	-	*	
L.	Liquid outlet, type	-	*	
M.	Liquid outlet, radius	-	*	
14.	**Conveyor**			
A.	Material - flights	-	≥ AL 111 2349 (AISI 316)	
B.	Material - hub	-	≥ AL 111 2327 (Lean duplex stainless steel)	
15.	**Wear Protection**			
A.	Bowl solids discharge	-	≥ Wear liner in tungsten carbide	
B.	Bowl feed zone liner	-	*	
C.	Conveyor flights	-	≥ Flame sprayed tungsten carbide	
D.	Conveyor feed zone	-	≥ Tungsten Carbide wear liners	
E.	Frame / casing	-	≥ Wear liner in upper casing	
16.	**Frame and Casing**			
A.	Material - casing / cover	-	≥ Stainless steel (AISI 316)	
B.	Inside surface of casing	-	Liners of stainless steel at discharge areas - painting in neutral compartment	
C.	Gaskets / seals - casing	-	*	
17.	**Motor**			
A.	Motor Energy Efficiency class	-	≥ IE3	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
B.	Protection class	-	≥ IP 55	
C.	Rated Speed	RPM	*	
D.	Main Drive power	kW	*	
E.	Main Drive Control	-	VFD	
F.	Back Drive power	kW	*	
G.	Back Drive Control	-	VFD	
H.	Back Drive Parts	-	*	
I.	Gear Box type	-	*	
J.	Gearbox, torque	Nm	*	
K.	Gearbox Ratio	-	*	
L.	Max. differential speed	RPM	*	
M.	Max. differential torque	Nm	*	
N.	G-force at operating speed	-	≥ 3500	
O.	Motor Design	-	Squirrel cage induction	
P.	Thrust Force	kN	*	
Q.	Soft start	-	Yes	
R.	Variable Frequency Converter	-	Yes	
S.	Direct Start	-	No	
18.	**Protection**			
A.	Earthing	-	Yes	
B.	Damper	-	Yes	
19.	**Assembly Dimension**			
A.	Length	m	*	
B.	Width	m	*	
C.	Height	m	*	
D.	Weight without motor	kg	*	
E.	Weight with motor	kg	*	
General Requirement				
20.	**Operation Data**			
A.	Feed	-	Digestate from Digesters	
B.	Digestate Density	t/m^3	Based on bidder's Mass Balance	
C.	Max. inlet particle size	mm	Based on bidder's process	
D.	TS content of digestate	%	Based on bidder's Mass Balance	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
E.	Quantity of Digestate to Dewatering	t/h	Based on bidder's Mass Balance	
21.	**Testing & Inspection**			
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	
22.	**Performance Guarantees**	-	SLS (solid liquid separation) along with its control shall be guaranteed for the rated capacity against the rated speed of motions and for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
23.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
24.	**Drawings & Documents to be submitted during detailed engineering stage**			
A.	GA drawing of solid liquid separation system with all the mountings & accessories	-	Yes	
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	
D.	Materials test Certificates	-	Yes	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
E.	Test certificates / reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

17.2 Datasheet - Digestate Transfer Pumps

17.2.1 Digestate from Digesters shall be pumped to the Digestate Sump by positive displacement type eccentric Screw Pumps suitable for handling digestate having solids. Each Pump shall be provided with Base Frame, Helical Gear Motor, Variable Frequency Drive, Temperature Control Unit for Stator and Pressure Indicator.

17.2.2 The below datasheet/table outlines the minimum requirements for the Digestate Transfer Pumps. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Digestate Transfer Pumps complete and efficient shall also fall under the bidder's scope of work.

17.2.3 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Pump including Base Frame, Helical Gear Motor, Temperature Control Unit for the Stator and all other Accessories etc. complete	
2.	Input Material	-	Digestate from Digesters	
3.	Quantity of Input Material	m^3/day	*	
4.	Total Solids in Input Material	-	*	
5.	pH of Input Material	-	*	
6.	Pumping Time	hr/day	12 (max.)	
7.	No. of Units to be provided	No.	As per bidder's design including 50% store standby (min.)	

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
8.	Capacity of each Unit to be provided	m^3/hr	As per bidder's design including 10% Factor of Safety	
9.	Type of each Unit	-	Positive displacement types of eccentric Screw Pump	
10.	Discharge Pressure of each Unit to be provided	kg/cm^2	As per bidder's design	
11.	Capacity of each unit	-	As per bidder's design	
12.	Material of Construction:	-		
A.	Base Frame	-	Structural Steel as per IS 2062	
B.	Body	-	-	
C.	Rotor, Shaft	-	SS 316	
D.	Stator	-	NBR, self-aligned	
E.	No. of Units to be provided	No.	As per bidder's design including 50% store standby (min.)	
F.	Capacity of each Unit to be provided	$m3/hr$	As per bidder's design including 10% Factor of Safety	

17.3 Datasheet - Digestate Sump

17.3.1 Digestate from Digesters shall be pumped to the Digestate Storage Sump. It shall be constructed in Reinforced Cement Concrete of grade M30 or higher. It shall be equipped with Air Blowers + Coarse Bubble Air Grid or Submersible Mixers for efficient mixing of its content, Nozzles and Instruments.

17.3.2 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope. The technical specifications are as follows

17.3.3 The below datasheet/table outlines the minimum requirements for the Digestate Sump. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Digestate Sump complete and efficient shall also fall under the bidder's scope of work.

17.3.4 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Tank with Mixing System, Nozzles, Staircase, Platform/Walkway with Handrails, Level Measuring Instrument and all other Accessories etc. complete	
2.	Input Material	-	Digestate from Digesters	
3.	Quantity of Input Material	m3/day	*	
4.	Total Solids in Input Material	-	*	
5.	pH of Input Material	-	*	
6.	Hydraulic Retention Time to be provided	day	1/2 (min.) excluding Free Board	
7.	No. of Tank to be provided	No.	1 (min.)	
8.	Volume of each Tank to be provided	m^3	*	
9.	Dimension of each Tank to be provided	-	*	
10.	Liquid Depth of each Tank to be provided	m	*	
11.	Free Board of each Tank to be provided	m	0.50 m (min.)	
12.	Total Depth of each Tank to be provided	m	Liquid Depth + Free Board	
13.	Mixing Rate	$m^3/hr/m^3$	1.50 m3/hr/m3 (min.)	
14.	Mixing System	-	Air Blowers + Coarse Bubble Air Grid or submersible Mixers	
15.	Material of Construction:			
	Tank	-	*	
	Air Blower: a. Type b. Base Frame c. Body + Lobes + Rotor d. Shaft	-	a. Twin/Tri Lobe, Roots, Positive Displacement b. Carbon Steel c. CI IS 210 Gr. FG 260 d. Carbon Steel C40 / EN e. 24/19	

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
	Mixer: a. Type b. Propeller c. Guidepost + Mounting d. Bracket	-	a. Submersible b. Structural Steel S235 as per EN 10025 c. Stainless Steel AISI 304	
	No. of Tank to be provided	No.	1 (min.)	
	Volume of each Tank to be provided	m3	As per bidder's design	
	Dimension of each Tank to be provided	-	As per bidder's design	

17.4 Datasheet - Sludge Dewatering Equipment Feed Pumps

17.4.1 Digestate from Digestate Sump shall be pumped to the Press Screw Separators by positive displacement type eccentric Screw Pumps suitable for handling digestate having 3-4% Total Solids. Each Pump shall be provided with a Base Frame, Helical Gear Motor, Variable Frequency Drive, Temperature Control Unit for Stator and Pressure Indicator. The technical specifications are as follows,

17.4.2 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

17.4.3 The below datasheet/table outlines the minimum requirements for the Sludge Dewatering Equipment Feed Pumps. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Sludge Dewatering Equipment Feed Pumps complete and efficient shall also fall under the bidder's scope of work.

17.4.4 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Pump including Base Frame, Helical Gear Motor, Temperature	

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
			Control Unit for the Stator and all other Accessories etc. complete	
2.	Input Material	-	Digestate from Digesters	
3.	Quantity of Input Material	m^3/day	*	
4.	Total Solids in Input Material	-	*	
5.	pH of Input Material	-	*	
6.	Pumping Time	hr/day	12 (max.)	
7.	No. of Units to be provided	No.	As per bidder's design including 50% standby (min.)	
8.	Capacity of each Unit to be provided	m^3/hr	As per bidder's design including 10% Factor of Safety	
9.	Type of each Unit	-	Positive displacement types of eccentric Screw Pump	
10.	Discharge Pressure of each Unit to be provided	kg/cm^2	As per bidder's design	
11.	Material of Construction:			
A.	Base Frame	-	Structural Steel as per IS 2062	
B.	Body	-	CI	
C.	Rotor, Shaft	-	SS 316	
D.	Stator	-	NBR, self-aligned	

17.5 Datasheet - Sludge Dewatering Equipment

17.5.1 Digestate from Digestate Sump shall be pumped to the Press Screw Separators which shall separate the Digestate into Solid (Dewatered Sludge) and Liquid (Centrate) phases. The Dewatered Sludge shall be then transported to the Composting Facility to produce Compost whereas the Centrate shall be taken to the Centrate Sump-1 and then pumped to the downstream Dewatering Equipment for further dewatering.

17.5.2 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

17.5.3 The below datasheet/table outlines the minimum requirements for the Sludge Dewatering Equipment Feed Pumps. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the

equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Sludge Dewatering Equipment Feed Pumps complete and efficient shall also fall under the bidder's scope of work.

