OFFICE OF THE MUNICIPAL CORPORATION, KORBA CHHATTISGARH

NOTICE INVITING TENDER

Main Portal: https://eproc.cgstate.gov.in

SYSTEM TENDER NO/161753 /NIT NO: 8098/W.S./Dated 26/11/2024

Online tender are invited by the Commissioner, Municipal Corporation, Korba for the following work in Form "F" for lump Sum contract from the contractors registered with Unified Registration System (Single Window) on GoCG PWD & e-Procurement System Portal (https://cgeprocurement.gov.in) through sub portal https://uadd.cgeprocurement.gov.in as per the 'key Dates' mentioned below. All other conditions for submission of tenders and criteria for prequalification etc. have been mentioned in the tender documents.

1.	**Name of Work**	**Construction, Testing, Commissioning of all the Components of Korba Sewage Master Plan Including Fifteen Years Operation & Maintenance of Entire System (under AMRUT 2.0).**
2.	**Probable amount of contract**	**Rs10694.40 Lacs**
3.	**Earnest money(EMD)**	**Rs 53.48 Lakh (Rupees Fifty Three Lakh Forty Eight Thousand only)**TDR/FDR in favour of Commissioner, Municipal Corporation Korba. **Note**: - The EMD should be valid for at least 12 months in auto-renewal mode. EMD will be returned to unsuccessful bidders after the award of contract.
4.	**Time allowed for completion(Including rainy season)**	27 months (including **03 (three) months** trial run and rainy season)
5.	**Cost of Tender document fee**	Rs 10000/- (Rupees Ten Thousand only) in the form of DD in favour of Commissioner,Municipal Corporation,Korba
6.	**Validity of Offer**	120 days from the day of submission of financial offer
7.	**Site Visit and Pre bid meeting**	1. **A Site visit will be organized by the Commissioner/Nodal Officer Amrut Mission 2.0, Korba, Chhattisgarh** (as per tender Notice) 2. **A Prebid meeting in context of this project shall be held in the office of Commissioner office Korba, Chhattisgarh**(as per tender Notice)

For further clarifications regarding Digital signature, The Bidders may contact **M/s Mjunction Service Ltd.**, on helpdesk Toll free number **1800 419 9140** or through Email ID pro-chips@gov.in they may contact to **Mr. Shailesh Kumar Soni, Sr. Manager, Infotech and Biotech Promotion Society (CHIPS) on Tel. No. 0771-4014158**

The tender documents containing detailed terms & conditions are available for free download on

GoCG e-

Procurement portal http://cgeprocurement.gov.inthrough sub portal of Urban Administration Development Department http://eproc.cgstate.gov.inBidders have to quote online their prices along with

Technical and Commercial bids in prescribed formats on the above mentioned portal only.

The Bidders intending to participate in this Tender are required to get enrolled on the above-mentioned

website and get empanelled on the Sub-Portal of Urban Administration &Development Department.

Enrolment on the above-mentioned Portal is mandatory. As the online Bids are required to be digitally signed, Bidders are required to obtain Class – II Digital Signature Certificates (DSCs).

The Bidders are also invited to get themselves trained on the operations of the e-Procurement System. Bidders may get in touch with the Service Provider of the e-Procurement System for confirming the time and date for their training session.

26.11.24

Commissioner
Municipal Corporation,
Korba (C.G.)

OFFICE OF THE MUNICIPAL CORPORATION, KORBA, CHATTISGARH
DETAILED NOTICE INVITING TENDER

SYSTEM TENDER NO/161753/NIT NO: 8098/W.S./Dated26/11/2024

Online tender for the works mentioned below are invited by the Commissioner, Municipal Corporation, Korba for the following work in Form "F" for lump Sum contract from the contractors registered with Unified Registration System (Single Window) on GoCG PWD Department & e-Procurement System Portal (https://eproc.cgstate.gov.in) as per the 'key Dates' mentioned below. All other conditions for submission of tenders and criteria for prequalification etc. have been mentioned in the tender documents and prequalification documents.

Name of work	Probable amount of contract (Rs. in Lacs)	Earnest money (Rs. in Lacs)	Time allowed for completion	Cost of Tender Document (in Rupees)	Validity of the Offer (After opening of financial bid)	Class of the Contractor
Construction, Testing, Commissioning of all the Components of Korba Sewage Master Plan Including Fifteen Years Operation & Maintenance of Entire System 1. Design and construction of Diversion weir at Kosabadi Nalla. 2. Investigation, Design & Construction of Interception Cum Diversion Chambers/Weirs for 11 Nos. At various nallas along the bed of Hasdeo River with manual screens, grit and diversion chambers. 3. Investigation, Designing and Construction of Kosabadi Wet Well with Pump houses and Screens. 4. Providing and installation of 1500 KVA substation at Kosabadi wet well & 33 MLD STP capacity 1500 KVA 5. Investigation, Designing and Installation of raw sewage Pumping Machinery for Kosawadi Nalla Wet well with all allied works. 6. Providing, Lowering, Laying, jointing & testing 700mm Dia DI K-9 pipes 9174 Mtr pumping main from Kosawadi Wet well to STP at Pragati Nagar.	**10694.40**	**53.48**	**27 months (including rainy season)**	**10000.00 (Rupees Ten Thousand only)**	**120 days**	**In Class 'A'**

Name of work	Probable amount of contract (Rs. in Lacs)	Earnest money (Rs. in Lacs)	Time allowed for completion	Cost of Tender Document (in Rupees)	Validity of the Offer (After opening of financial bid)	Class of the Contractor
7. Interceptor sewer line from Gerva Nalla to Kosabadi. 8. Investigation, Design &Construction of MS Truss Bridge on RCC Piers across Hasdeo River for a Length of 750M to accommodate 700mm Dia Raw sewage pumping Main including providing and fixing jointing testing and commissioning 700mm Dia 10mm thick MS pipes on MS chairs and interconnection with DI pipes. 9. Investigation, Designing and Construction of 33 MLD STP based on SBR Technology (With 4 Basins) for Secondary Treatment with all allied Civil works such as Compound Wall, Internal Roads, Beautification and landscaping etc. Complete. All Electro-mechanical works with PLC & SCADA for entire system. 10. Allied civil work & Quarters. 11 Land development work at Wet well. 12. Operation and maintenance of entire scheme including Solar power plant for 15 years						

1.1 NOTE:

1. Registration and subsequent empanelment for e-tendering website (Sub-portal)https://eproc.cgsstate.gov.inand department's sub-portal is mandatory.
2. The tender documents containing detailed terms & conditions are available for free download on GoCG e-Procurement portal (http:/eproc.cgstate.gov.in) Bidders have to quote online their prices along with Key Submission and Technical bid (as per PQ criteria) in prescribed formats on the above mentioned portal as per the details mentioned in the tender document.
3. The Bidders intending to participate in this Tender are required to get enrolled on the above mentioned website. Enrolment on the above mentioned Portal is mandatory. As the online Bids are required to be digitally signed, Bidders are required to obtain Class – II Digital Signature Certificates (DSCs). The Bidders may contact **M/s Mjunction Service Ltd.,** on

helpdesk Toll free number **1800 419 9140** or through Email ID – pro-chips@gov.in or they may contact to **Mr. Shailesh Kumar Soni, Sr. Manager, Chhattisgarh Infotech and Biotech Promotion Society (CHIPS) on Tel. No. 0771-4014158.**

4. The Bidders have to digitally sign their bids before submitting the bids hashes online. Thus, the Bidders are advised to obtain Digital Certificates. The registered contractors may obtain information required for issuance of a Class II Digital Signature Certificate from the Controller of Certifying Authorities(www.cca.gov.in) or the Service Provider of eProcurement System for Government of Chhattisgarh.
5. Validity of offer - 120 days from last date of opening of financial offer.
6. The Technical offer shall be opened in presence of the Bidders or their authorized representatives, who may choose to be present. The date and place of opening of financial offer will be intimated to the Qualified Bidders subsequently after opening of technical offer.
7. The department reserves the right to change the key dates of the tender process.
8. Sufficient hindrance free space is available for construction.
9. Bidders are advised to visit the site sufficiently in advance of the date fixed for the submission of the tender at their own cost. The Tenderer shall be deemed to have full knowledge of all relevant documents and site conditions, assessment of work etc. whether the bidder inspects it or not.
10. A Prebid meeting in context of this project shall be held as stated above in NIT. The contractors shall give their suggestions and conditions in writing based on which Corrigendum/Amendments/clarifications shall be framed and uploaded which will supersede the original NIT Conditions unless otherwise specified.
11. Cess @ 1 % (one percent) or latest shall be deducted at source from every bill of contractor under "Building and other Construction for workers welfare, cess Act-1996.
12. The Municipal Corporation reserves the right to reject any part of/whole tender without assigning any reason and to restrict the list of pre-qualified bidders to any number deemed fit by it.
13. If any pre-qualified bidder withdraws his offer before the validity period or makes/propose any modifications in the terms and conditions of the tender, the earnest money of said bidder shall stand forfeited.
14. Before the deadline for submission of tender, the Commissioner, Korba Municipal Corporation can modify tender document by issuing amendment.
15. NIT Details, Prebid meeting minutes and Any amendment thus issued shall be part of the tender document and shall be published on website.
16. The bidders are required to submit 'Envelope "A & B" physically and online as per dates Indicated in Key Dates. The Physical Envelope should contain the following: -

a) **Envelop 'A'** (Key Submission - Submit physically & online)- All the required document submission are mandatory for opening of Technical Bid.

i. The Earnest Money Deposit (EMD)in the form of FDR/TDR of a Nationalised /Scheduled bank of India in favour of the "Commissioner, Municipal Corporation, Korba" payable at 'Korba'.

ii. The tender fee as mentioned in NIT in original with physical Envelope and scan copy (online). It is non-refundable.

iii. Affidavit in Original. (Non-Judicial stamp in 500 Rs.) (as per Enclosed APPENDIX-13 in Tender Documents)

iv. Attested copy of Valid Registration Certificates. CG PWD and (Partnership Deed, registration amendment certificate as the case may be)

v. Attested copy of PAN card issued by I.T. Department.

vi. Attested copy of Valid GST/ CGST Registration must be valid up to Bid due date as per key dates otherwise tender will be disqualified while opening.

vii. Valid Bank Solvency certificate in Bank Letter Head. (Not Older than 12 Months) Mention the Bank Dispatch No. or Ref. No. or Verifiable unique number or Date otherwise tender will be disqualified while opening)

viii. PQ Documents of Technology provider.

ix. The scanned copy of all the documents mentioned above shall also be submitted online.

b) **Envelop- 'B"(Technical Bid - Submit physically & online) -** Also, the Envelop Shall be submitted physically. In all cases the submission which is online shall prevail.

i. Power of Attorney/Letter of authorization to sign the bid

ii. Partnership deed /MOA of company

iii. Technical & Financial prequalification documents

iv. BID CAPACITY

v. Affidavit regarding Balance amount of work in hand

vi. ITR of last five years (up to 31-03-24)

vii. The bidder should have a positive net worth. The certificate from C.A. shall be attached.

viii. Affidavit regarding not being declared CDR by any bank.

ix. As per Pre-Qualification Criteria mentioned in PQ document. (Appendix-1 to 12)

c) **Envelop- "C" - (Financial Bid - Submit only Online)**

Total Lump sum offer (Cost of works + cost of 15 yrs. O&M) (including GST, other taxes etc) shall be submitted online only. In addition, breakup of the Lump Sum offer as per the "Form F"is required to be submitted/uploaded online only in "ENVELOPE "C" on Bidder's letter head with seal and signature. Physical submission of Envelope C shall not be considered.