17.5.4 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Belt Filter Press: Belt Filter Press including Flocculator, Dewatering Polyelectrolyte Dosing System, Online Dynamic Mixer, Filtrate Collection Tray, Filtrate Collection Tray, Stand-alone Electrical cum PLC Panel and all other Accessories complete	
2.	Input Material	-	Digestate from Digesters	
3.	Quantity of Input Material	m^3/day	*	
4.	Total Solids in Input Material	-	*	
5.	pH of Input Material	-	*	
6.	Processing Time	hr/day	12 (max.)	
7.	No. of Units to be provided	No.	As per bidder's design	
8.	Capacity of each Unit to be provided	m^3/hr	As per bidder's design including 10% Factor of Safety	
9.	Type	-	Multi-stage type Belt filter press	
10.	Material of Construction:			
A.	Belt filter Press Frame, Structure	-	Stainless Steel AISI 304L	
B.	Belt	-	Polyester (918 microns)	
C.	Belt Guide & Support	-	Stainless Steel AISI 304L	
D.	Filtrate collect Tank	-	Stainless Steel AISI 304L	
E.	Roller Shaft & Flanges	-	Carbon Steel E24+ Rilsan Coating	

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
F.	Hardware	-	SS 316	

17.6 Datasheet - Centrate Storage Sump

17.6.1 Centrate from Press Screw Separators shall be taken to the Centrate Sump. It shall be constructed in Reinforced Cement Concrete of grade M30 (min.). It shall be equipped with Air Blowers + Coarse Bubble Air Grid or Submersible Mixers for efficient mixing of its content, Nozzles and Instruments.

17.6.2 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

17.6.3 The below datasheet/table outlines the minimum requirements for the Centrate Storage Sump. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Centrate Storage Sump. complete and efficient shall also fall under the bidder's scope of work.

17.6.4 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Tank with Mixing System, Nozzles, Staircase, Platform/Walkway with Handrails, Level Measuring Instrument and all other Accessories etc. complete	
2.	Input Material	-	Centrate / Filtrate from Digestate Dewatering Equipment	
3.	Quantity of Input Material	m^3/day	As per bidder's design	
4.	Total Solids in Input Material	-	*	
5.	pH of Input Material	-	*	
6.	Hydraulic Retention		*	

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
	Time to be provided	day		
7.	No. of Tank to be provided	No.	1 (min.)	
8.	Volume of each Tank to be provided	m^3	As per bidder's design	
9.	Dimension of each Tank to be provided	-	As per bidder's design	
10.	Liquid Depth of each Tank to be provided	m	As per bidder's design	
11.	Free Board of each Tank to be provided	m	0.50 m (min.)	
12.	Total Depth of each Tank to be provided	m	Liquid Depth + Free Board	
13.	Mixing Rate	m^3/hr	1.50 $m^3/hr/m^3$ (min.)	
14.	Mixing System	-	Air Blowers + Coarse bubble air grid or submersible mixers	
15.	Material of Construction:			
A.	Tank	-	RCC M30	
B.	Air Blower: a. Type b. Base Frame c. Body + Lobes + Rotor d. Shaft	-	a. Twin/Tri Lobe, Roots, b. Positive Displacement c. Carbon Steel d. CI IS 210 Gr. FG 260 e. Carbon Steel C40 / EN 24/19	
C.	Mixer: a. Type b. Propeller c. Guidepost + Mounting Bracket	-	a. Submersible b. Structural Steel S235 as per EN 10025 c. Stainless Steel AISI d. 304	

17.7 Datasheet - Dewatering Equipment Feed Pumps

17.7.1 Dewatering Equipment Feed Pumps shall be positive displacement type eccentric Screw Pumps suitable for handling digestate having solids. Each Pump shall be provided with a Base Frame, Helical Gear Motor, Variable Frequency Drive, Temperature Control Unit for Stator and Pressure Indicator.

17.7.2 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in the bidder's scope.

17.7.3 The below datasheet/table outlines the minimum requirements for the Dewatering Equipment Feed Pumps. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Dewatering Equipment Feed Pumps. complete and efficient shall also fall under the bidder's scope of work.

17.7.4 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply	-	Pump including Base Frame, Helical Gear Motor, Temperature Control Unit for the Stator and all other Accessories etc. complete.	
2.	Input Material	-	Centrate from Press Screw Separators	
3.	Quantity of Input Material	m^3/day	*	
4.	Total Solids in Input Material	-	*	
5.	pH of Input Material	-	*	
6.	Pumping Time	hr/day	12 (max.)	
7.	No. of Units to be provided	No.	As per bidder's design	
8.	Capacity of each Unit to be provided	m^3/hr	As per bidder's design including 10% Factor of Safety	
9.	Type of each Unit	-	Positive displacement types of eccentric Screw Pump	
10.	Discharge Pressure of each Unit to be provided	kg/cm^2	As per bidder's design	
11.	Material of Construction	m^3/hr		
A.	Base Frame	-	Structural Steel as per IS 2062	

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
B.	Body	-	CI	
C.	Rotor, Shaft	-	SS 316	
D.	Stator	-	NBR, self-aligned	

17.8 Datasheet - Dewatering Equipment

17.8.1 Dewatering Equipment shall be either of the following types:

a. Solid Bowl type Decanter Centrifuge
b. Multi-stage type Belt Filter Press

17.8.2 The Dewatered Sludge shall be transported to the Composting Facility to produce Compost whereas the Centrate / Filtrate shall be pumped to the Effluent Treatment Plant (ETP) for further treatment.

17.8.3 The below datasheet/table outlines the minimum requirements for the Dewatering Equipment Feed Pumps. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Dewatering Equipment Feed Pumps. complete and efficient shall also fall under the bidder's scope of work.

17.8.4 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply		• Decanter Centrifuge including Flocculator, Dewatering Polyelectrolyte Dosing System, Online Dynamic Mixer, Main Drive, Back Drive, Stand-alone Electrical cum PLC Panel and all other Accessories etc. complete. • Belt Filter Press including Flocculator, Dewatering Polyelectrolyte Dosing System, Online Dynamic Mixer, Filtrate Collection Tray, Wash Water	

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
			Pump, Air Compressor, Stand-alone Electrical cum PLC Panel and all other Accessories complete.	
2.	Input Material	-	Ammonia Stripped Effluent from Dewatering Equipment Feed Sump	
3.	Quantity of Input Material	m^3/day	*	
4.	Total Solids in Input Material	-	*	
5.	pH of Input Material	-	*	
6.	Processing Time	hr/day	12 (max.)	
7.	No. of Units to be provided	No.	As per bidder's design	
8.	Capacity of each Unit to be provided	m^3/hr	As per bidder's design including 10% Factor of safety	
9.	Type of each Unit	-	Solid Bowl type Decanter Centrifuge or Multi-stage Belt Filter Press	
10.	Discharge Pressure of each Unit to be provided	kg/cm2	As per bidder's design	
11.	Material of Construction:			
	Decanter Centrifuge a. Frame b. Cover c. Bowl d. Screw	-	a. Carbon Steel b. Stainless Steel AISI 316 c. Lean Duplex Stainless Steel d. Stainless Steel AISI 316 with Tungsten Carbide Wear Liners and Tungsten Carbide Coating on Leading Flights near Small End	
	Belt Filter Press a. Frame + Structure b. Belt	-	a. Stainless Steel AISI 304L Polyester (900 microns min.) b. Stainless Steel AISI 304L c. Stainless Steel AISI 304L d. Carbon Steel E24	

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
	c. Belt Guide Support d. Filtrate Collect Tank e. Roller Shaft & Flanges			

18 COMPOSTING FACILITY

The solid digestate from solid-liquid separators shall be transported to the composting plant facility. At the composting plant, it shall undergo aerobic decomposition. After composting, the Compost shall be screened using a Drum Screen and stored in the Compost Storage Shed for further sale by OIL.

18.1 Solar-Enhanced Green House Type Composting Facility

18.1.1 The composting facility shall be of Solar Green House type compromising closed polycarbonate sheds which allow the solar radiation into the sheds, suitable ventilation system, spreader cum turner machines etc. Bidder shall indicate the required Polycarbonate sheds and the number of spreaders cum turner machines etc., which shall be subject to the approval of the Owner. All the associated civil, mechanical, electrical and C&I works shall be in the scope to the bidder.

18.1.2 Compost produced in Composting Facility shall be pass through Compost Screening, and then stored in the Compost Storage Shed for further sale to the Fertilizer Plants.

18.1.3 The produced FOM must comply with the latest FCO standards (Except for Electrical Conductivity and Heavy Metals Content which are not applicable for MSW based FOM).

18.1.4 The leachate generated in the area shall follow the natural flow of the plot and be collected in a designated pit as per the plot plan. This leachate shall then be recirculated to the hydrolysis tank for biogas production.

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Input Material	- - -	Dewatered Sludge from Digestate Dewatering System	
2.	Quantity of Input Material	TPD	*	
3.	Dry Solids in Input Material	- - -	*	
4.	Quantity of Dry Solids	TPD	*	
5.	Average Outlet Dryness required	- - -	70% dry solids minimum	

18.1.5 Solar Composting Facility shall be provided to achieve minimum 70% dry solids consistency. It shall be a state-of-the-art, essentially a covered Facility and shall operate in all seasons including monsoon. It shall consist of the following:

18.2 Datasheet - Green House

Sl. No.	Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Minimum Height of Side Wall	m	*	
2.	Minimum Height of Roof Ridge	m	*	
3.	Flooring of Green House	-- -	RCC M30	
4.	Covered area of the facility L x B	Sq. m.	As per bidder's design	

Sl. No.	Description	Unit	**Data (Data marked thus * to be filled by the Bidder)**	**Vendor Data (Duly filled in by the Bidder)**
5.	Roof Ventilation Flap		Shall be provided for opening the Roof on one side over the entire Length. It shall be driven by motor and 2 limit switches. It shall be of 1.50 m width	
6.	Axial Fans	---	Shall be mounted inside the Green House at 60 Degree angle downwards. Each fan shall have a Free Blowing Capacity of 8,000 m^3/hr	
7.	Additional Requirements	---	Should be designed to withstand the wind conditions prevalent at the Site	
8.	Material of Construction:			
	Structural Steel Work	---	Hot Dipped Galvanized Steel Sections	
	Roof + Gable Wall + Side Walls	---	1.50 mm thick (min.) UV Coated Corrugated Polycarbonate Sheets	

18.3 Datasheet - Solar Composting Machine

18.3.1 Solar Composting Machine shall have the ability to till and convey in both (forward and backward) directions with the same speed and efficiency. It shall have the ability to till and convey dewatered sludge with a height up to 40 cm and to stack up and convey dried sludge up to 80 cm. It shall have interchangeable sludge tilling tools bolted on the frame and shall use combs and knives for palletisation of sludge.

18.3.2 The Machine shall till and convey dewatered sludge over the entire width of the drying hall in one operation (while it moves forward or backward once). The tilling and conveying tool of the Machine shall not be in contact with the floor of the Green House.

18.3.3 The Machine shall have a self-driven unit with cylindrical mounted shovels able to turn in both directions and be adjusted down to 10 mm above the ground. The movement of the Machine shall be chainless. The Machine shall move at a maximum speed of 2.0 m/min while turning dewatered sludge and at a maximum speed of 8.0 m/min when running freely.

18.3.4 The Machine shall have standardized motors with integrated gear boxes, steel construction with anti-corrosion painting with colour finishing, total thickness of painting shall be 100µm. Safety line on each side shall be provided. The machine shall be equipped with acoustic and digital start up signals.

18.3.5 There shall be a control switchboard mounted on the Machine itself. It shall have a minimum of IP 54 Protection, shall be well ventilated and shall be able to operate up to a maximum ambient temperature of 50 °C. It shall be equipped with PLC, Frequency Converters for the continuous control of the turning motors with MPI-Bus communication to the stationary control switchboard described below:

- The bus connection should contain an overload protection. Apart from above, the Machine shall include one (1) stationary switchboard per machine mounted in the front end of the Green House. The control switchboard shall be equipped with PLC, graphical touch panel, emergency stop equipment, overload protected internal MPI-bus connection to the machine mounted switchboard and to the other turning machines.
- The complete control system shall be fully tested and ready to be connected for use. The control shall be programmed with fixed functions for several scenarios to handle different sludge conditions with manual operating functions for the motor drives, automatic functions as solar radiation dependent sludge turning, time-controlled start of machine function for separate weekdays and control of ventilation dependent on conditions of air.
- All functions shall be operated from an easy-to-use HMI on the touch panels integrated in the doors of the stationary control panels.

18.3.6 Each Machine shall have one (1) combined Sensor for Temperature and Humidity, including 4-20 mA signal amplifier, one (1) Pyranometer and one (1) Climate Sensor for Temperature, Humidity, Wind and Rain.

18.3.7 The Machine shall include an energy supply system designed to glide freely over the entire length of the Green House. The energy supply system shall include all necessary accessories such as trolleys, track supports and sliding C-rails.

18.3.8 As a minimum, the Solar Composting Machine shall confirm to following minimum standards:

Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
Diameter of Turning Drum	mm	*	
Total Width	mm	*	
Total Length	mm	*	

Description	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
Free Height required above Machine	mm	*	
Free Distance required between the Walls	mm	*	
Rotating Speed	RPM	30-60 (Variable)	
Maximum Travelling Speed	m/min	8.0	
Maximum Working Speed	m/min	2.0	
Drum's Lifting Range	mm	*	
Drum Driver	No.	2	
Travelling Drive	No.	2	
Lifting Drive	No.	1	
Material of Construction:			
Framework + Turning Drum + Combs and Knives + Side Walls	---	Mild Steel	
Coating:			
Framework and Turning Drum	---	Zink Dust Primer, Paint Coat	
Combs and Knives	---	Hot Dip Galvanized	

18.4 Compost Screening Plant

18.4.1 Compost produced in Solar-Enhanced Composting Facility shall be pass through Compost Screening Plant to remove Glass, Inert, Plastic etc. and then stored in the Compost Storage Shed for further sale by OIL.

Sl. No.	Description	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	Scope of Supply		Screen including Support Frame, Feeding Hopper and all other Accessories etc. complete	
2.	Input Material	---	Compost produced in Solar-Enhanced Composting Facility	

Sl. No.	Description	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
3.	Quantity of Input Material	TPD	*	
4.	Bulk Density of Input Material	kg/m^3	*	
5.	Processing Time	hr/day	12 (max.)	
6.	No. of Units to be provided	No.	*	
7.	Capacity of each Unit to be provided	TPH	As per bidder's design including 25% Factor of Safety	
8.	Type of each Unit	---	As per bidder's design	
9.	Throughput rate of each Unit	:	As per bidder's design	
10.	Material of Construction:			
	Support Legs + Base Frame	---	Structural Steel S235 as per EN 10025	
	Body and Side Plates etc.	---	Structural Steel S235 as per EN 10025	
	Screen Deck	---	Structural Steel S235 as per EN 10025	

18.4.2 All other mechanical, electrical and instrumentation accessories, whether specified or not, but required for completion of the entire system shall be in bidder's scope.

18.5 Datasheet - Composting and Bagging Unit

18.5.1 The below datasheet/table outlines the minimum requirements for the entire Composting and Bagging Unit. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Composting and Bagging system to complete and efficient shall also fall under the bidder's scope of work.