Note:

i. The tenderer who was blacklisted will not be allowed to bid for this tender. The tenderer shall submit an Affidavit in this regard.

ii. Bidder has to submit Certificate of Turnover of last 5 years clearly highlighting year wise Construction Turnover, duly signed by a Practicing Chartered Accountant along with seal and UDIN of CA issuing the certificate. (For Calculation of Component A in case of Bidding Capacity). In the absence of above requirements, bids shall be rejected.

iii. In the event of withdrawing his/her offer before the expiry of the period of validity of offer or failing to execute the agreement as required by conditions of the notice inviting tender (N.I.T.) he/she will not be entitled to tender for this work in case of recall of tenders. In addition to forfeiture of his/her earnest money as per provisions of tender condition as may be applicable for the work, the Commissioner Municipal Corporation Korba will restrict the contractor/firm for a period of one year in participation of all tenders. If the tenderer has

committed a similar default after restriction period on earlier occasion(s) as well, then COMMISSIONER will recommend for demotion in registration to the committee of 'Unified Registration System' (e-Registration) with Chhattisgarh P.W.D. State Governments will be permanently. This special condition will supersede anything contrary to it in the tender document.

iv. Bidders are advised to go through the Notice Inviting tenders & the complete tender document /P.Q/Bid Capacity document thoroughly and all Certificates, appendices, enclosures as mentioned in the document will have to be submitted by the bidders strictly in the prescribed format, at the time of submission of Technical bid, failing which the bidder shall disqualify for the work & his financial offer of the bidder shall not be opened and no representation, appeal or objection, what so ever in this regard shall be entertained by the department.

1.2 SPECIAL CONDITION- DELETED

SYSTEM TENDER No. 161753 (1st Call)

NIT No./--/KMC/AMRUT/2024-25

Korba Dated 26/11/2024

Table 1: Key Dates

Task	Date	Time
Bid Start Date	26.11.2024	**15:31**
Prebid Meeting	04.12.2024	**15.00**
Date of Site Visit	04.12.2024	**12.00**
Bid Due Date	20.12.2024	**17:30**
Physical Doc Submission End Date	24.12.2024	**15:00**
Bid Open Date (Scheduled)	24.12.2024	**16:00**

26.11.24

Commissioner
Municipal Corporation,
Korba (C.G.)

प्रतिलिपि :– प्रोग्रामर, संचालनालय, नगरीय प्रशासन एवं विकास विभाग, नया रायपुर (छ.ग.) को uad.cg.gov.in में अपलोड किये जाने हेतु प्रेषित।

TENDER/NIT HEADER DETAIL

ORGANIZATION NAME	Urban Administration and Development Department (UADD)	PROCUREMENT CATEGORY	WORKS
TENDER NO.	161753	TENDER DEALING OFFICER	- Bhushan Ram Oraon(DFLT)
NUMBER OF ITEMS ALREADY ATTACHED	0	MATCHING	NO
CURRENCY	INR - INDIAN RUPEE	TENDER CATEGORY	LUMPSUM
NIT TYPE	RESTRICTED TENDER		
VENDOR CLASS	A	OFFICE/DIVISION(PWD) NAME	COMMISSINOR, MUNICIPAL CORPORATION, KORBA
PROBABLE AMOUNT OF CONTRACT(PAC) [INR]	1069440000.00	SECTION/CIRCLE(PWD) NAME	TENDER SECTION
DIVISION / DISTRICT NAME	MUNICIPAL CORPORATION, KORBA		
DESCRIPTION	F.No. 8098/Water Supply/2024/KMC		
DETAILED DESCRIPTION	Construction, Testing, Commissioning of all the Components of Korba Sewage Master Plan Including Fifteen Years Operation & Maintenance of Entire System (under AMRUT 2.0).		
IS AUCTION ENABLED?	N	BID PART NUMBER	1
NUMBER OF BID PART(S)	2		

ATTRIBUTE(S)

ATTRIBUTE NAME	ATTRIBUTE VALUE
BID VALIDITY PERIOD (in days)	120
Tender / Work Completion Time (in months)	27(VALUE)
Required Past Technical Experience	As per RPF/NIT
Required Financial Turnover (in INR)	AS PER NIT
Required Bid Capacity (in INR)	AS PER NIT

PAYMENT DETAILS

DETAILS	
Tender/Processing/Bid Fees	N/A
EMD/Bid Security	5348000.00 INR

DATE-TIME DETAIL(S)

BID SUBMISSION START DATE	Nov 26, 2024 06:00:03:PM	BID DUE DATE	Dec 20, 2024 05:30:35:PM
BID OPEN DATE (SCHEDULED)	Dec 24, 2024 04:00:00:PM	PHYSICAL DOC SUBMISSION END DATE	Dec 24, 2024 03:00:47:PM

PRE-BID DISCUSSION DETAILS

PRE-BID DISCUSSION	OFFLINE	PRE-BID END DATE	Dec 4, 2024 05:00:28:PM
PRE-BID MEETING START DATE	Dec 4, 2024 03:00:07:PM		

ALTERNATE BID DECRYPTOR(S)

USER DETAILS
MR BUYER ADMIN(DFLT)
- Mitresh Verma(DFLT)
- Bhushan Ram Oraon(DFLT)

TERM AND CONDITION DETAIL(S) - SPECIAL TERM(S)

SL. NO.	CATEGORY	DESCRIPTION
1	SPECIAL TERM(S)	SPECIAL TERM(S) As per RPF/NIT

TENDER SPECIFIC REQUIRED ATTACHMENT(S)

Envelop B

SL. NO.	SUPPORTING DOCUMENT NAME	MANDATORY	ALLOW EXEMPTION	GROUP
1	Power of Attorney/Letter of authorization to sign the bid	YES	NO	OTHER
2	Partnership deed /MOA of company	YES	NO	OTHER
3	Technical & Financial prequalification documents	YES	NO	OTHER
4	BID CAPACITY	YES	NO	OTHER
5	Affidavit regarding Balance amount of work in hand	YES	NO	OTHER
6	ITR of last five years (up to 31-03-24)	YES	NO	OTHER

KORBA MUNICIPAL CORPORATION

CONSTRUCTION, TESTING, COMMISSIONING OF ALL THE COMPONENTS OF KORBA SEWAGE MASTER PLAN WITH 15 YEARS OPERATION AND MAINTENANCE

TENDER DOCUMENTS

Form "F"
(Lump-sum Contract)

E-Procurement Tender Notice
Portal: http:/eproc.cgstate.gov.in

(PAC Rs.10694.40 Lacs)

COST OF TENDER DOCUMENT& BID PROCESSING FEE – Rs.10,000.00

OFFICE OF THE COMMISSIONER MUNICIPAL CORPORATION, KORBA CHHATTISGARH

Web site: www.KorbaMunicipal.in
E-mail:corporation@gmail.com

OFFICE OF THE MUNICIPAL CORPORATION, KORBA CHHATTISGARH

NOTICE INVITING TENDER

Main Portal: https://eproc.cgstate.gov.in

SYSTEM TENDER NO/----------/NIT NO: ----------/Dated----/----/2024

Online tender are invited by the Commissioner, Municipal Corporation, Korba for the following work in Form "F" for lump Sum contract from the contractors registered with Unified Registration System (Single Window) on GoCG PWD & e-Procurement System Portal (https://cgeprocurement.gov.in) through sub portal https://uadd.cgeprocurement.gov.in as per the 'key Dates' mentioned below. All other conditions for submission of tenders and criteria for prequalification etc. have been mentioned in the tender documents.

1.	**Name of Work**	**Construction, Testing, Commissioning of all the Components of Korba Sewage Master Plan Including Fifteen Years Operation & Maintenance of Entire System.**
2.	**Probable amount of contract**	**Rs10694.40 Lacs**
3.	**Earnest money(EMD)**	**Rs 53.48 Lakh (Rupees Fifty Three Lakh Forty Eight Thousand only)** TDR/FDR in favour of Commissioner, Municipal Corporation Korba. **Note**: - The EMD should be valid for at least 12 months in auto-renewal mode. EMD will be returned to unsuccessful bidders after the award of contract.
4.	**Time allowed for completion(Including rainy season)**	**27** months (including **03 (three) months** trial run and rainy season)
5.	**Cost of Tender document fee**	Rs 10000/- (Rupees Ten Thousand only) in the form of DD in favour of Commissioner, Municipal Corporation, Korba
6.	**Validity of Offer**	120 days from the day of submission of financial offer
7.	**Site Visit and Pre bid meeting**	**1. A Site visit will be organized by the Commissioner/Nodal Officer Amrut Mission 2.0, Korba, Chhattisgarh** (as per tender Notice) **2. A Prebid meeting in context of this project shall be held in the office of Commissioner office Korba**, **Chhattisgarh**(as per tender Notice)

For further clarifications regarding Digital signature, The Bidders may contact **M/s Mjunction Service Ltd.**, on helpdesk Toll free number **1800 419 9140** or through Email ID pro-chips@gov.in they may contact to **Mr. Shailesh Kumar Soni, Sr. Manager, Infotech and Biotech Promotion Society (CHIPS) on Tel. No. 0771-4014158**

The tender documents containing detailed terms & conditions are available for free download on GoCG e-Procurement portal http://cgeprocurement.gov.inthrough sub portal of Urban Administration Development Department http://eproc.cgstate.gov.inBidders have to quote online their prices along with Technical and Commercial bids in prescribed formats on the above mentioned portal only.

The Bidders intending to participate in this Tender are required to get enrolled on the above-mentioned website and get empanelled on the Sub-Portal of Urban Administration &Development Department. Enrolment on the above-mentioned Portal is mandatory. As the online Bids are required to be digitally signed, Bidders are required to obtain Class – II Digital Signature Certificates (DSCs).

The Bidders are also invited to get themselves trained on the operations of the e-Procurement System. Bidders may get in touch with the Service Provider of the e-Procurement System for confirming the time and date for their training session.

Commissioner
Municipal Corporation,
Korba (C.G.)

INDEX

OFFICE OF THE MUNICIPAL CORPORATION,
KORBA, CHATTISGARH
DETAILED NOTICE INVITING TENDER

SYSTEM TENDER NO/----------/NIT NO: ----------/Dated----/----/2024

Online tender for the works mentioned below are invited by the Commissioner, Municipal Corporation, Korba for the following work in Form "F" for lump Sum contract from the contractors registered with Unified Registration System (Single Window) on GoCG PWD Department & e-Procurement System Portal (https://eproc.cgstate.gov.in) as per the 'key Dates' mentioned below. All other conditions for submission of tenders and criteria for prequalification etc. have been mentioned in the tender documents and prequalification documents.