18.5.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Composting and Bagging Unit System (full set)	-	Full system from composting, windrowing, co-composting to bagging unit.	
B.	Quantity	Nos.	*As per the Design	
C.	Maintenance tools & tackles kit	set	1set to be supplied in a separate steel toolbox.	
D.	Included accessories	-	1. Truck Loader 2. Windrow Turner 3. Conveyors 4. Feed Hopper 5. Trommel Screen 6. Lump Breaker 7. Rejection discharge 8. Directional Chute 9. Discharge hopper 10. Load cell 11. Sewing Belt Conveyor 12. Centralize Control Panel	
Manure Conveying & Bagging				
2.	**General specification**			
A.	Type	-	*	
B.	Application	-	*	
C.	MOC of contact parts	-	MS Painted	
D.	MOC of non-contact parts	-	MS Painted	
E.	Operation type	-	Continuous	
F.	Operating Temperature	-	Ambient	
G.	Full system design operating hours	hr	16h/day	
H.	Capacity of filling of 50kg bags in 1 hr	-	*	
I.	Bulk Density	kg/m^3	*	
J.	Moisture Content in final compost	%	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
3.	**Feeding Hopper**			
A.	Capacity	Litre	*	
B.	Size (Inlet)	mm x mm	*	
C.	Outlet	mm x mm	*	
D.	Thickness	mm	*	
E.	Height	mm	*	
F.	MOC	-	MS	
4.	**Trommel Screen**			
A.	Type	-	Horizontal	
B.	Capacity	TPH	*	
C.	Diameter	mm	*	
D.	Length	mm	*	
E.	Mesh hole size	mm	*	
F.	Mesh wire thick	mm	*	
G.	Mesh type	-	Wire mesh	
H.	Ribbon & baffles assembly	-	Inside mesh for material movement	
I.	Drive type	-	Direct drive	
J.	Gear box type	-	*	
K.	Gearbox Output RPM	-	*	
L.	Gear box make	-	*	
M.	Motor (Non-FLP)	-	*	
N.	Motor make	-	*	
O.	Motor starter	-	VFD	
P.	Brush	-	*	
Q.	Wheel	-	*	
R.	Universal Coupling	-	*	
5.	**Belt Conveyor - 1 (From Feeding Hopper to Trommel)**			
A.	Working Length	m	*	
B.	Transfer Capacity	TPH	*	
C.	Belt Width	mm	*	
D.	Belt Thick	mm	*	
E.	Belt details	-	M24 Grade, Black Rubber Belt	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
F.	Convey MOC	mm	MS	
G.	Drive & Non drive pulley	mm	*	
H.	Gear box type	-	*	
I.	Gearbox RPM	-	*	
J.	Motor	-	*	
K.	Motor Make	-	*	
L.	Motor Starter	-	VFD	
6.	**Belt Conveyor - 2 (From Trommel Bottom to Agitator)**			
A.	Working Length	m	*	
B.	Transfer Capacity	TPH	*	
C.	Belt Width	mm	*	
D.	Belt Thick	mm	*	
E.	Belt details	-	M24 Grade, Black Rubber Belt	
F.	Convey MOC	-	*	
G.	Drive & Non drive pulley	-	*	
H.	Gear box type	-	*	
I.	Gearbox RPM	-	*	
J.	Motor	-	*	
K.	Motor Make	-	*	
L.	Motor Starter	-	VFD	
7.	**Belt Conveyor - 3 (Transfer Over Size Material into Storage Bay)**			
A.	Working Length	m	*	
B.	Transfer Capacity	TPH	*	
C.	Belt Width	mm	*	
D.	Belt Thick	mm	*	
E.	Belt details	-	M24 Grade, Black Rubber Belt	
F.	Convey MOC		MS	
G.	Drive & Non drive pulley	mm	*	
H.	Gear box type	-	*	
I.	Gearbox RPM	-	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
J.	Motor	-	*	
K.	Motor Make	-	*	
L.	Motor Starter	-	DOL	
8.	**Belt Conveyor - 4 (For Stitching Machine)**			
A.	Working Length	m	*	
B.	Transfer Capacity	TPH	*	
C.	Belt Width	mm	*	
D.	Belt Thick	mm	*	
E.	Belt details	-	M24 Grade, Black Rubber Belt	
F.	Convey MOC	-	MS	
G.	Drive & Non drive pulley	mm	*	
H.	Gear box type	-	*	
I.	Gearbox RPM	-	*	
J.	Motor	-	*	
K.	Motor Make	-	*	
L.	Motor Starter	-	VFD	
9.	**Bag Filling Machine**			
A.	Bag filling capacity	TPH	*	
B.	Bag size	kg	*	
C.	No. of bag per hour	Bags	*	
D.	Filling hopper	Litre	*	
E.	Agitator Location	-	Inside filling hopper	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
F.	Agitator Motor	-	*	
G.	Agitator gearbox	-	*	
H.	Agitator gearbox make	-	*	
I.	Bag clamping arrangement	-	*	
J.	Clamping Cylinder	-	*	
K.	Solenoid Valve	-	*	
L.	Loadcell	-	*	
M.	Weight Controller	-	General measure	
N.	Control Valve (for bag filling)	-	*	
O.	Control valve motor & gear box	-	*	
P.	Gearbox RPM	-	*	
Q.	Gear box make	-	*	
R.	Motor make	-	*	
S.	Control valve (Belt Conveyor) starter	-	VFD	
T.	Foot switch	-	For clamping & Stitching machine	
10.	**Stitching Machine**			
A.	Stitching Machine (Manual)	-	Double thread, Mechanical Thread cut	
B.	Speed	bags/ min		
C.	Spring balancer	-	Yes	
11.	**Crusher**			
A.	Capacity	TPH	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
B.	Feeding Hopper Capacity	Litre	*	
C.	Motor	-	*	
12.	**MCC Cum Control Panel**			
A.	Control panel size	-	*	
B.	Control Panel MOC	-	MS Painted	
C.	VFD Make	-	*	
D.	PLC Make & Model	-	*	
E.	HMI Make	-	*	
F.	DOL Make	-	*	
G.	Push Button/ Indictor	-	*	
H.	Cable (Panel Wiring)	-	*	
I.	Field Cable	-	*	
13.	**Manure Screening MOC**			
	Feed Hopper	-	IS2062	
	Belt Conveyor (1,2,3 and 4)	-	IS2062	
	Trommel Screen	-	IS2062	
	Lump Breaker	-	IS2062/ SS304	
	Rejection discharge chute	-	IS2062	
14.	**Bagging System MOC**			
	Directional Chute	-	IS2062	
	Conveyor belt	-	IS2062	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
	Discharge Hopper	-	IS2062	
	Load cell	-	IS2062	
	Sewing Belt Conveyor	-	IS2062	
	Centralize Controlling Panel	-	IS2062	
15.	**Testing & Inspection**			
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	
16.	**Performance Guarantees**	-	Manure Conveying & Bagging along with its control shall be guaranteed for the rated capacity for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
17.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
18.	**Drawings & Documents to be submitted during detailed engineering stage**			
A.	GA drawing with all the mountings & accessories	-	Yes	
B.	Technical Data Sheets	-	Yes	
C.	Manufacturer's standard quality plan	-	Yes	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
D.	Materials test Certificates	-	Yes	
E.	Test certificates/reports for various shop test conducted	-	Yes	
F.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

19 EFFLUENT TREATMENT PLANT (ETP)

19.1 Design Requirement

19.1.1 Design Flow

Sl. No.	Design Parameters	Unit	Indicative Value* (* Bidder to provide actual values)
1	Design Flow	m^3/day	*

19.1.2 Raw Effluent Quality

Sl. No.	Parameters	Unit	Indicative Value* (* Bidder to provide actual values)
1	pH	--	*
2	Biochemical Oxygen Demand (BOD5)	mg/l	*
3	Chemical Oxygen Demand (COD)	mg/l	*
4	Total Suspended Solids (TSS)	mg/l	*
5	Ammonia	mg/l	*
6	Alkalinity	mg/l	*

20 CONVEYORS

20.1 Datasheet - Belt Conveyor

20.1.1 The below datasheet/table outlines the minimum requirements for the entire Belt Conveyor system. However, the bidder must ensure that all parameters related to

safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Belt Conveyor system to complete and efficient shall also fall under the bidder's scope of work.

20.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Conveyor system (with auxiliaries)	-	Belt Conveyor (Horizontal and Inclined)	
B.	Quantity	Nos.	*As per the Design	
C.	Maintenance Tools & tackles kit	set	1 set to be supplied in a separate steel toolbox. Bidder to furnish the list.	
D.	Included accessories	-	Yes	
2.	**Design Requirement**			
A.	Service	-	Continuous	
B.	Normal Capacity	TPH	*	
C.	Design Capacity	TPH	*	
D.	Material to be handled	-	Feedstock/FOM	
E.	Material Size	-	*	
F.	Conveyor Profile	-	Horizontal/ Inclined	
G.	Length (Horizontal)	-	*	
H.	Lift of the conveyor	-	*	
I.	Inclination	-	*	
J.	Belt Width	-	*	
K.	No. of Inlets	-	*	
L.	Feed from	-	*	
M.	Discharge to	-	*	
N.	Belt speed	m/s	≥0.8	
O.	Belt Rating/Ply	-	≥315/3	
P.	Belt Fabric	-	≥All Nylon (N/N)	
Q.	Top Cover Thickness	mm	≥3	
R.	Bottom Cover Thickness	mm	≥1.5	
S.	Cover grade	-	≥M24	
T.	Percentage elongation of conveyor belt	-	≤2% of span between idlers	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
U.	Troughing angle of belt	deg.	*	
3.	**Details of Pulley**			
I.	**Head Pulley**			
A.	Material	MoC	IS:2062	
B.	Thickness	mm	*	
C.	Outer diameter	mm	*	
D.	Rubber Lagging	mm	*	
E.	Lagging type	-	Diamond Groove type	
F.	Lagging Hardness	-	*	
G.	Width	mm	*	
H.	Sleeve	-	*	
I.	Shaft Material / Type	-	EN8 / Solid Shaft	
J.	Shaft diameter at bearing	mm	*	
K.	Bearing Diameter / Life	-	*	
L.	Plummer block	-	*	
II.	**Tail Pulley**			
A.	Material	MoC	IS:2062	
B.	Thickness	mm	*	
C.	Outer diameter	mm	*	
D.	Rubber Lagging	mm	*	
E.	Lagging type	-	Plain	
F.	Lagging Hardness	-	*	
G.	Width	mm	*	
H.	Sleeve	-	*	
I.	Shaft Material / Type	-	EN8 / Solid Shaft	
J.	Shaft diameter at bearing	mm	*	
K.	Plummer block	-	*	
III.	**Snub Pulley**			
A.	Material	MoC	IS:2062	
B.	Thickness	mm	*	
C.	Outer diameter	mm	*	
D.	Rubber Lagging	mm	*	
E.	Lagging type	-	Plain	
F.	Width	mm	*	
G.	Sleeve	-	*	
H.	Shaft Material	-	EN8	
I.	Shaft diameter at bearing	mm	*	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
J.	Plummer block	-	*	
IV.	**Bend Pulley**			
A.	Material	MoC	IS:2062	
B.	Thickness	mm	*	
C.	Outer diameter	mm	*	
D.	Rubber Lagging	mm	*	
E.	Lagging type	-	Plain	
F.	Lagging Hardness	-	*	
G.	Width	mm	*	
H.	Sleeve	-	*	
I.	Shaft Material / Type	-	EN8 / Solid Shaft	
J.	Shaft diameter at bearing	mm	*	
K.	Plummer block		*	
V.	**Pressure Pulley**			
A.	Material	MoC	IS:2062	
B.	Thickness	mm	*	
C.	Outer diameter	mm	*	
D.	Rubber Lagging	mm	*	
E.	Lagging type	-	Plain	
F.	Width	mm	*	
G.	Shaft Material	-	EN8	
H.	Shaft diameter at bearing	mm	*	
I.	Plummer block	-	*	
4.	**Details of Idler**			
I.	**Carrying Idler**			
A.	Type		Single Roll Flat	
B.	Shell/Tube Diameter	mm	*	
C.	Shell/Tube Length (Each Roll)	mm	*	
D.	Shaft Dia. At bearing	mm	*	
E.	MoC	-	EN8	
F.	Spacing	-	*	
II.	**Return Idler**			
A.	Type	-	Single Roll Flat	
B.	Shell/Tube Diameter	mm	*	
C.	Shell/Tube Length (Each Roll)	mm	*	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
D.	Shaft Dia. At bearing	mm	*	
E.	MoC	-	EN8	
F.	Spacing	-	*	
III.	**Impact Idler**			
A.	Type	-	Single Roll Flat	
B.	Shell/Tube Diameter	mm	*	
C.	Shell/Tube Length (Each Roll)	mm	*	
D.	Shaft Dia. At bearing	mm	*	
E.	MoC	-	EN8	
F.	Spacing	-	*	
G.	Rubber Lagging Dia / Material	-	*	
IV.	**Self-aligning carrying Idler with guide rollers**			
A.	Type	-	Single Roll Flat	
B.	Shell/Tube Diameter	mm	*	
C.	Shell/Tube Length (Each Roll)	mm	*	
D.	Shaft Dia. At bearing	mm	*	
E.	MoC	-	EN8	
F.	Spacing	-	*	
V.	**Self-aligning return Idler with guide rollers**			
A.	Type	-	Single Roll Flat	
B.	Shell/Tube Diameter	mm	*	
C.	Shell/Tube Length (Each Roll)	mm	*	
D.	Shaft Dia. At bearing	mm	*	
E.	MoC	-	≥EN8	
F.	Spacing	-	*	
5.	Details of take up type			
A.	Type		Screw	
B.	Travel		*	
C.	Screw Dia. & Thread Pitch	-	*	
D.	Screw MOC	-	≥EN8	
E.	Motor Power	-	*	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
F.	Motor Speed	-	*	
G.	Motor Duty	-	≥IE-3	
H.	VFD	-	*	
I.	Motor Make	-	*	
J.	Hold back/brakes arrangement	-	Integral	
K.	Gear box type	-	*	
L.	Gear box Ratio	-	*	
M.	Service factor	-	*	
N.	Primary Coupling type	-	*	
O.	Coupling model / Make	-	*	
P.	Secondary Coupling type	-	Geared	
Q.	Model of Coupling	-	*	
R.	Coupling Make	-	*	
6.	Belt Cleaner			
A.	Internal cleaner type	-	V-Plough Type	
B.	External Cleaner	-	Primary & Secondary	
C.	External cleaner type Primary	-	Spring Loaded - Pu blade	
D.	External cleaner type Secondary	-	Sprung back elastomount - HDTS tip	
E.	External cleaner mounting location	-	Within discharge chute	
7.	Skirting			
A.	Skirt Length	m	Full Length of Conveyor	
B.	Skirt plate Thickness	mm	*	
C.	Skirt Rubber	-	Double Lip TYPR Natural Rubber	
D.	Top seal plate	-		
8.	**Details of other accessories**			
A.	Deck Plate below carrying idler	-	At feeding points - 3.15 mm thick MS plate	
B.	Stringer and Gallery	-	Yes	
C.	Stringer MoC	-	Rolled Section and Cold Form Sections	
D.	Stringer Member Size	-	*	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
E.	Hood (Throughout the conveyor)	-	Corrugate Crimped Hood	
F.	Hood MoC	-	Galvalume	
G.	Hood Thickness	mm	≥0.45	
9.	**Bearing**			
A.	Bearing Make	-	*	
B.	Plummer block male	-	*	
C.	Bearing Type	-	Spherical Roller Double Row Self Aligning	
10.	**Discharge Chute**		*	
A.	Plate Thickness	mm	*	
B.	Plate MoC	-	IS:2062	
C.	Liner	-	SS-410 Material Contact Places	
D.	Hardware Grade	-	4.4	
11.	**Safety Switches**			
I.	**Zero Speed Switch (ZSS)**			
A.	Make	-	*	
B.	Type	-	Proximity type	
C.	Location	-	At tail end	
D.	Contact	-	2NO + 2NC	
II.	**Belt Sway Switch (BSS)**			
A.	Make	-	*	
B.	Type	-	Roller	
C.	Location	-	*	
D.	Contact	-	2NO + 2NC	
E.	Spacing	-	*	
III.	**Pull Chord Switch (PCS) for belt conveyor**			
A.	Type	-	Lever Type	
B.	Location	-	*	
C.	Contact	-	2NO + 2NC	
D.	Spacing	-	*	
E.	Walkway	-	*	
12.	**Protection**			
A.	Earthing	-	Yes	

Sl. No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
B.	Guards for all rotating parts	deg.	360°	
13.	**Testing & Inspection**			
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	
14.	**Performance Guarantees**	-	Belt Conveyors along with its control shall be guaranteed for the rated capacity against the rated speed of motions and for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at the bidder's cost.	
15.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
16.	**Drawings & Documents to be submitted during detailed engineering stage**			
A.	Technical Data Sheets	-	Yes	
B.	Manufacturer's standard quality plan	-	Yes	
C.	Materials test Certificates	-	Yes	
D.	Test certificates / reports for various shop test conducted	-	Yes	
E.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

20.2 Chain Conveyor

20.2.1 The below datasheet/table outlines the minimum requirements for the entire Chain Conveyor system. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Chain Conveyor system to complete and efficient shall also fall under the bidder's scope of work.

20.2.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Scope of Supply**			
A.	Conveyor system (with auxiliaries)	-	Chain Conveyor	
B.	Quantity (with redundancy)	Nos.	*As per the Design	
C.	Commissioning Spare	set	1	
D.	Maintenance Tools & tackles kit	set	1	
2.	**Design Requirement**			
A.	Service	-	Continuous	
B.	Normal Capacity	TPH	*	
C.	Design Capacity	TPH	*	
D.	Material to be handled	-	Feedstock/FOM	
E.	Material Size	-	*	
F.	Conveyor Profile	-	Horizontal	
G.	Length (Horizontal)	-	*	
H.	No. of Feed Points	-	*	
I.	No. of outlets	-	*	
J.	Feed from	-	*	
K.	Discharge to	-	*	
L.	Chain speed	-	*	
M.	Hardware grade	-	4.6	
3.	**Material Characteristics**		*	
A.	Abrasiveness	-	Mild Abrasive	
B.	Material Size	mm x mm	Less than 1 mm	
C.	Material Temperature	°C	Ambient	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
D.	Moisture	%	*	
4.	**Construction Details**			
A.	Length (Feed to Discharge Length (C/C) - Horizontal)	m	*	
B.	Length (Sprocket C / C length Horizontal)	m	*	
C.	Total Length of conveyor End Plate	m	*	
D.	Inclination	deg.	*	
E.	Chain Conveyor Width	mm	*	
F.	Chain Conveyor Height	mm	*	
G.	Size of slat (Width x height)	mm x mm	*	
H.	Thickness of slat	-	3 with stiffeners	
I.	Slat Fixing Arrangement	-	Bolted with nyloc nut	
5.	**Trough/ Casings**			
A.	Material	-	*	
B.	Top Cover Plate Thickness	mm	*	
C.	Side Plate Thickness	mm	*	
D.	Bottom Plate Thickness	mm	*	
E.	Chain Runner Material / Thickness	mm	*	
F.	Liner for Bottom Plate	mm	*	
6.	**Chain Specification**			
A.	Pitch	-	*	
B.	Breaking strength per strand	-	*	
C.	No. of strands	-	*	
D.	Strand centre to centre	-	*	
E.	Chain make	-	*	
F.	Chain Material	-	*	
7.	**Shaft**			
A.	Shaft material		EN-8	
B.	Drive shaft Diameter at Bearing	mm	*	
C.	Plummer block centre to centre	mm	*	
D.	Driven shaft Diameter at bearing	mm	*	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
8.	**Head Sprocket**			
A.	MoC	-	Cast Steel	
B.	No. of Teeth on Sprocket	-	*	
C.	P.C.D. of Sprocket	-	*	
9.	**Tail Sprocket**			
A.	MoC		Cast Steel	
B.	No. of Teeth on Sprocket	Nos.	*	
C.	P.C.D. of Sprocket	mm	*	
D.	Sprocket with key other with bush	-	Yes	
10.	**Details of take up type**		Screw Take up	
A.	Take up length	mm	*	
B.	Dia. Of screw & Pitch of Thread	mm x mm	*	
C.	Screw MOC		EN-8	
11.	**Drive details**			
A.	Motor Power	kW	*	
B.	Motor Speed	RPM	*	
C.	Motor Duty	-	IE-3	
D.	Make of motor	-	*	
E.	Gear box type	-	*	
F.	Gear Ratio	-	*	
G.	Service factor	-	*	
H.	Primary Coupling type	-	*	
I.	Secondary Coupling Type	-	Geared	
J.	Model of Coupling / Make	-	*	
K.	Coupling Diameter	mm	*	
L.	Pitch of Chain & Type (Simplex / Duplex)	mm	*	
M.	No. of Teeth of Drive Sprocket (Power Transmission)	Nos.	*	
N.	No. of Teeth of Driven Sprocket (Power transmission)	Nos.	*	
O.	Make of Transmission Chain & Sprocket	-	*	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
12.	**Bearing and Housing**			
A.	Bearing Type	-	*	
B.	Plummer block & Bearing Make	-	*	
C.	Tail Shaft Take Up Unit Block	-	*	
D.	UCT Unit Make	-	*	
13.	**Discharge Chute**			
A.	Plate Thickness	mm	*	
B.	Plate MoC	-	IS:2062	
14.	**Supporting Structure**		Yes	
A.	MoC	-	IS:2062	
15.	**Safety Switches**			
I.	**Zero Speed Switch (ZSS)**		Yes	
A.	Make	-	*	
B.	Type	-	Proximity type	
C.	Location	-	At tail end	
D.	Contact	-	2NO + 2NC	
16.	**Protection**			
A.	Earthing	-	Yes	
B.	Guards for all rotating parts	Deg.	360°	
17.	**Testing & Inspection**			
A.	Material Test Certificate	-	Yes	
B.	Shop Test Certificates	-	Yes	
C.	Performance Test Certificates	-	Yes	
18.	**Performance Guarantees**	-	Chain Conveyor along with its control shall be guaranteed for the rated capacity against the rated speed of motions and for the service conditions specified. If the shop/site performance tests indicate the failure of any of the components to achieve the guaranteed performance, the	