Name of work	Probable amount of contract (Rs. in Lacs)	Earnest money (Rs. in Lacs)	Time allowed for completion	Cost of Tender Document (in Rupees)	Validity of the Offer (After opening of financial bid)	Class of the Contractor
Construction, Testing, Commissioning of all the Components of Korba Sewage Master Plan Including Fifteen Years Operation & Maintenance of Entire System **1**. Design and construction of Diversion weir at Kosabadi Nalla. 2. Investigation, Design & Construction of Interception Cum Diversion Chambers/Weirs for 11 Nos. At various nallas along the bed of Hasdeo River with manual screens, grit and diversion chambers. 3. Investigation, Designing and Construction of Kosabadi Wet Well with Pump houses and Screens. 4. Providing and installation of 1500 KVA substation at Kosabadi wet well & 33 MLD STP capacity 1500 KVA 5. Investigation, Designing and Installation of raw sewage Pumping Machinery for Kosawadi Nalla Wet well with all allied works. 6. Providing, Lowering, Laying, jointing & testing 700mm Dia DI K-9 pipes 9174 Mtr pumping main from Kosawadi Wet well to STP at Pragati	**10694.40**	**53.48**	**27 months (including rainy season)**	**10000.00 (Rupees Ten Thousand only)**	**120 days**	**In Class 'A'**

Name of work	Probable amount of contract (Rs. in Lacs)	Earnest money (Rs. in Lacs)	Time allowed for completion	Cost of Tender Document (in Rupees)	Validity of the Offer (After opening of financial bid)	Class of the Contractor
Nagar. 7. Interceptor sewer line from Gerva Nalla to Kosabadi. 8. Investigation, Design &Construction of MS Truss Bridge on RCC Piers across Hasdeo River for a Length of 750M to accommodate 700mm Dia Raw sewage pumping Main including providing and fixing jointing testing and commissioning 700mm Dia 10mm thick MS pipes on MS chairs and interconnection with DI pipes. 9. Investigation, Designing and Construction of 33 MLD STP based on SBR Technology (With 4 Basins) for Secondary Treatment with all allied Civil works such as Compound Wall, Internal Roads, Beautification and landscaping etc. Complete. All Electro-mechanical works with PLC & SCADA for entire system. 10. Allied civil work & Quarters. 11 Land development work at Wet well. 12. Operation and maintenance of entire scheme including Solar power plant for 15 years						

1.1 NOTE:

1. Registration and subsequent empanelment for e-tendering website (Sub-portal)https://eproc.cgsstate.gov.inand department's sub-portal is mandatory.
2. The tender documents containing detailed terms & conditions are available for free download on GoCG e-Procurement portal (http:/eproc.cgstate.gov.in) Bidders have to quote online their prices along with Key Submission and Technical bid (as per PQ criteria) in prescribed formats on the above mentioned portal as per the details mentioned in the tender document.
3. The Bidders intending to participate in this Tender are required to get enrolled on the above mentioned website. Enrolment on the above mentioned Portal is mandatory. As the online Bids are required to be digitally signed, Bidders are required to obtain Class – II Digital Signature Certificates (DSCs). The Bidders may contact **M/s Mjunction Service Ltd.,** on

helpdesk Toll free number **1800 419 9140** or through Email ID – pro-chips@gov.in or they may contact to **Mr. Shailesh Kumar Soni, Sr. Manager, Chhattisgarh Infotech and Biotech Promotion Society (CHIPS) on Tel. No. 0771-4014158**.

4. The Bidders have to digitally sign their bids before submitting the bids hashes online. Thus, the Bidders are advised to obtain Digital Certificates. The registered contractors may obtain information required for issuance of a Class II Digital Signature Certificate from the Controller of Certifying Authorities(www.cca.gov.in) or the Service Provider of eProcurement System for Government of Chhattisgarh.
5. Validity of offer - 120 days from last date of opening of financial offer.
6. The Technical offer shall be opened in presence of the Bidders or their authorized representatives, who may choose to be present. The date and place of opening of financial offer will be intimated to the Qualified Bidders subsequently after opening of technical offer.
7. The department reserves the right to change the key dates of the tender process.
8. Sufficient hindrance free space is available for construction.
9. Bidders are advised to visit the site sufficiently in advance of the date fixed for the submission of the tender at their own cost. The Tenderer shall be deemed to have full knowledge of all relevant documents and site conditions, assessment of work etc. whether the bidder inspects it or not.
10. A Prebid meeting in context of this project shall be held as stated above in NIT. The contractors shall give their suggestions and conditions in writing based on which Corrigendum/Amendments/clarifications shall be framed and uploaded which will supersede the original NIT Conditions unless otherwise specified.
11. Cess @ 1 % (one percent) or latest shall be deducted at source from every bill of contractor under "Building and other Construction for workers welfare, cess Act-1996.
12. The Municipal Corporation reserves the right to reject any part of/whole tender without assigning any reason and to restrict the list of pre-qualified bidders to any number deemed fit by it.
13. If any pre-qualified bidder withdraws his offer before the validity period or makes/propose any modifications in the terms and conditions of the tender, the earnest money of said bidder shall stand forfeited.
14. Before the deadline for submission of tender, the Commissioner, Korba Municipal Corporation can modify tender document by issuing amendment.
15. NIT Details, Prebid meeting minutes and Any amendment thus issued shall be part of the tender document and shall be published on website.
16. The bidders are required to submit 'Envelope "A & B" physically and online as per dates Indicated in Key Dates. The Physical Envelope should contain the following: -

a) **Envelop 'A'** (Key Submission - Submit physically & online)- All the required document submission are mandatory for opening of Technical Bid.

i. The Earnest Money Deposit (EMD)in the form of FDR/TDR of a Nationalised /Scheduled bank of India in favour of the "Commissioner, Municipal Corporation, Korba" payable at 'Korba'.

ii. The tender fee as mentioned in NIT in original with physical Envelope and scan copy (online). It is non-refundable.

iii. Affidavit in Original. (Non-Judicial stamp in 500 Rs.) (as per Enclosed APPENDIX-13 in Tender Documents)

iv. Attested copy of Valid Registration Certificates. CG PWD and (Partnership Deed, registration amendment certificate as the case may be)

v. Attested copy of PAN card issued by I.T. Department.

vi. Attested copy of Valid GST/ CGST Registration must be valid up to Bid due date as per key dates otherwise tender will be disqualified while opening.

vii. Valid Bank Solvency certificate in Bank Letter Head. (Not Older than 12 Months) Mention the Bank Dispatch No. or Ref. No. or Verifiable unique number or Date otherwise tender will be disqualified while opening)

viii. PQ Documents of Technology provider.

ix. The scanned copy of all the documents mentioned above shall also be submitted online.

b) Envelop- 'B"(Technical Bid - Submit physically & online) - Also, the Envelop Shall be submitted physically. In all cases the submission which is online shall prevail.

i. Power of Attorney/Letter of authorization to sign the bid
ii. Partnership deed /MOA of company
iii. Technical & Financial prequalification documents
iv. BID CAPACITY
v. Affidavit regarding Balance amount of work in hand
vi. ITR of last five years (up to 31-03-24)
vii. The bidder should have a positive net worth. The certificate from C.A. shall be attached.
viii. Affidavit regarding not being declared CDR by any bank.
ix. As per Pre-Qualification Criteria mentioned in PQ document. (Appendix-1 to 12)

c) **Envelop- "C" - (Financial Bid - Submit only Online)**

Total Lump sum offer (Cost of works + cost of 15 yrs. O&M) (including GST, other taxes etc) shall be submitted online only. In addition, breakup of the Lump Sum offer as per the "Form F" is required to be submitted/uploaded online only in "ENVELOPE "C" on Bidder's letter head with seal and signature. Physical submission of Envelope C shall not be considered.

Note:

i. The tenderer who was blacklisted will not be allowed to bid for this tender. The tenderer shall submit an Affidavit in this regard.

ii. Bidder has to submit Certificate of Turnover of last 5 years clearly highlighting year wise Construction Turnover, duly signed by a Practicing Chartered Accountant along with seal and UDIN of CA issuing the certificate. (For Calculation of Component A in case of Bidding Capacity). In the absence of above requirements, bids shall be rejected.

iii. In the event of withdrawing his/her offer before the expiry of the period of validity of offer or failing to execute the agreement as required by conditions of the notice inviting tender (N.I.T.) he/she will not be entitled to tender for this work in case of recall of tenders. In addition to forfeiture of his/her earnest money as per provisions of tender condition as may be applicable for the work, the Commissioner Municipal Corporation Korba will restrict the contractor/firm for a period of one year in participation of all tenders. If the tenderer has committed a similar default after restriction period on earlier occasion(s) as well, then COMMISSIONER will

recommend for demotion in registration to the committee of 'Unified Registration System' (e-Registration) with Chhattisgarh P.W.D. State Governments will be permanently. This special condition will supersede anything contrary to it in the tender document.

iv. Bidders are advised to go through the Notice Inviting tenders & the complete tender document /P.Q/Bid Capacity document thoroughly and all Certificates, appendices, enclosures as mentioned in the document will have to be submitted by the bidders strictly in the prescribed format, at the time of submission of Technical bid, failing which the bidder shall disqualify for the work & his financial offer of the bidder shall not be opened and no representation, appeal or objection, what so ever in this regard shall be entertained by the department.

1.2 SPECIAL CONDITION- DELETED

SYSTEM TENDER No. ----------

NIT No./--/KMC/AMRUT/2024-25 Korba Dated --/--/2024

Table 1: Key Dates

Task	Date	Time
Bid Start Date		**17:31**
Prebid Meeting		**14.00**
Date of Site Visit		**11.30**
Bid Due Date		**17:30**
Physical Doc Submission End Date		**16:30**
Bid Open Date (Scheduled)		**17:00**

Commissioner
Municipal Corporation,
Korba (C.G.)

1.3 PRE-QUALIFICATION DOCUMENT

A. Technical Pre-qualification Criteria

The minimum eligibility criteria in respect of particular experience to be fulfilled by the bidder are as follows :

S. No.	PQ Criteria for AMRUT 2.0
The bidders should have executed/completed Procurement Construction / Design-Build /Design-Build Operate contract including design, installation, supply, construction, testing and commissioning successfully of following works within last Seven years: -	
1	Construction of at least one Sewage Treatment Plant based on Any technology but excluding WSP/ Oxidation ponds/Lagoons of capacity not less than 50%(i.e. 16.5 MLD) of the highest capacity of STP mentioned in the NIT in a single contract.
2	Experience of providing, jointing laying, testing and successful completion of Half the diameter of the highest diameter of Raw Sewage Pumping Main (350 mm Dia) DI/MS pipelines for a minimum Half the length of its quantity mentioned in the NIT (5000 m) in a Single Contract.
3	Must have experience of Operation & Maintenance of half of the highest capacity (i.e. 16.50 MLD)of Sewage Treatment plant as mentioned in the NIT but excluding WSP/ Oxidation. ponds/Lagoons for the duration of not less than 3 years under single contract.
4	The bidder must submit Technology tie up agreement on Rs. 500/- Stamp Paper with the technology provider having proven experience in India for providing SBR Technology along with PLC/SCADA for at least half of the highest capacity of STP (i.e. 16.50 MLD) mentioned in the NIT during last 7 years and running successfully the same for at least 3 years. Technology provider shall also have experience of designing the STP for achieving the outlet parameters of BOD ≤10 mg/l, COD ≤50 mg/l and TSS≤ 10 mg/l, TN≤ 10 mg/l and TP<1 mg/l. i. Technology provider shall have registered office in India. ii. Technology provider shall be jointly and severely responsible for performance of the STPs. He shall attend all review meeting as and when called by KMC. iii. Technology provider can tie up with multiple bidders; however, he cannot participate directly in the bidding as a Main bidder or as JV Partner. Otherwise, his bid will be rejected. iv. The lowest bidder must submit PBG of Rs. 10.00 Lakhs from the technology provider along with PQ documents within 7 days of Lol. The PBG of technology provider shall be retained

	by KMC and shall only be released after successful completion of the defect Liability period. The PBG shall be in favour of "The Commissioner" KMC.
5	**Joint Venture** - Not Allowed
Note:-Either bidder or their MOU partners should not be blacklisted/ debarred from any of the department/ULBs/PSUs.	

Note:-The experience certificate of work executed in Govt./Semi Govt./Public Sector undertaking/Municipal Corporations, issued by an officer not below the rank of Executive Engineer shall be acceptable. The Experience certificate of successful completion of work in contractor's/firm's/company's own name indicating name of work, Agreement no. work order no. and date, amount of contract, stipulated period of completion, actual period of completion during last seven years i.e 2017-18 to 2023-24 shall be acceptable.

Any subcontracting work done anywhere in India, during last seven years, with prior approval of competent Authority (Govt/Semi Govt/Corporations),such subcontractor will also get the credit for work towards his experience.