S.No.	Particulars	Unit	Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
			deficiency shall be made good at the bidder's cost.	
19.	**Surface Preparation and Painting**	-	Painting shall be suitable for protecting the equipment as per the site condition.	
20.	**Drawings & Documents to be submitted during detailed engineering stage**			
A.	Technical Data Sheets	-	Yes	
B.	Manufacturer's standard quality plan	-	Yes	
C.	Materials test Certificates	-	Yes	
D.	Test certificates / reports for various shop test conducted	-	Yes	
E.	O&M Manuals (including manufacturer's catalogues, spares ordering procedure)	-	Yes	

21 LAB EQUIPMENT

This section is intended to cover the various lab equipment used in CBG plant. The list of minimum equipment to be supplied is furnished in this specification shall be complete in every respect & suitable for satisfactory operation of the CBG plant.
The sizes of machines / equipment and their capacity shall be selected by the Contractor based on the requirement specific to the equipment and systems being proposed by them.

21.1 Datasheet - Lab Equipment

21.1.1 The below datasheet/table outlines the minimum requirements for the Lab Equipment. However, the bidder must ensure that all parameters related to safety, proper functionality, and maximum runtime of the equipment are met. Any equipment or accessories not specified in this specification but necessary to make the Lab Equipment to complete and efficient shall also fall under the bidder's scope of work.

21.1.2 Bidder shall be required to complete the data sheet wherever it is marked (*filled by bidder & Vendor data) and submit the fully completed datasheet/table along with their bid submission.

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
1.	**Laboratory Hot Air Oven (Total Solids Content) - Design Requirement**			
A.	Quantity	Nos.	*	
B.	Capacity	cm	*	
C.	Construction	-	Double walled construction. Outer body made of mild steel powder coated. Inner body made of Stainless-steel grade SS 304	
D.	Insulation		Glass wool insulation between two walls.	
E.	Temperature range	°C	50 - 250	
F.	Accuracy	°C	+/- 1	
G.	Temperature controlled by	-	Thermostatic	
H.	Shelves	-	*	
I.	Heater	-	Special nichrome heater designed for long life	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
			and saving of power consumption.	
2.	**Digital Muffle Furnace (Volatile solids content) - Design Requirement**			
A.	Quantity	Nos.	*	
B.	Capacity	cm	*	
C.	Construction	-	Double walled construction. Outer body made of mild steel powder coated. Inner body made of ceramic muffle make	
D.	Insulation	-	Special type ceramic insulation between body.	
E.	Coil	-	*	
F.	Temperature range	°C	Up to 1150.	
G.	Accuracy	°C	+/-1	
H.	Temperature controlled by	-	PID with dual LCD display for viewing set and current temperature	
I.	Safety	-	Special type thermocouple fuses to protect overheating. Overtemperature protection with separate display and controller	
J.	Sensor	-	K type calibrated sensor.	
3.	**Benchtop pH meter (pH measurement)**			
A.	Quantity	Nos.	*	
B.	pH meter, electrode stand, universal power adapter, literature CD, printed quick start guide, computer interface cable and meter test certificate.	-	Yes	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
C.	Waterproof BNC connector (ammonia combination)	-	Yes	
D.	BNC inputs: pH, ORP or ion selective electrode	-	Yes	
E.	Pin-tip (reference electrode)	-	Yes	
F.	8 pin MiniDIN (ATC temperature probe)	-	Yes	
G.	Stirrer input (stirrer probe)	-	Yes	
H.	Accessories for pH meter	-	Yes	
I.	Ion selective electrode, 1 m cable (ammonia combination)	-	Yes	
4.	**Digital automatic potentiometric titration apparatus (VFA, Acidity and alkalinity)**			
A.	Quantity (Full set)	Nos.	*	
B.	Glass electrode	Nos.	*	
C.	Calomel reference electrode	Nos.	*	
D.	Platinum electrode	Nos.	*	
5.	**Wood moisture meter (Moisture content in wood)**			
A.	Quantity	Nos.	*	
B.	Battery voltage	V	*	
C.	Dimensions	mm	*	
D.	Battery type	-	*	
E.	Weight	g	*	
F.	Accessories carrying case, 9 V battery and operational manual.	-	*	
G.	Operating humidity	% RH	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
H.	Accuracy	%	±1	
I.	Country of origin	-	*	
J.	No. of Batteries	Nos.	*	
K.	Display type	-	LCD (10 mm)	
L.	Display digit	-	2	
M.	Measurement range	%	5 - 40	
N.	Items in Pack	Piece	*	
O.	Resolution	-	0.01	
6.	**Vortex mixer (Mixing/Sample preparation for analysis)**			
A.	Quantity	No.	*	
B.	Type	-	Vortex mixer with brushless motor and suitable for interchanging mixing heads	
7.	**Electronic balance (Lab sample weighing)**			
A.	Quantity	Nos.	*	
B.	Capacity	kg	*	
C.	Accuracy	mg/g	100/0.1	
D.	Display type	-	Double display with tare facility	
E.	Battery backup	h	8	
8.	**Water still manesty pattern (Distilled water equipment for lab analysis)**			
A.	Quantity	No.	*	
B.	Capacity	l/h	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
C.	Material of construction of the entire unit	-	Stainless steel	
D.	Condenser	-	Shall be opened easily for periodic cleaning	
E.	Mounting type	-	Wall mounting	
F.	Heating elements	-	Without tubing and the entire heating element shall be easily replaceable	
9.	**COD digestors - Digital (COD analysis)**			
A.	Quantity	Nos.	*	
B.	Construction	-	1. Double wall construction with insulation for minimum heat loss. 2. Outer cabinet made of mild steel duly coated.	
C.	COD tubes	-	3. Aluminium block with holes.	
D.	Temperature controller	-	Solid state digital temperature controller with appropriate heater and insulation.	
E.	Selectable time	-	Up to 120 min. with alarm to set the digestion period.	
F.	Sample analyses after digestion	-	Colorimetric or titrimetric method	
G.	Temperature range	°C	Above ambient to 180	
H.	Resolution	°C	1	
I.	Display	-	Digital 12 mm red LED	
J.	Control	-	Digital electronic temperature controller	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
K.	Heater rating	W	*	
L.	Sensor material	-	*	
M.	Timer	Min.	Selectable 15, 30, 45, 60, 90 and 120 min with alarm	
N.	Glass tube quantity and diameter	Nos. & mm	*	
O.	Volume of each sample	ml	*	
P.	Number of COD tubes	Nos.	*	
10.	**Saccharometer: portable - handheld (Methane measurement)**			
A.	Quantity	Nos.	*	
11.	**UV Visible spectrophotometer (COD and protein, sugar, carbohydrates, lignin, etc. analysis)**			
A.	Quantity	Nos.	*	
12.	**Research centrifuge (Protein, carbohydrate and lipid estimation)**			
A.	Quantity	Nos.	*	
B.	Centrifuge accessory: Angle head	Nos.	*	
13.	**Oil free vacuum pump 1/16 HP, TID 25 (Sample filtration/preparation)**			
A.	Quantity	Nos.	*	
14.	**Soxhlet apparatus (Biomolecules analysis/extraction)**			
A.	Quantity	Nos.	*	
B.	Condenser for Soxhlet apparatus	Nos.	*	
C.	Allihn 400 mm	Nos.	*	
D.	Liebig 400 mm	Nos.	*	
15.	**Autoclave (semi-automatic) and accessories (Lignin analysis)**			

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
	Quantity	Nos.	*	
16.	**Quantities of lab glass wares and other accessories**			
	Desiccators set - Plain, clear glass (300 mm)	Nos.	*	
	Silica crucibles		*	
	• 25 ml	Nos.	*	
	• 100 ml	Nos.	*	
	Crucible tong		*	
	• SS tong 8"	Nos.	*	
	• SS tong 12"	Nos.	*	
	Thermometer: Temperature range -10 to 110 °C with 0.5 °C allowable deviation	Nos.	*	
	Conical flasks with narrow mouth		*	
	• 500 ml	Nos.	*	
	• 1000 ml	Nos.	*	
	Beakers		*	
	• 250 ml (Low form)	Nos.	*	
	• 500 ml	Nos.	*	
	• 1000 ml	Nos.	*	
	Measuring cylinders (Hexagonal):		*	
	• 50 ml	Nos.	*	
	• 100 ml	Nos.	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
	• 500 ml	Nos.	*	
	• 1000 ml	Nos.	*	
	Volumetric flask		*	
	• 100 ml	Nos.	*	
	• 250 ml	No.	*	
	• 500 ml	Nos.	*	
	Round bottom flask (B-24)			
	• 500 ml	Nos.	*	
	• 1000 ml	Nos.	*	
	Measuring jug (Euro design)			
	• 1000 ml	Nos.	*	
	• 5000 ml	Nos.	*	
	Wash bottle: 500 ml	Nos.	*	
	Funnel: 75 mm	Nos.	*	
	Dropping bottles: 60 ml	Nos.	*	
	Syringes: Plastic sterile with needle	Nos.	*	
	Spatula: SS spatula 8"	Nos.	*	
	Buchner funnel: 125 mm	Nos.	*	
	All Glass filter assembly: Millipore	Nos.	*	
	Retort stand: 9" x 6": Clamp boss head	Nos.	*	
	Heating mantle			