Experience of work done by way of subletting directly from Prime contractor without prior approval of competent authority will not be considered.

B. Financial Pre-qualification Criteria

To qualify in the Tender bidder must have financial experience in last Five years.

S. No.	PQ Criteria for AMRUT 2.0	Value of work(Qualifying Value)	PAC Value Rs. 10694.40 Lacs
1.1	Experience for Last 5 years will be considered		
1.2	Achieved in "any one financial year" a financial turnover (in all classes of Construction Works (Civil)) value of construction work of at least 60% (Sixty percent) the amount equal to the probable amount of contract for which bid has been invited. **And**	Rs.6416.64 In Lacs	60%

	Satisfactorily completed at least one similar work equal in value 50% (fifty percent) of the Probable amount of contract as on date of submission of financial offer. **Or** Satisfactorily completed at least two similar works each costing minimum 40% (forty percent) of the probable amount of contract for which the tender is invited as on date of submission of financial offer. **Or** Satisfactorily executing at least one similar work having received payment of value not less than 60% (Sixty percent) of the value of probable amount of contract as on date of submission of financial offer.	Rs.5347.20 in In Lacs Rs.4277.76 In Lacs Each Rs.6416.64 In Lacs	50% 40% 60%
2	**Bid Capacity = (2.5 x A x N) - B** Where A= Maximum value of works executed in any one financial year during the last 5 years (with 10% compounded rate per year). Where N = Period of completion in years (shown in NIT) Where B = Value of works in hand The bid capacity of contractor/firm/company should be equal or more than the PAC shown in NIT.		

Note: -

1. "Similar work" means- successfully completed sewage treatment plant based on any Technology/Sewerage Projects with STP.
2. Contractor has to submit Certificate of Turnover of last 5 years clearly highlighting year wise Construction Turnover, duly signed by a Practicing Chartered Accountant along with seal and UDIN of CA issuing the certificate (For Calculation of Component A in case of Bidding Capacity). In the absence of above requirements, bids shall be rejected.
3. The turn over shall be indexed at the compounded rate of 10 %(ten percent) for each earlier year.

The value of completed work shall be updated to the values of current financial year @ compounded rate of 10% (Ten percent) per year from completion year of work. The completion year shall be taken as base year.

Even though the tenderer meets the above qualifying criteria, they are subject to be disqualified if they have:

(i) Made misleading, incorrect or false representations in the forms, statements, affidavits and attachments submitted in proof of the qualification requirements.

Other condition including qualification and details of work can be seen in the office of the undersigned during office hours and downloaded online directly from the portal http:// eproc.cgstate.gov.in and shall be submitted online on or before date mentioned above. This NIT shall also form the part of agreement. The details can be viewed on the website http://eproc.cgstate.gov.in .

Commissioner
Municipal Corporation
Korba (C.G.)

2.0 DELETED

2.4 LEAD AND LIFT FOR WATER

The contractor shall make his own arrangement for supply of water for construction, testing and other purposes. No lead and lift for water will be paid.

2.5 LEAD AND LIFT OF MATERIALS

No lead and lift for any material will be paid. The tendered amount should be inclusive of all lead and lift for the materials. The contractor should himself verify the lead of different materials before submitting his tender.

The contractor will have to arrange for the temporary electric connection at site of work at his own cost for dewatering, curing, vibrator, testing and internal and outside electric fittings, etc.

3.0 INSTRUCTIONS FOR BIDDERS

3.1 SUBMISSION OF TENDERS

The Bidders shall Also, have to submit Bids online (decrypt the bids using their Digital Certificate and encrypt the bids) as per mentioned key dates. There shall be three separate Online envelopes as under:-

1) **ENVELOPE - A** (Submit physically & online)

The first online envelope shall contain the details of Earnest Money, scanned copy of the Physical Earnest Money. The envelope shall contain documents as mentioned in detailed in respective NIT clause.

The Physical Earnest Money which is to be submitted manually in Physical Envelope –A where it should be clearly written on the envelope as under:-

ENVELOPE - A

EARNEST MONEY

From - (… Name of Contractor…)

and should reach Commissioner, Municipal corporation, Korba. as per date and time mentioned in the key dates.

2) **ENVELOPE - B** (Submit physically & online)

The Second Online envelope shall contain terms and conditions and all the technical details and specifications of the proposed work and documents as mentioned in respective NIT clause. The Scanned copy of terms and conditions, along with technical specifications and drawings etc.

i. Experience certificate of successful completion of work of same nature in contractor's/firm's/company's own name indicating agreement no., work order no. and date, amount of contract, stipulated period of completion, actual period of completion during last seven year i.e. 2017-2018 to 2023-2024. The certificate should be issued by an officer not below the rank of Executive Engineer and shall be countersigned by the officer not below the rank of Executive Engineer or equivalent. The experience of Sublated works shall not be considered.

ii.The details of works in hand indicating name of work, Agreement no., work order no., and date, amount of similar contract, period of completion, value of work and balance work in hand with details of work on the date of submission of Tender.

iii. Valid registration certificate in Class 'A'.

iv.Financial turnover of similar works during last five financial years i.e. 2019-2020 to 2023-2024and prequalification documents in footstool be submitted online in Envelope "B".

3) **ENVELOPE - C** (Submitonlyonline)

This Envelope shall contain only the Lump-sum offer. The tenderer shall have to duly fill their Lump-sum offer in appropriate online form meant for it.

3.2 EARNEST MONEY

Tenderer will submit with the Earnest Money, **Rs.53.48 lakhs only** in the form of Fixed Deposit Receipt/Term Deposit Receipt in favour of the "**Commissioner, Municipal Corporation, Korba**payable at "**Korba, Chhattisgarh**". This will be returned to the unsuccessful tenderer. The Earnest Money of the successful tenderer will be retained as part of the Security Deposit.

3.3 FORM OF EARNEST MONEY

In shape of FDR/TDR from Nationalised bank or scheduled bank drawn in the favour of "**The Commissioner, Korba Municipal Corporation, Korba**" payable at Korba will be submitted by the bidder. The maturity date shall be till the end of 12 months.

3.4 EARNEST MONEY IN SEPARATE COVERS

The Earnest Money, in any one of the prescribed forms should be deposited as mentioned under respective para of NIT. If the Earnest Money is not found in accordance with the prescribed mode, the tender of the tenderer shall not be opened.

3.5 ADJUSTMENT OF EARNEST MONEY - DELETED

3.5.1 REFUND OF EARNEST MONEY

(i) If it is decided on the same day to reject all the tenders, the earnest money of all tenderers shall be refunded immediately after taking decision by the competent authority.

(ii) The earnest money of tenderers whose tenders are rejected shall be refunded.Also,in case ofthe tenderer whose tender is accepted, and /or conveyed after expiry of thevalidity period,Earnest money shall be refundable unless validity period extended by the tenderer.

3.6 SECURITY DEPOSIT

(i) The Security Deposit to be taken for the due performance of the contract under the terms and conditions printed on the tender form will be the earnest money plus an amount to make it equal to 5% (five percent) of the accepted cost of the work, as per clause 1 of condition of contract of form "F". The five percent Security Deposit may be converted into Fixed Deposit Receipt of any Nationalised and Scheduled

Bank. The security deposit shall be recovered from the running bills @ 5 percent as per clause-1 of the condition of contract..

(i) 5% security deposit shall be deducted from each running bill. One moity of security deposit shall be refunded on completion of work as certified by the engineer in charge. The balance 50% amount shall be refunded on completion of defect liability period or settlement of final bill, whichever is later.

(ii) The Security Deposit for O & M period shall be returned after the 15 years period is over and the property has been taken over by KMC.

(iii) The amount of the E.M.D. shall not be adjusted when value of work done reaches the limit of the amount of contract or exceeds the probable amount of contract.

3.7 IMPLICATION OF SUBMISSION OF TENDERS

Bidders are advised to visit the site sufficiently in advance of the date fixed for the submission of the tender. The Tenderer shall be deemed to have full knowledge of all relevant documents and site conditions etc. whether bidder inspects it or not.

3.8 The submission of a tender by the bidder implies that he has read the notice, conditions ofthe tender and al the contract documents and has made himself fully aware of all the standards and specifications in this respect laid down in the relevant is specifications, IRC specifications, CPHEEO manual on Sewerage and sewage treatment, and annexure-e having the scope and the specification of the work to be done. The bidder will be deemed to have seen the site of works.

The bidders shall make their own arrangement for supply of water for construction, purposes. No lead and lift for any material including water will be paid. The tender offer should be inclusive of all leads and lifts for the materials. The bidder should himself verify the leads &Royalty Charges of different materials before submitting the tender

3.9 INCOME TAX CERTIFICATE – CLAUSE DELETED

3.10 ESCALATION

The scope of work includes all costs, and no escalation will be paid on this account.

3.11 LIST OF WORKS IN PROGRESS

Tenders must be accompanied by a list of Contracts already held by the tenderer at the time of submitting the tender, in the Department and elsewhere showing therein. The amount of each contract balance of work remaining to be done and the amount of solvency-certificate produced by the bidder at the time of enrolment in the department

3.12 RELATIONSHIP

The bidder shall not be permitted to tender for works in the Corporation, (responsible for award and execution of contract) in which his near relative is posted. He shall intimate the names of

his near relative working in Chhattisgarh. State and Municipal Corporation, Korba. He shall Also, intimate the name of person working with him in any capacity or subsequently employed by him and who are near relatives to any Gazetted Officer in the Chhattisgarh. Any breach of this condition by the bidder would render himself liable to be removed from the approved list of contractors.

NOTE: - By the term "near relative" is meant wife, husband, parents and son, Grandson, brothers, sisters, brothers in laws, father in law and mother in law.

4.0 OPENING AND ACCEPTANCE OF TENDERS

4.1 PLACE AND TIME OF OPENING

The tenders shall be opened at time and place stated in para 1. In the first instance, the Physical envelope containing the earnest money shall be opened. If the earnest money is found proper, the online envelope -A containing the Earnest Money details, its scanned copy and scan copy of documents required as minimum qualification to bid shall be opened. If the tenderer found qualified as per minimum qualification, the online Envelope B containing the terms and conditionsminutes of Prebid meeting (amendments/corrigendum/clarifications) will be opened in the presence of such contractors, who choose to be present.

The tenders shall be opened at time and place stated in Detailed Tender Notice. In the first instances, the documents required as minimum qualification to bid shall be opened. If the tenderer found qualified as per minimum qualification, the online Envelope B will be opened in the presence of such contractors, who choose to be present.

After short listing of prequalified contractors, their online financial offers shall be opened. The contractor having quoted lump sum offer in prescribed online proforma and arrived at a minimum cost shall be declared as the lowest bidder.

4.2 POWER OF THE COMMISSIONER/ EXECUTIVE ENGINEER

The Commissioner/ Executive Engineer does not bind himself to accept or recommend for acceptance to the higher authority, the lowest or any tender or to give any reasons for his decision.

4.3 CONDITIONAL TENDER

Conditional tenders are liable to be rejected.

4.4 CANVASSING

Canvassing for support in any form for the acceptance of any tender is strictly prohibited. Any tenderer doing so will render himself liable to penalties which may include removal of his name from the Register of approved contractors of penal action under section 8 of M.P. VinirdishtaBhrashtacharacharanNivaranVidheyak, 1982.

4.5 SUBMISSION OF TENDER

Sealed envelope of EMD and other sealed envelope stipulated in the NIT after received before the stipulated date shall only be opened.

4.6 AUTHORITY OF EXECUTIVE ENGINEER

The authority competent to accept a tender, reserves the right for accepting the tender for the whole work or for a distinct part of it, or distributing the work between two or more Bidders.