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
	• 500 ml	Nos.	*	
	• 1000 ml	Nos.	*	
17.	**Quantities of lab chemicals and reagents**			
	KOH pellets (85% purified): 500 g	Nos.	*	
	Lead acetate paper strips	Nos.	*	
	Number of pH buffer capsules			
	1. pH 4.0 powder	Nos.	*	
	2. pH 7.0 powder	Nos.	*	
	3. pH 9.0 powder	Nos.	*	
	pH strips: Between 1 to 14	Nos.	*	
	Ethanol (laboratory grade): 500 ml	Nos.	*	
	Nitric acid (69-70%): 500 ml	Nos.	*	
	Sulfuric acid (98%): 2.5 L	Nos.	*	
	Ammonia water (25%w/v solution): 500 ml	Nos.	*	
	Cotton apron full	Nos.	*	
18.	**Personal Protective Equipment**			
	Gloves			
	1. Nitrile gloves of size - S, M, L, Box of 100	Nos.	*	
	2. Heat resistance asbestos gloves	Nos.	*	
	Safety masks: Special quality chemical gas mask with filter	Nos.	*	
	Safety goggles	Nos.	*	

S.No.	Particulars	Unit	Owner's Data (Data marked thus * to be filled by the Bidder)	Vendor Data (Duly filled in by the Bidder)
	Tissue paper roll (Lab consumables)	Nos.	*	
19.	**Lab testing and analysis**			
	Digital temperature	Nos.	*	
	Digital timer	Nos.	*	
	Magnetic stirrer	Nos.	*	
20.	**Data recording**			
	New desktop	Nos.	*	
	Printer	Nos.	*	
	UPS 600 VA	Nos.	*	

Appendix -3

LIST OF APPROVED MATERIALS, BRANDS & MANUFACTURERS ALONG WITH INSPECTION CATEGORY

LIST OF APPROVED MAKES / BRANDS / MANUFACTURERS / VENDORS

Mechanical:

S. No.	Items	Make / Brand / Manufacturer / Vendor	Inspection Category
1.	Infeed Bunker	Smicon, Wuxi Wilson, Equivalent	A
2.	Iron Separator / Eddy Current Separator	Bakker, Goudsmit, STEINERT, Equivalent	B
3.	Organic Extraction System	Smicon, Equivalent	A
4.	Grit Removal System	DRYCAKE, FLSmidth, Fluiteco, McLanahan, Smicon, Equivalent	B
5.	Mixer for Digesters	Anaergia, Stallkamp, SUMA, Equivalent	B
6.	Dual Fuel Hot Water Generation System	ME Energy, Thermax, Equivalent	B
7.	Bio-Gas Holder (Double Membrane Type)	EcoMembrane, Nesemeier, Sattler, Vergas, VSO, Equivalent	B
8.	Bio-Gas Flaring System	CRA, GGE, Nutzen, Equivalent	B
9.	Bio-Gas Desulphurization System	CRA, DMT, DU Digital, GGE, Green Power, Nutzen, Praj, PAQUES, SLPP RE-NEW, Equivalent	B
10.	Bio-Gas Genset	Caterpillar, Jenbacher, MWM, Siemens, Equivalent	A
11.	Bio-Gas Purification / Upgradation System	Bio-Gas Engineering, Clarke Energy, Nutzen, SLPP RE-NEW, Equivalent	A
12.	High-Pressure Compressor	Bauer, Burckhardt, Chicago Pneumatic, Jyotech, ICL, Equivalent	A
13.	**Sludge Dewatering System:**		
	Decanter Centrifuge	Alfa Laval, GEA Westfalia, Humboldt, Hiller, ITE, Pennwalt, Pieralisi, Equivalent	B
	Belt Filter Press	Alfa Laval, Andritz, Dewaco, EMO, FLSmidth, Siemens, Teknofanghi, Equivalent	B

S. No.	Items	Make / Brand / Manufacturer / Vendor	Inspection Category
	Press Screw Separator	CRI-MAN, EYS, FAN, Paulmichl, WAM, Equivalent	B
14.	Solar Drying System	IST-Anlagenbau, Equivalent	B
15.	Thermal Drying System	Huber, Kilburn, VOMM, Equivalent	B
16.	Conveyor	BRT Hartner, Dutch Spiral, Eggersmann, Fluiteco, Integrated Pacline, JASH, WAM, Westeria, Wuxi Wilson, Equivalent	B
17.	Weighbridge	Avery, Eagle, Endeavour, Expert, Precision, Statweigh, Equivalent	B
18.	Fan	EVG Engi-Con, Hyderabad Pollution Controls, Howden, Nadi Airtechnics, Equivalent	B
19.	**Pump:**		
	Centrifugal Pump	ABS, Egger, Flowmore, Grundfos, Homa, Hydrocal, Johnson, Jyoti, Kirloskar, Kishor, KSB, Wilo, Equivalent	B
	Progressive Cavity Pump	Allweiler, Netzsch, Roto, Wangen, Equivalent	B
	Metering Pump	Grosvenor, Grundfos, Milton Roy, Prominent, Positive Metering, Sandur, Shapotools, Equivalent	B
	Air Compressor	Atlas Copco, ELGI, Ingersoll Rand, Kirloskar Pneumatic, Equivalent	B
20.	Air Blower	Arzen, Airvak, Everest, Kaiser, Kay, KPT, Siemens, Swam, Turbo Max, Equivalent	B
21.	**Pipe:**		
	• MS Pipe	Jindal, Tata, SAIL, Welspun, Equivalent	C
	• SS Pipe	Jindal, Prakash, Ratnamani, Remi, SAIL, Equivalent	C
	• CI Pipe	Electro Steel, Kesoram, Equivalent	C
	• DI Pipe	Electro Steel, Jindal, Welspun, Equivalent	C
	• HDPE Pipe	Astral, Duraline, Georg Fischer, Reliance, Equivalent	C

S. No.	Items	Make / Brand / Manufacturer / Vendor	Inspection Category
	• UPVC Pipe	Astral, Georg Fisher, Equivalent	C
22.	Valves	Audco, ARI, BDK, Fischer, Jash, Hawa, Intervalve, Kiroloskar, VAG, Equivalent	B
23.	Electrical Hoist	Brady & Morris, Kone Cranes & Demag, Elephant, Hercules, Equivalent	C
24.	Double Girder EOT Crane	Brady & Morris, ElectroMech, Konecranes & Demag, Equivalent	B
25.	**Earthmovers / Vehicles:**		
	• Wheel Loader / Crawler Excavator	BEML, Caterpillar, Doosan, Escorts, JCB, L&T, Liebherr, TATA, Volvo, Equivalent	C
	• Skid Steer Loader	Caterpillar, Bobcat, JCB, Vectra, Equivalent	C
	• Truck	AMW, Ashok Leyland, Bharat Benz, Eicher, Mahindra & Mahindra, TATA, Volvo, Equivalent	C
	• Suction Tanker	Isuzu, Kam-Avida, TPS, Equivalent	C
	• Tractor	Eicher, Escorts, John Deere, Mahindra & Mahindra, New Holland, Equivalent	C
26	Cleaning Equipment	Karcher, Nilkamal, Roots, Equivalent	C

Electrical:

S. No.	Items	Make / Brand / Manufacturer / Vendor	Inspection Category
1.	PVC Pipes and Accessories	AKG, Astral, Avonplast, Modi, Precision, Polycab, Equivalent	C
2.	Copper Multi-strand Wires	Anchor, C&S, Finolex, Flexolite, Gloster, Great White, Havells, HPL, Indo Asian, KEI, KundanCab, L&T, Polycab, Rallison, RR KABEL, Skytone, Terexel, Vishal, Vinay	C
3.	Switches / Sockets / TV / Telephone Sockets etc. (Modular) – Cat A	Anchor-Panasonic (Woods, Volvo, Ave), Arteor, Crabtree (Anthena, Thames), Legrand (Mosaic, Myrius), MK (Blenze), Schnieder (Opale, Zencelo), SSK (Signature)	C

S. No.	Items	Make / Brand / Manufacturer / Vendor	Inspection Category
4.	Switches / Sockets / TV / Telephone Sockets etc. (Modular) – Cat B	ABB (Cherion), Anchor-Panasonic (Roma), CPL(Genius), Crabtree (Verona), Fino, Greatwhite (Myra), Havells (Coral, Havells (Oro), Legrand (Mylink), L&T (Oris), MK(Midas), RR Kabel, Schneider (Livia), Pearlz), Vinay (Corum)	C
5.	MCB / ELCB / RCCB / Isolators / MCCB / DB	ABB, CAT A: Legrand, Hager, L & T, Mitsubishi, Schneider, Siemens	C
		ABB, Anchor by Panasonic, CAT B: Standard, C & S, Havells, Indo Asian, Mitsubishi, Schneider	C
6.	SFU / Fuse Switch Unit	Crompton, C & S, Cuttler Hammer, HPL, Indo Asian, L & T, Schneider, Siemens	C
7.	Outdoor Boxes	Clipsal, Henzel, Hunter, National, Sintex	C
8.	HRC Fuses	ABB, BCH, C&S, Crompton, Cuttler Hammer, GE, Havells, HPL, Indo Asian, L & T, Merlin Gerin, Schneider, Siemens,	C
9.	Industrial Sockets	Clipsal, C & S, Crompton, Cuttler Hammer, Legrand	C
10.	Fan Regulator	To match with the switch, sockets	C
11.	UG Cables	Asian, Avocab, CCI, Finolex, Gemscab, Gloster, KEI, NICCO, Terexel/ Indo Asian, Polycab, Universal	C
12.	Cable Glands	Bracco, Comet, Comex, Dowels, Jainson, Polycab, Siemens	C
13.	Cable Jointing	Cabseal, CCI-Xycon, M Seal, Raychem	C
14.	Ceiling Fans	Bajaj (Regal Gold), Crompton (High Speed), Havells (Fusion II), Khaitan (Zeed/ Flair/ Aero/ Cleo), Usha (Striker Deco),	C
15.	Exhaust / Pedestal Fan	Almonard, Anchor, Bajaj, Crompton, Khaitan, Orient, Usha	C
16.	Fixture	Atlantis Lighting, Bajaj, Disano, Erco,	C

S. No.	Items	Make / Brand / Manufacturer / Vendor	Inspection Category
		GE, Jaquar (as specified in BOQ), KeselacSchreder, Ligman, Lighting Science, Philips, Pyrotech, Samudhra	
17.	Telephone Wire / Cables	Anchor, Delton, Finolex, Gemscab, ITL, L&T, National, Polycab, Skytone, Tata (Lucent)	C
18.	Cable Tray & Race Ways (Factory Fabricated)	Bravo, Globe, Indiana, Legrand, Parmar Industries, Pratik- Sales- RK - PCTS Equivalent, Rico Steel, Sadhana, Slattco	C
19.	Network Cable	Anchor, Avaya, Digisol, D-link, Finolex, KEI, Legrand, Polycab, Schneider, Equivalent	C
20.	Transformer	Aum Transformer, Bharat Bijlee, Crompton, Hitachi Energy, Kirloskar, KTL, Schneider, Urja, Equivalent	A
21.	DG Set (Assembled by authorized OEA / OEM)	Engine: Ashok Leyland, Caterpillar, Cummins, Greaves Cotton, KOEL, Perkins, Equivalent	B
		Alternator: Crompton Greaves, Jyothi, KEC, Leroy Somer-Trident, Marelli, Meccalte, Stamford, Equivalent	B
22.	Capacitor	ABB, Asian, KhatauJunkar, Legrand, L&T, Schneider, Siemens, Universal, Equivalent	C
23.	ACB	ABB, C & S, GE, Legrand, L & T, Mitsubishi, Schneider, Siemens, Equivalent	C
24.	VCB / HT Switch with Cubicle / SF6	ABB, Crompton, Megawin, Siemens, Equivalent	C
25.	CT's / PT's	AE, Indcoil, Kappa, Megawin, Pragati, Ricco, Equivalent	C
26.	APFC Relay	Alstom, Emercon, Epcos, GEC, L & T, Equivalent	C
27.	Contactor / Timer / Starter	C & S, Cuttler Hammer, HPL-Mollar, L & T, Schneider, Siemens, Equivalent	C
28.	Tri-Vector Meter / Energy	AE, C & S, IndoAsian, L & T, Siemens,	C

S. No.	Items	Make / Brand / Manufacturer / Vendor	Inspection Category
	Meter	Schneider, Rishab, Tecnic, Equivalent	
29.	Ammeter / Voltmeter / Power Factor meter / Frequency meter	ABB, AE, HPL, IMP, Meco, Rishab, Equivalent	C
30.	Lightning Protection System	Indelec, Stormaster (LPI), Synergy, True power, Equivalent	C
31.	HT / LT Panels	ABB, Chavare Engineering, Control Centre, DB Enterprises, Electcontrol, Imperial, Kenson Engineers, Kris Controls, Megawin, Peaton Electrical, PES, Sun Control, Technocraft, Vivid, any panel manufacturer having CPRI approval for similar panels	B
32.	GI Pipes	Jindal, Tata, Zenith, Equivalent	C
33.			
34.	Rotary Switch / Selector Switch	GE, Kaycee, L & T, Siemens, Equivalent	C
35.	Telephone Tag Box	ITL or any equivalent approved make	C
36.	UPS / Inverter	Access power / Accutech, Aplab, APC, Consul Neowatt, Dubas, Numeric, Power Ware, Renutron, Schneider, Sinexcel, Socomec, Streamline, Techser, Vertiv, Equivalent	C
37.	Batteries	Amaron, Exide, HBL, Tata Green, Panasonic, Quanta, Equivalent	C
38.	RMU with Cubicle	ABB, CGL, L&T, Megawin, Schneider, Equivalent	B
39.	Changeover Switch	ABB, C&S, HPL, Indo Asian, L&T, Schneider, Siemens, Equivalent	C
40.	Voltage Stabilizer	Everest, Jindal, Oricon, Servel, V-Guard, Equivalent	C
41.	GI Octagonal Poles	Aster, Bajaj, KL Industries, Valmont, Equivalent	C
42.	Split AC / IRV Units	Bluestar, Carrier, Daikin, Hitachi, LG, Mitsubishi, Samsung, Toshiba, Voltas-Midea	C
43.	VFDs	ABB, Danfoss, Mitsubishi, Schneider,	C

S. No.	Items	Make / Brand / Manufacturer / Vendor	Inspection Category
		Siemens	

Instrumentation / Automation:

S. No.	Items	Make / Brand / Manufacturer / Vendor	Inspection Category
1.	PLC	Allen Bradley, Honeywell, Mitsubishi, Schneider, Siemens	B
2.	HMI	Allen Bradley, Honeywell, Mitsubishi, Schneider, Siemens	C
3.	SCADA	Allen Bradley, Ellipse, Honeywell, Mitsubishi, Schneider, Siemens, Wonderware	C
4.	Computer	Apple, Dell, HP, Lenovo, Equivalent	C
5.	Ethernet Switch	Allen Bradley, CISCO, D-Link, Evon, ORING, Phoenix, Schneider	C
6.	Ethernet to Optical Convertor	Allen Bradley, P&F, Schneider, UL Electronics	C
7.	Pressure Gauge	Forbes Marshall, General Instrument, H Guru, IFM, Kromschroder, Pricol, Waaree, Wika	C
8.	Pressure Switch	Danfoss, Forbes Marshall, General Instrument, Honeywell, IFM, Kromschroder, Vogelsang, Waaree, Wika	C
9.	Pressure Transmitter	E&H, Emerson, IFM, Kromschroder, Vogelsang, Yokogawa	C
10.	Level Switch	Chemtrol, E&H, Emerson, P&F, Pune Techtrol, SBEM, Siemens, Waree	C
11.	Level Transmitter	E&H, Forbes Marshall, Emerson, Fischer, Seitz, Siemens, Yokogawa	C
12.	Flow Transmitter	Aquametro, E&H, Emerson, Fischer, Forbes Marshall, Yokogawa	C
13.	Temperature Indicator	Aquametro, General Instrument, E&H, Fischer, Waaree, Wika	C
14.	Temperature Transmitter	Aquametro, E&H, Emerson, Fischer, Hach, Omega, Yokogawa	C
15.	Analyzer	E&H, Emerson, Forbes Marshall,	C

S. No.	Items	Make / Brand / Manufacturer / Vendor	Inspection Category
	(pH, DO etc.)	Hach, INCA, Union, Potence Gas	
16.	Telephone Wire, Cables	Delton, Finolex, Gemscab, ITL, L&T, National, Polycab, Skytone, Tata (Lucent), Equivalent	C
17.	Network Cable	Avaya, D-Link, Digisol, Finolex, Legrand, Schneider, Systemec	C
18.	EPABX System	Alcatel, Avaya, Crest IT, LG Aria, Matrix, NEC, Panasonic, Siemens	C
19.	Close Circuit TV, NVR, Radio Frequency Identification System, ERP	Crest IT, Hik Vision, Vivotek, FindnSecure	C
20.	Telephone Instrument	Avaya, BPL, NEC, Panasonic, Siemens, Tata	C
21.	LED TV / Monitor	Dell, LG, Panasonic, Samsung, Sony, Equivalent	C

INSPECTION PROCEDURE:

- All Mechanical, Electrical and Instrumentation Items have been listed and classified as Category A, B and C based on their value and criticality of function in the above List along with Inspection Category.
- The Bidder shall submit the Datasheet, QAP and General Arrangement Drawings of the Equipment for review/approval by NMMC or its designated agency.
- Items classified as Category A and B shall be inspected by a reputed third-party inspection agency as per approved list of OIL
- For items classified as Category A, over and above the third-party inspection, MCC or its designated agency will carry out inspection at Manufacturer's Works / Factory prior to packing and dispatch.
- For items classified as Category B, the Inspection Report of the third-party inspection agency shall be adequate.
- Items classified as Category C, being low value items, shall be procured from the approved Manufactures/Makes listed above and the third-party inspection shall not be required.
- If any of the Category C Items is a part of the Category A or Category B Items, the same shall be inspected along with the main Item by the third-party inspection agency.