All works to be executed under this contract shall be executed under the direction and subject to the approval in all respects, of concerning Engineer-in-charge of the Municipal Corporation Korba under which the work is being executed, he shall be entitled to direct at what point or points and in what manner works are to be commenced and from time to time carried out.

4.7 VALIDITY OF OFFER

Tender shall remain valid up to 120 days from the last date of submission of financial offer and in the event of the Bidders withdrawing the offer before the aforesaid date for any reason whatsoever, Earnest Money Deposited with the tender shall be forfeited to the Government.

4.7.1 In the event withdrawing their offer before the expiry of the period of validity of offer or failing to execute the agreement as required in notice inviting tender (N.I.T.), the bidder will not be entitled to tender for this work. In case of recall of tenders, in addition to forfeiture of their earnest money as per provisions of condition of the N.I.T., as may be applicable for the work, if the bidder has committed a similar default on earlier occasion(s) as well, then their registration in the department may be suspended temporarily for a period of 2 (two) years, from such date as may be ordered by the authority who had registered the bidder.

5.0 SPECIFICATIONS

5.1 The detailed specifications for the work have been given in the enclosed Annexure-E. However, the following order of priority regarding specifications shall be followed by the contractor. Specifications given in the Annexure-E enclosed.

5.2 Specifications for pipes, valves, specials, rubber, gaskets RCC and other civil works and materials shall be governed by the relevant latest IS codes, CPHEEO Manual and National Building code of India (latest revision).
Manual on Sewerage& Sewage Treatment (latest edition) published by CPHEEO, New Delhi. Any other specifications, not covered under the above said standards, as shall be decided by the Engineer-in-Charge i.e. Executive Engineer.

5.3 Workmanship

(i) The Contractor shall ensure that the Materials and workmanship are in accordance with the requirements specified in this Agreement, Specifications and Standards and Sound Engineering practice. The work shall be of the specified quality and standard, both in respect of ingredients as well as the intended functions it is supposed to perform for service life.

(ii) The Contract warrants that all Materials shall be new, unused, not reconditioned, unless otherwise allowed as per contract or by Engineer-in-Charge, and in conformity with Specification and Standards, Applicable Laws and Sound Engineering Practice, and that the Contractor shall not use any materials which are generally recognized as being deleterious under Sound Engineering Practice.

Quality Assurance System

The Contractor shall devise a quality assurance mechanism to ensure compliance with the

provisions of this Agreement (the "Quality Assurance Plan" or "QAP").

(i) The Contractor shall, submit to the Engineer-in-Charge, its Quality Assurance Plan 15(fifteen) days in advance of start of the execution stage specified in the NIT. The Engineer-in-Charge shall convey its comments to the Contractor within a period of 7 (seven) days of receipt of the QAP stating the modifications, if any, required and the Contractor shall incorporate those in the QAP conforming with the provisions of this clause. The QAP shall include the following:

(i) Contractor's Organization & structure, duties and responsibilities of individual key personnel, quality policy of contractor, procedure for control of nonconformities and corrective action, inspections and documentation.

(ii) Internal quality audit system.

5.4 Specification for building work(Including water supply and sanitary fittings.)

The contractor shall execute the work in conformity with the standards and procedure laid down latest CPWD specifications/ISI codes for buildings or special specification whenever enclosed separately and in accordance with the approved drawings.

5.4.1 **Concrete**

All concrete shall be Mixed in concrete mixer and compacted by mechanical vibrators. Slump test shall be carried out during concreting and sample test cubes prepared and tested for strength in accordance with the code. The Department will carryoutthetestingatthecostofcontractor.

The results of the tests shall conform with the required standard and if the Engineer-in- charge considers that a structural test is necessary, the same shall be carried out as instructed by the Engineer-in-charge at the contractor's expense and should the result of this be unsatisfactory the contractor will be bound to take down and re-construct the particular portion of which has given unsatisfactory test results.

5.4.2 **Bricks**

The contractor should use the bricks manufactured on the metric system, as far as possible.

5.4.3 Timber

All timber used in the woodwork for works must be properly seasoned. In case of important buildings mechanical seasoning should be done in good seasoning plant.

In case the contractor does not procure good, seasoned wood, he may be asked to get it seasoned in plant at his own expense.

Maintenance of roofs. Subject to the provision in the agreements, it will be the responsibility of the contractor to see that the roof does not leak, during the period of the first rainy season in respect of tile and sheet roofing and two consecutive

rainy seasons in respect of lime concrete and cement concrete terraced roof, after its completion. He will make good and replace all the defective work on this account at his own cost.

5.5 SPECIFICATION OF ELECTRICALWORKS

5.5.1 The work will be carried out as per the approved drawing and as directed by the Electrical Inspector PWD The work will be governed by "General specifications" for the Electrical works in Government buildings in Madhya Pradesh in force from 1972. All electrical materials must bear the “I.S.I.” mark.

5.5.2 All samples of electrical accessories should be got approved from the Engineer-in-charge prior to their use in work. The contractor will have to arrange and afford all facilities for their inspection and rectify the defects pointed out by them. The item involved in the Electrical work is enclosed in Annexure E Chapter 14.

5.5.3 The period of testing and refund of the deposit will be 6 months after completion of work.

5.5.4 In case of supply of ceiling fan, table fan, exhaust fan, cabin fan, tube light fixtures will be made by the Department as mentioned in the S.O.R. As such, labour rates only as per S.O.R. will be paid for fitting of such items in position as per S.O.R.

5.5.5 The contractor should submit an “as-built” detailed wiring diagram on tracing cloth showing the point position of switch length of point, position of D.B., and main switch circuit No. in which points fall at the time of the final bill. Otherwise, a deduction of 1/2 percent (Half percent) will be made from the contract sum of all electrical items.

5.6 SPECIFICATIONS FOR ROAD/ BRIDGE/ CULVERT WORKS.

The road/bridge/culvert works shall be carried out according to MORTH specificationsfor road & bridge works / Specifications for Rural roads, its manual / specification in force and/or special specification or the relevant specifications published by the Indian Road Congress.

5.7 CONTRADICTIONS OR AMENDMENTS

In the event of contradiction between the stipulationsof the Schedule of rates (schedule of raterelevant to this NIT) and aforesaid specification(vide Para 5.1 to 5.6 above) the stipulations of the schedule of rates shall gain precedence.In the event of contradictions, if any, between different specifications and or codes ofpractice, referred to above the decision of Engineer-in-Chief shall be final.

5.8 BLASTING

In case limited/suppressed blasting resorted to by the contractor in excavation of trenches, it will be the responsibility of the contractor to observe all rules and regulations permission licence, procurement, preservation and storage of Explosive material etc.

5.9 CHANGE IN SPECIFICATIONS

Nothing in earlier clause shall, However, curtail the right of the Executive Engineer to alter the specifications for any part or whole of the work if he considers it necessary in the interest of work. On all matters where there is difference of opinion, between the contractor and the Executive Engineer, the matter will be decided by the Commissioner, Municipal Corporation Korba, which shall be binding to the bidders.

6.0 SUPPLY OF MATERIALS

6.1 CEMENT

The Contractor shall procure minimum 43 grade, unless otherwise stated separately confirming to BISSpecifications, ordinary Portland cement, as required in the work only, from reputed manufacturers of cement having a production capacity of one million tons per annum or more, and as approved by Employer, Ministry of Industry, Government of India and holding license to use BIS certification mark for their product, whose name shall be got approved from Engineer-in-Charge. Supply of cement shall be taken either in silos or in 50 kg. bags bearing manufacturer's name and BIS marking. Samples of cement arranged by the Contractor shall be taken by the Engineer-in-Charge and got tested in accordance with provisions of relevant BIS codes. Cost of such tests shall be borne by the contractor. In case test results indicate that the cement arranged by contractor does not conform to be relevant BIS codes the same stand rejected and shall be removed from the site by the Contractor at his own cost within one week time of written order from the Engineer-in-charge.

The cement shall be brought at site in bulk supply of approximately 50 tons from the manufacturer direct, or as decided and approved by the Engineer-in-charge, as the case may be.

The cement godown of the sufficient capacity should be constructed by the contractor and at all time it should have a stock of minimum of 2000 bags. The contractor shall facilitate the inspection of the cement godown by the Engineer-in-Charge at any time. Storage of cement shall be as per CPWD specification.

CEMENT BROUGHT AT SITE AND CEMENT REMAINING UNUSED AFTER COMPLETION OF WORK SHALL NOT BE REMOVED FROM SITE WITHOUT WRITTEN PERMISSION OF THE ENGINEER-IN-CHARGE.

7.0 MISCELLANEOUS CONDITIONS

7.1. SUBLETTING WORK

The contractor shall not without the prior approval of the authority who has accepted the tender in writing, sublet or assign to any other party or parties, any portion of the work under the contract. Where such approval is granted, the contractor shall not be relieved of any obligation or duty or responsibility, which he undertakes under the contract. However, such subletting in no case be more than 25 % of contract value. But if required can be increased up to 50(fifty) % with the prior permission of the next higher authority accepting the tender or the Government as the case may be.

7.2 TAXES

7.2.1

(i) GST, Building and other Construction Workers Welfare Cess or any other tax, levy or Cess in respect of input for or output by this contract shall be payable by the contractor and KMC shall not entertain any claim whatsoever in this respect except as provided under Clause 7.2.2.

(ii) The contractor shall deposit royalty and obtain necessary permit for supply of the red bajri, stone, kankar, stone aggregate, earth, sand etc. from local authorities. (iii) If pursuant to or under any law, notification or order any royalty, cess or the like becomes payable by the Government of India and does not any time become payable by the contractor to the State Government, Local authorities in respect of any material used by the contractor in the works, then in such a case, it shall be lawful to the Government of India and it will have the right and be entitled to recover the amount paid in the circumstances as aforesaid from dues of the contractor.

7.2.2

(i) All tendered rates shall be inclusive of any tax, levy or cess applicable on last stipulated date of receipt of tender including extension if any. No adjustment i.e. increase or decrease shall be made for any variation in the rate of GST, Building and Other Construction Workers Welfare Cess or any tax, levy or cess applicable on inputs. However, effect of variation in rates of GST or Building and Other Construction Workers Welfare Cess or imposition or repeal of any other tax, levy or cess applicable on output of the works contract shall be adjusted on either side, increase or decrease. Provided further that such increase including GST shall not be made in the extended period of contract for which the contractor alone is responsible for delay as determined by authority for extension of time under Clause 5 in Schedule F.

(ii) The contractor shall keep necessary books of accounts and other documents for the purpose of this condition as may be necessary and shall allow inspection of the same by a duly authorized representative of the Government and/or the Engineer-in-charge and shall also furnish such other information/document as the Engineer-in-Charge may require from time to time.

(iii) The contractor shall, within a period of 30 days of the imposition of any such further tax or levy or cess, or variation or repeal of such tax or levy or cess give a written notice thereof to the Engineer-in-charge that the same is given pursuant to this condition, together with all necessary information relating thereto.

7.3 ROYALTY

Minerals extracted for works carried out on behalf of the government, from the quarries in possession of and controlled by the State Government or otherwise is subject to payment of Royalty by the contractor to whom it shall not be refundable.

7.4 MODEL RULES RELATED TO LABOUR, WATER SUPPLY AND SANITATION IN

7.4.1 Labour camps

The contractor will be bound to follow the Model Rules, relating to layout Water Supply and sanitation in labour camps, as per Annexure - A and the provisions of the National Building Code of India, in regard to construction and safety.

7.5 FAIR WAGES

The contractor(s) shall pay not less than the fair wages to labour engaged by him on the work (copy of the Rules enclosed as Annexure - "A")

7.6 WORKS IN THE VICINITY

The Commissionerreserves the right to take up Departmental work or to award works on the contract in the vicinity without prejudice to the terms of contract.

7.7 BEST QUALITY OF QUARRIED MATERIALS

If the quarry material of more than one quality is found, the material approved by the Executive Engineer will only be used by the contractor. If the materials of required Specification is not available in the nearby area/quarry, the contractor shall have to arrange the same from the place where it is available.

7.8. REMOVAL OF UNDESIRABLE PERSONS

The contractor shall on receipt of the requisition from the Executive Engineer, at once remove any person employed by him on the work who in the opinion of the Executive Engineer is unsuitable or undesirable.

7.9 AMOUNT DUE FROM CONTRACTOR

Any amount due to Government from the Contractor on any account of concerning work may be recovered form him as arrears of Land Revenue.

7.10 TOOLS &PLANTS

The contractor shall arrange at his own cost all Tools and Plants required for proper execution of work.

7.11 RIGHT TO INCREASE OR DECREASE OF WORK

The competent authority reserves the right to increase or decrease any item of work during the execution of the contract and the contractor will be bound to comply with the order of the competent authority without any claim for compensation or higher rates for additions and alterations.

7.12 TIME SCHEDULE

The work shall be done by the contractor according to the schedule fixed in consultation with the competent authority. BAR/PERT/CPM chart showing detailed programme shall have to be submitted and adhered to by the contractor.

7.13 TIME OF COMPLETION

The time allowed for carrying out the work i.e.**27**months including rainy season shall be strictly observed and shall be reckoned from the date of issue of written order to commence the work. Delay beyond the specified time limit will be subject to liquidated damages according to clause 13 of Form "F" of Lump sum contract.

7.14 PAYMENTS BY CHEQUES/ ONLINE ACCOUNTING SYSTEM

The running payments shall be made in accordance with the Break up schedule of payment as

per "Annexure F" (form "F")

7.15 TRANSPORT OF MATERIALS

The contractor shall make his own arrangements for transport of all materials. The Executive Engineer is not bound to arrange for priority in getting wagons or any other materials though all possible assistance by way of recommendation will be given if it is found necessary in his opinion, if the recommendation proves to be in-effective, the contractor shall have no claim for any compensation on that account.

7.16 The methodology and equipment, material, labour, transport to be used on the project shall be furnished by the contractor to the Engineer-in-charge well in advance of commencement of work and approval of the Engineer-in-charge obtained prior to its adoption and use.

The contractor shall give a trial run of the equipment for establishing its capability toachieve the laid down specifications and tolerance to the satisfaction of the Engineer-inchargebefore commencement of work, if so desired by the Engineer-in-charge.

All equipment provided shall be of proven efficiency and shall be operated and maintained at all time in a manner acceptable to the Engineer-in-charge.

No equipment or personnel will be removed from site without permission of the Engineer-incharge.

7.17 Programme of Work

The works to be carried out under this Contract form an important part of the execution of this Project, Satisfactory progress of the entire project as a whole depends upon the timely completion of these works. For this reason, great importance needs to be attached for proper programming for the works with adequate provision for guarding against all the delays normally encountered in execution of various activities.

The contractor shall include with his tender a critical path network diagram which commences from the date of issue of Order of Commencement and includes inter alia the various activities as per the programme of works, furnished as specified in Schedule.

1) Activity duration in months and event times should be in months from the first event on the network and event numbers:
2) A tabulation of months from the starting date of the network to enable earliest and latest event dates to be read off; duration in months to be the last day of the month and the monsoon months of 15th June to 15th October to be specially indicated in the Table:
3) The timing of events shown in the programme of work to be adhered to and shown in the network.
4) The erection programme shall be shown in detail (with not more than 15 activities) with durations in weeks shown in brackets behind the duration in months on the network diagram wherever considered necessary.

5) The programme for setting-up, treating, delivery, storage (if necessary) and installation of the Plant.
6) Placing being a part of the erection programme.
7) Programme for submission of Instruction Manuals and Record Drawings.

As soon as practicable, and in any case not later than four weeks, after acceptance of his tender the Contractor shall submit to the Engineer-in-Charge for his approval a programme showing the order of procedure in which he proposes to carry out the works.

Particulars to be shown on the programme shall include:

1) Submission of drawings.
2) Placing of work orders.
3) Stages of manufacture.
4) Tests at place(s) of manufacture.
5) Deliveries to Site;
6) Construction of Civil works ready for erection of Plant.
7) Mechanical completion of erection at site.
8) Tests at site.
9) Finishing and completion of civil and electrical woks.

Any approval of or consent to the Contractor's programme by the Engineer-in-Charge shall not relieve the Contractor of his duties and responsibilities under the Contract.

7.18. REVISED PROGRAMME OF WORK IN CASE OF SLIPPAGE

In case of slippage from the approvedwork programme at any stage, the contractor shall furnish revised programme to make upthe slippage within the stipulated time schedule and obtain the approval of the EngineerinCharge to the revised programme. Such progress report shall be submitted monthly (by5th of each month) in the prescribed format in the tender documents.

7.18.1. PROGRESS

The Contractor shall submit to the Engineer-in-Charge during the first week of each month a "Monthly Progress Report" with weighted activities all in an approved format so that actual progress at the end of the preceding month may be compared with the Contractor's programme.

The progress report shall Also, include status report on the following approved individual formats:

1) Drawings.
2) Supplies of Plant Items.

3) Construction programme.

4) Construction Progress.

5) Overall Progress Curve.

From time to time the Municipal Commissioner Korba or Engineer-in-Charge will call meetings in their office or at the Engineer's Site Office, as they deem necessary for the purpose of control of the Contract, a responsible representative of the Contractor shall attend such meetings.

The Contractor shall regularly review his programme in the light of the progress actually achieved and shall submit for approval updated PERT/CPM network and bar charts at intervals to be agreed with the Engineer-in-Charge. If progress falls behind that needed to ensure timely completion of the various parts of the works, the Contractor shall submit proposals for improving his methods and pace of working to the satisfaction of the Engineer-in-Charge shall carry out such measures as are needed to ensure that the works are completed on time.

7.19. PRODUCTION, SUBMISSION AND APPROVAL OF ENGINEERING DOCUMENTS

The production, submission and approval procedure for design & drawings and documents shall comply with the following requirements.

7.19.1. Meaning

The following meanings shall apply:

"Preliminary drawings" means drawings which the Contractor submits to the Engineer-in – Charge through PMC for approval and any drawings returned by the Engineer-in-Charge marked "Preliminary" or not marked "Approved".

"Approved Drawings" means drawings which the Engineer-in-Charge has marked

"Approved" and returned to the Contractor. Approval in this context means that the work described thereon may proceed.

"Preliminary" and "Approved" as applied to designs and documents shall have the same meanings as applied above to drawings. A drawing which forms part of an approved design or document shall not be considered as approved drawing unless it has been marked "Approved".

7.19.2. Numbering and Titling

The Contractor shall institute a reference numbering system for designs, drawings and documents so that each number used is unique. The numbering and title information on designs, drawings and documents shall be designed so that management, transmittal and communication therewith can be carried out expeditiously.

7.19.3. Submission Procedure

Every drawing submitted by the Contractor to the Engineer-in-Charge through Project Development and Management Consultants for checking and approval shall be based on previously approved designs or documents. Interrelated drawings shall be submitted at the same time in a complete and self-sufficient set.

In the case of first submissions by the Contractor to the Engineer in charge for approval, each design, drawing and document shall reach the Engineer's review office in time to allow 30 working days (excluding weekends and national holidays) for checking by the Engineer-in-Charge before return to the Contractor. Contractor has to carry out the required changes for the queries raised during the vetting without any extra charge.

7.19.4. Manufacture's and Contractor's Certificate

Where certificates are required by the Specification or relevant Reference Standard, the original and one copy of each such certificate shall be provided by the Contractor.

Certificates shall be clearly identified by serial or reference number where ever possible to the material being certified and shall include information required by the relevant Reference Standard or Specification Clause.

The instruction manuals shall describe the installation as a whole and shall give a step-by-step procedure for any operation likely to be carried out during the life of such item of Plant, including the erection, commissioning, testing, operation, maintenance, dismantling and repair.

Maintenance instructions shall include charts showing lubrication, checking, testing and replacement procedures to be carried out daily, weekly, monthly and at longer intervals to ensure trouble-free operation. Where applicable, fault location charts shall be included to facilitate tracing the cause of malfunction or breakdown.

A section dealing with procedures for ordering spares shall Also, be included in the instruction.

Three draft copies of the manual shall be submitted to the Engineer's Representative prior to commissioning the works. Five final copies of the amended and corrected manuals and drawings shall be provided at the commencement of the period of Maintenance.

All the electrical and mechanical equipments shall be subjected to approved third party inspection at place of manufacture, at contractor's cost.

Transit insurance of all equipments shall be the contractor's responsibility.

Contractor shall have to take the certificate from the Electrical Inspector for regarding all electrical equipments before commissioning of plant.

Important instructions charts shall be framed and fixed at appropriate and prominent places.

7.19.5. Maintenance Instructions:

A maintenance manual shall be provided as supporting documents to the equipment manufacturer's instructions.

(i) Maintenance Manual

Checking, testing and replacement procedures to be carried out on all mechanical and electrical plant items on a daily, weekly and monthly basis or at longer intervals to ensure trouble free operations.

Fault location and remedy charts to facilitate tracing the cause of malfunctions or breakdown and correcting faults.

A complete list of recommended lubricants, oils and their charts.

A spares schedule, which shall consist of a complete list of item wised spares for all electrical and mechanical plant items with ordering references and part numbers.

A complete list of manufacturer's instructions for operation and maintenance of all bought-out equipment. The list shall be tabulated in alphabetical order giving the name of the Supplier/Manufacturer, identification of the plant item giving the model number and the literature provided including instruction leaflets and drawing numbers.

Preventive maintenance details.

7.19.6. Record Drawings:

The Contractor shall provide record drawings including those drawings submitted by the Contractor to show the whole of the plant as installed and all civil works as built. These shall include all such drawings, diagrams and schedules as are necessary for a complete understanding of the works. Information given on record drawings shall include tolerance, clearances, loadings, finishes, materials and ratings of Plant and associated civil works. The Contractor shall ensure that the approved and completion drawings are marked up, to show the condition of plant as installed and associated Civil Works, as built and two copies of such marked up prints shall be submitted to the Engineer-in-Charge for approval prior to the preparation of Record Drawings. Submission to and approval by the Engineer-in-Charge or Record Drawings shall be pre-requisite for the last taking over certificate. All the Record Drawings shall be of A2 size, in five copies, out of which 3 sets shall be plastic, laminated for long-life. In addition, one set of Microfilm of all the Record Drawings Also, shall be furnished. The text of all the reports shall be prepared on a widely used IBM compatible MS Word / MS Excel, and all the Drawings shall be prepared using AutoCAD Software and in .pdf form. When reports, drawings are furnished to Municipal Corporation Korba, two copies of the processor files together with 2 copies of a descriptive memorandum linking these files to the text, drawings etc., shall Also, be provided to the Municipal Corporation Korba on CDs, Pen drive, data base preferable on MS office and AutoCAD latest versions and in .pdf form.

7.20. The contractor shall have to provide a ruled duplicate register at site named "Site orderbook". It shall be in the custody of departmental supervisory staff. The Engineer-inCharge or his authorized representative shall record their instructions in this book, whichshallbenotedbythecontractororhisauthorizedrepresentativeforcompliance.

7.21. If any item of work is found to be substandard but the Engineer-in-Charge is of the opinion that the same is structurally adequate and can be accepted at the reduce rate, then in such cases, the Engineer-in-Charge shall have to submit proposals for appropriate reduction of rates supported by an analysis, in justification thereof, through a D.O. letter to the Superintending Engineer concerned and obtain his approval expeditiously (ordinarily within 15 days). The approved analysis along with orders of the Superintending Engineer shall have to be appended IN the bills of the contractor.

8.0 SPECIAL CONDITIONS

8.1 AGREEMENT

The Notes and specifications given in the detailed notice inviting tenders and its annexure are to be read in conjunction with conditions given in the short notice inviting tenders and the conditions of Contract. These have been intended to supplement the provisions, in the NIT and

the conditions of the Contract. All these will be binding on the contractor and shall form part of the agreement. However, in case of any contradiction betweenCorrigendum/Clarifications /Amendments and the NIT, the CORRIGENDUM/CLARIFICATIONS/AMENDMENTS will supersede.

8.1.1 EXECUTION OF AGREEMENT

The Tenderer whose tender has been accepted shall have to execute the agreement with in a fortnight of the communication of the acceptance of his tender by the competent authority. Failure to do so will result in the Earnest Money being forfeited to KMC and tender being cancelled.

8.1.1 TECHNICAL SUPERVISION :-

(a)The contractor shall employ the Technical Staff during the execution of work as mentioned in the Appendix 11 of this NIT-

(b) The Technical Staff should be available at the site and take instructions from the Engineer-in-Charge or other supervisory staff.

(c) In case the contractor fails to employ the technical staff as aforesaid, the E.E. shall have the right to take suitable remedial measures.

(d) The contractor shall give the names and other details of the graduate engineer/diploma engineer whom he intends to employ or who is under employment with him, at the time of the agreement and also give his curriculum vitae.

(e) The contractor shall give a certificate to the effect that the graduate engineer/diploma engineer is exclusively in his employment.

(f) A graduate engineer or diploma engineer may look after more than one work in the same locality, but the total value of such works under him shall not exceed Rs. 100 lakhs in the case of a graduate engineer and Rs. 50 lakhs in the case of a diploma engineer.

(g) It shall not be necessary for the firm/company whose one of the partners is a graduate engineer/diploma engineer to employ another graduate engineer/diploma engineer subject to the conditions provided under 8.1.2(a), (b), and (f).

(h) The Retired Assistant Engineer who is holding a diploma may be treated at par with a Graduate for the operation of the above clause.

Note: Such Degree or Diploma engineer must be always available on the work site on a day-to-day basis and actively supervise, instruct, and guide the contractor's workforce and also receive instructions from the Departmental Engineers/Sub Engineers.

In case the contractor fails to employ the above technical staff or fails to employ technical staff/personnel as submitted by the contractor in Prequalification documents if prequalification is called and/or the technical staff/personnel so employed are generally not available on the work site and/or do not receive or comply with the instructions of the Department Engineers, the Executive Engineer shall recover/deduct from his bills, , In case of the contractor fails to employ the technical staff as aforesaid he shall be liable to pay to the government a sum of **Rs. 20,000/- (Rupees Twenty Thousand) for each month of default.** If the default continues for more than 2 months, then such default can be treated as a "Fundamental Breach of Contract" and the contract can be terminated, and action shall be taken.

ANNEXURE

Other than form 'F' and condition of contract documents appended as annexures with this N.I.T. and these shall be part of Contract Agreement.

8.2 Conditions applicable for contract

All the conditions of the tender notice will be binding on the contractors in addition to the conditions of the contract in the prescribed form :

Following documents annexed with this N.I.T shall form an integral part of the contract document. Annexure- "A" : Model Rules relating to labour water supply etc.
Annexure-"B" : Contractor's labour regulations.
Annexure-"C":
(a) Drawings
(i) Site plan/location
(ii) Key Plan and Flow Diagram
(iii) Alignment of the interceptor sewer
Annexure D : Statement showing the lead of materials
Annexure E : Specifications of Entire Work
Annexure F : Breakup schedule of Payments

9.0 BID OPENING AND EVALUATION

9.1 Bid Opening

1) The Municipal Corporation Korba will open the bids received (except those received late). In the event of the specified date for the submission of bids being declared a holiday for Municipal Corporation Korba, the Bids will be opened at the appointed time and location on the next working day.

2) The envelope containing the technical bid shall be opened. The document marked "cost of bidding document" will be opened first and if the cost of the bidding documents is not there, or incomplete, the remaining bid documents will not be opened, and bid will be rejected.

3) In all other cases, the amount of Earnest Money, forms and validity shall be announced. Thereafter, the bidders' names and such other details as the Municipal Corporation Korbamay consider appropriate, will be announced by the Municipal Corporation Korbaat the time of opening.

4) The Municipal Corporation Korba will prepare minutes of the Bid opening, including the information disclosed to those present in accordance with relevant Clause of ITB.

5) Evaluation of the technical bids with respect to bid security, qualification information and other information furnished in Part I of the bid in pursuant to relevant Clause of ITB, shall be taken up and completed and a list will be drawn up of the responsive bids whose financial bids are eligible for consideration.

6) The Municipal Corporation Korbashall inform, by email, telegram or fascimal, the bidders, whose technical bids are found responsive, date, time and place of opening as stated in the Notice Inviting Bid.

In the event of the specified date being declared a holiday for the Municipal Corporation Korba , the bids will be opened at the appointed time and location on the next working day through they or their representative, may attend the meeting of opening of financial bids.

7) At the time of the opening of the 'Financial Bid',(Envelope 'C') the names of the bidders whose bids were found responsive in accordance with relevant clause of ITB will be announced. The financial bids of only these bidders will be opened. The responsive bidders' names, the Bid prices, the total amount of each bid, and such other details as the Municipal Corporation Korba may consider appropriate will be announced by the Municipal Corporation Korba at the time of bid opening.

8) Process to be Confidential (a) Information relating to the examination, clarification, evaluation, and comparison of bids and recommendations for the award of a contract shall not be disclosed to bidders or any other persons not officially concerned with such process until the award to the successful Bidder has been announced. Any attempt by a Bidder to influence the Municipal Corporation Korba 's processing of bids or award decisions may result in the rejection of his Bid

9) Clarification of Bids and Contacting the Municipal Corporation Korba

9.1 No Bidder shall contact the Municipal Corporation Korbaon any matter relating to its bid from the time of the bid opening to the time the contract is awarded.

9.2 Any attempt by the bidder to influence the Municipal Corporation Korba bid evaluation, by any means, bid evaluation, bid comparison or contract award decision may result in the rejection of bidder's offer.

9.2 Examination of Bids and Determination of Responsiveness

1) During the detailed evaluation of "Technical Bids"(**Envelope 'B'**), the Municipal Corporation Korba will determine whether each Bid

(a) Meets the eligibility criteria as defined in relevant Clauses.
(b) Has been properly signed;
(c) Is accompanied by the required securities; and
(d) Is substantially responsive to the requirements of the bidding documents.

During the detailed evaluation of the "Financial Bids"(Envelope 'C'), the responsiveness of the bids will be further determined with respect to the remaining bid conditions, i.e., priced bill of quantities, technical specifications and drawings.

2) A substantially responsive "Financial Bid" is one, which conforms to all the

terms, conditions, and specifications of the bidding documents, without material deviation or reservation. A material deviation or reservation is one

(a) Which affects in any substantial way the scope, quality, or performance of the Works;
(b) Which limits in any substantial way, inconsistent with the bidding documents, the Municipal Corporation Korba 's rights or the Bidder's obligations under the Contract; or
(c) Whose rectification would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

9.3 Corrections of Errors

1) Bids determined to be substantially responsive, will be checked by the Municipal Corporation Korba for any arithmetic errors. Errors will be corrected by the Municipal Corporation Korbaas follows:

   (a) Where there is a discrepancy between the rates in figures and in words, the rate in words will govern; and
   (b) Where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern.

2) The amount stated in the Bid will be adjusted by the Municipal Corporation Korba in accordance with the above procedure for the correction of errors and shall be considered as binding upon the Bidder. If the Bidder does not accept the corrected amount, the Bid will be rejected, and the Earnest money shall be forfeited in accordance with relevant Clause of ITB.

9.4 Evaluation and Comparison of Bids

1) The Municipal Corporation Korba will evaluate and compare only the bidsdetermined to be substantially responsive in accordance with relevant Clause of ITB.

2) In evaluating the bids, the MUNICIPAL CORPORATION, Korba will determine for each Bid the evaluated Bid price by adjusting the Bid price by making correction, if any, for errors pursuant to relevant Clause of ITB.

3) If the Bid of the successful Bidder is seriously unbalanced in relation to the Engineer's estimate/PAC of the cost of work to be performed under the contract, the Municipal Corporation Korba may require the Bidder to produce detailed price analysis for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed.

4) After evaluation of the price analysis, the Municipal Corporation Korbamay require that the amount of the Performance Bank Gurantee set forth in relevant Clause of ITB be increased as described in relevant clause.

Commissioner
Municipal Corporation
Korba, Chhattisgarh

10.0 SPECIAL CONDITIONS

(1) Project Management Consultants (PMC) engaged by KMC C.G., will carry out complete supervision, quality control of activities carried out by contractor including checking measurement, designs, drawings, contractors bill, all deliverables till completion of the contract & rectification of deliverables.

(2) APPPROVAL OF DESIGNS & DRAWINGS

All design calculations & detailed drawings of all components (Electrical, Mechanical & Structural) of the project shall be got approved by Indian Institute of Technology (IIT)/ National Institute of Technology (NIT) at the cost of contractor and then submitted to Korba Municipal Corporation for approval. It will be mandatory on the part of the contractor to prepare the detailed designs and the Basic Engineering Package (BEP) from the same institute.

(a)The successful bidder shall carry out detailed topographical survey of all the components of the work including HFL survey and shall first submit General Arrangement drawing accommodating all the proposed units & submit the same for approval through PMC.All costs shall be borne by the contractor.

(b)Contractor shall Also, prepare & submit hydraulic designs & after its approval, shall prepare & submit structural design & architectural drawings, get them approved byIIT /NIT and finally submit them for approval of Engineer –in- charge through PMC. All costs shall be borne by the contractor. No extra charges shall be paid for the revision in designs to be carried out for complying the quaries raised during the scrutiny.

(c)The PMC deployed by the Engineer-in-charge shall act as the representative of the Engineer-in-charge to the Contract. Unless specified otherwise, the PMC shall be involved in testing of materials, supervision of works to ensure quality as per required (IS / Technical specifications) standards. Contractor shall provide support and assistance in all field works, checking of measurements, bills, work done (temporary / permanent) in the field, including all works to be carried out by the Engineer-in-charge. However, written approval of designs, drawings, additions, alterations, omissions, substitutions, approval for non-schedule items / rates as required shall be obtained from competent Authority of Municipal Corporation.

(3) THIRD PARTY INSPECTION of all items before procurement shall be carried out by **DGSD/SGS/ RITES** based on Datasheets, Quality Assurance Plan & complete specifications as submitted by the Contractor to Engineer –in- charge. Third Party Inspection charges will be borne by the Contractor.

Third Party Inspection (TPI) of all pipes, fittings and all kinds of valves, Electro-mechanical equipment shall be carried out based on the Quality Assurance Plan duly prepared and submitted by the contractor. These TPI charges will be borne by the contractor. Further for witnessing the tests at works of the manufacturer by 2 No. officials of the Korba Municipal Corporation, the contractor shall arrange the same and bear the entire cost.

(4) PERFORMANCE BANK GUARANTEE

i. The contractor shall submit an irrevocable Performance Guarantee at specified percentage of the tendered amount in addition to other deposits mentioned elsewhere in the contract for his proper performance of the contract agreement, (not withstanding and/or without prejudice to any other provisions in the contract) within 15 Days from

the date of issue of letter of acceptance. This period can be further extended by the Engineer in- charge up to a maximum period with 0.1% per day delay charges on written request of the contractor stating the reason for delays in submitting the Performance Guarantee, to the satisfaction of the Engineer-in-Charge. This Guarantee shall be in the form of Bank Guarantee from any of the Commercial Banks.

ii. The Performance Guarantee shall be submitted by the contractor on format as per NIT and shall be initially valid up to the stipulated date of completion plus minimum 6 months beyond that. In case the time for completion of work gets enlarged, the contractor shall get the validity of Performance Guarantee extended to cover such enlarged time for completion of work. After recording of the completion certificate for the work by the competent authority, the performance guarantee shall be returned to the contractor, without any interest as mentioned below.

iii. The Engineer-in-Charge shall not make a claim under the performance guarantee except for amounts to which the KMC is entitled under the contract (not withstanding and/or without prejudice to any other provisions in the contract agreement) in the event of:

(a) Failure by the contractor to extend the validity of the Performance Guarantee as described herein above, in which event the Engineer-in-Charge may claim the full amount of the Performance Guarantee.

(b) Failure by the contractor to pay KMC any amount due, either as agreed by the contractor or determined under any of the Clauses/Conditions of the agreement, within 30 days of the service of notice to this effect to the contractor by Engineer-in-Charge.

iv. In the event of the contract being determined or rescinded under provision of any of the Clause/Condition of the agreement, the performance guarantee shall stand forfeited in full and shall be absolutely at the disposal of the KMC.

v. As per requirement of the client or otherwise specified in the contract, part completion certificate may be issued for the project for the part(s) which have been completed in all respect and are ready for use. However, statutory approvals, Completion drawing of various services, wherever required, shall be obtained before handing over of the project. Scope of the completed part(s) shall be mentioned in such part completion certificate.

The part completion certificate shall include outstanding balance work that need to be completed in accordance with the provisions of the contract. This part completion certificate shall be recorded by the authority as per contract value of work.

For Capital Works

The Performance Bank Guarantee shall be five percent of the work Order amount and valid until three Months from the date of issue of the certificate of completion or after Defect liability period whichever is later.

Operation and Maintenance work

In the case of Bank Guarantee for O & M period, the Performance Bank Guarantee will be 5% of the amount of the offer quoted for 15 years O & M and will have to be furnished after the construction phase is over.

(5) RECEIPT FOR PAYMENT BY PARTNERS HAVING POWER OF ATTORNEY

All correspondence with the Employer and receipts for payments made on account of a work when executed by a firm must be signed in the name of the firm by one of the Partners holding Power of Attorney.

(6) MOBILISATION ADVANCE

Mobilization advance up to 5% (Five percent) of the contract value shall be given if requested by the contractor within one month of the date of order to commence the work. In such a case the contractor shall furnish Bank Guarantee from schedule bank for the equal amount in favour of the Commissioner before sanction and release of the advance. The advance shall be Interest free. The 5% (Five percent) advance shall be given in two stages

Stage-1:2% (Two percent) of the contract value payable after signing of the agreement

Stage-2:3% (Three percent) of the contract value payable on receipt of the certificate from the contractor that he has established complete testing laboratories and has engaged workers/technicians and have brought requisite plants and machineries at work site, and also, that the work is physically started and only after construction programme is submitted by the contractor and is duly approved by the Executive Engineer.

(7) RECOVERY OF ADVANCE

The recovery of above advances (mobilizations, plants and machineries) shall be recovered in equal monthly installments on pro- rata basis (after 15% (Fifteen percent) of contract work is executed) from each of the further running bills. However, all these advances shall be fully recovered when 80% (Eighty percent) contract sum is complete or when 75% (Seventy Five percent) of stipulated or validity extended period is over – which ever event is earlier.

(8) USE OF DI FITTINGS

Provision of laying & jointing of DI fittings P.N. 1.6 conforming to IS: 9523:2000 duly inspected and approved by RITES/SGS/DGS & D as per tender. DI specials shall be manufactured as per IS: 9523 and shall be ISI marked. In case of flanged joints, the flanges shall be at right angles to the axis of the pipe machined on the face. The bolt-hole circle shall be concentric with the bore and bolt holes shall be located off the centre lines as per IS: 9523. Fittings shall be tested as per IS: 9523.

(9) HINDRANCE FREE ALIGNMENT OF PIELINE ETC

Korba Municipal Corporation will provide hindrance free alignment. The bidders should inspect the whole alignment but the tenderer should make himself conversant with site conditions, strata, nallah crossings, road crossings, railway crossings, canal crossings etc completely. All permissions from Government/ Semi Government Authorities shall be taken by Korba Municipal Corporation for above works. Contractor has to bring to the notice of KMC in advance regarding shifting of utilities required to be carried out. Contractor has to carry out the required shifting following all safety norms and time constrains if any. Shifting schedule has to be got approved by KMC.

(10) DEPTH OF EXCAVATION FOR LAYING OF PIPELINE

The crown of the pipeline will be kept minimum 1.0 m below the firm GL and as per the

actual requirement of site and design & planning as approved.

(11) ORDER OF PRIORITY

Order of priority as given below shall prevail: -

- Specifications as per NIT.
- Specifications as per S.O.R.
- Specifications mentioned in CPHEEO Manual (Latest Edition) for various Sewage collection, conveyance and treatment components.
- Relevant IS Codes.

(12) STATUS OF ENVIRONMENTAL CLEARANCE

Since this being a Sewage Treatment Project involves neither displacement /rehabilitation of people nor any pollution of water body , hence no Environmental Clearance is required**.**

Consent to Establish: Shall be taken by KMC, however all the relevant data and checklists shall be filled by the Contractor.

Consent to Operate: Shall be taken by the contractor as and when required, however the fees to be paid to CGEB shall be Borne by the KMC.

(13) VALVES WITH ACTUATORS

The valves should be provided with actuatorswhereverapplicable.

(14) LAYOUT PLAN OF INTERCEPTOR SEWER PIPE LINE

Location of pipes with all the appurtenances, invert of pipe and all the land marks with geo coordinates marked on the L-section will be prepared by the contractor for the approval of Engineer-in-Charge as mentioned in ANNEXURE-E.

(15) PREPARATION OF GIS BASED MAP

Contractor has to prepare an entire layout plan of indicating the complete interceptor sewer with all the appurtenances including all existing and proposed structures of the scheme including locations of all diversion weirs, existing water supply anicuts, Intake well and all other landmarks etc on GIS platform with supply of GIS softwarewithin 30 days from the date of work order.Failure to this shall lead to deduction of Rs.10 lakhs from the immidiate payment. The GIS Base map shall be put on the web site of the Municipal Corporation and monthly updated by the contractor indicating the progress of the work achieved during execution period and in O & M periodin seperate attributes. The dely in updation of work progress in GIS platform shall attract a penalty of Rs. 60000/- per quarter.

(16) PROCUREMENT OF PIPES & VALVES

Contractor shall take written procurement clearance for the specified quantities of pipes, valves, specials etc from Engineer-in-Charge before taking procurement action.

(a) Road breaking and its reinstatement will be carried by the contractor as per tender.

(17) INTERCONNECTIONS OF RISING MAINS

The contractor is expected to visit the site of work and make his own assessment of quantum of work required to be carried out, Further before actual **implementation** of work the drawing of

interconnections will have to be got approved from the Engineer-in-Charge. The interconnections of rising mains of all STPs with the wet well is included in the scope of work of this Contract.

(18) STPs EFFLUENT DISCHARGE ARRANGEMENT

The discharge of the STPsmust be taken into theproposedTTP in future. However, the contractor must make drainage arrangement for entire effluent of STPsinto the nearby river/ Nala through gravity. The invert level of the outlet of the STPs should therefore be fixed considering H.F.L. of Nala /natural drain so that drainage by gravity during flood can be possible. However, in normal course the effluent shall be sent to proposed TTP for further disposal.

(19) 3 MONTHS TRIAL RUN OF COMPLETE WORK AFTER COMPLETION OF WORK

(a) The tender must be inclusive of operation of the plant for the THREE months trial run period free of charge by contractor's trained and qualified Engineers who should be completely familiar with the equipment supplied and erected and they shall train the Departmental Staff in operation & maintenance of the plant within that period. Detailed operation manual as well as the drawings of equipment supplied, should Also, be supplied by the contractor free of cost. The cost of electrical energy and pay to departmental staff if anydeployedfor training of operation of the plant, WILL BE PAID by the Department during this period.Cost of chemical etc. including complete O & M shall be borne by the contractor including replacement and warranty of any item component/spares. Critical Design Parameters must be demonstrated within the test run for this period of three months."

(b) Period of construction shall be reckoned from date of issue of work order to time of completion. Defect liabilities, tests, guarantee and trial run will be as per N.I.T.

After satisfactory completion of the complete work including testing, installation, commissioning, the Engineer-in-charge will issue the Completion Certificate. After which 3 months of trial run at actual work will be carried out. Any non-compliance in terms of running, delivery and performance of each component of the complete work will be maintained and recorded by the Engineer-in-Charge. Record of the incoming raw sewage quality (physical, chemical and biological parameters) and that of the treated sewage rendered fromtheproposedSTPs shall be maintained.

Each day/part of the day when raw sewage Intake structure or the Sewage treatment Plant does not deliver as per the norms of Contract Agreement and CPHEEO Manual means that the trial run will be extended by that many days without any extra cost to KorbaMunicipalCorporation.

(20) LIST OF SPARES TO BE MAINTAINED DURING O &M PERIOD OFSTPs

The contractor shall operate and maintain the sewage treatment plant including all the civil structures, electro-mechanical equipment, pipes, pipe specials, instrumentation provided by him in the sewage Treatment Plants. He will maintain spares with stores for the proper upkeep of the STPs. List of spares is given in schedules.

For repairs and proper upkeep of the STPs in case any repair to any equipment is required, noextra payment will be paid to the contractor.

For non-compliance of the effluent quality parameter a penalty of Rs. 5000/- for one event in a day shall be levied.

(21) TESTING OF RAW AND TREATED SEWAGEDURING 15 YEARS O & M BY THE CONTRACTOR

Daily the contractor has to get the raw and treated sewage tested at least three times at 8 hour interval for the parameters viz., turbidity, color, taste, pH, TDS, Total hardness, residual chlorine conductivity, Alkalinity, Chlorides and coliform for all Sewage Treatment Plants.

(22) GENERAL REQUIREMENTS FOR BUILDING WORKS

Unless otherwise specified, all the building works shall generally comply with the following Employer's Requirements:

(a) All buildings shall have reinforced concrete framework.

(b)75 mm thick PCC Damp Proofing Course in M20 shall be provided to all building walls at plinth level with anti-termite treatment in foundation & plinth.

(c) The plinth level of the Structures such as admin building and pumphouse shall be minimum 0.6M above the finished ground level.

(23) TOPOGRAPHIC SURVEY

The contractor will carry out the Topographic survey work by using Total station/ DGPS of the entire site where the components of the project are required to be constructed/laid. This is mandatory to confirm the levels and the lengths . Only after this exercise is carried out, contractor should prepare the detailed designs, drawings, L-sections based on the design etc. The cost of all the necessary survey and investigation regarding the HFL study etc. shall be deemed to be included in the contractors offer. The drawings attached with the NIT are for tender purpose only, no claim shall be entertained for any values/ Levels mentioned on the tender drawings. The contractor must prepare their designs and drawings as per the conditions of NIT and shall submit for approval to KMC.

(24) The flows of Nalas mentioned in the scope of work have been assessed/measured at the time of preparation of DPR, However, the contractor shall reascertain (remeasure) the flows and accordingly prepare all the designs of pumps and other components. The cost of such variations if any shall be deemed to be included in the contractors lumpsum offer. During survey if the contractor observes any additional Nala or stream which is necessary to be intercepted then the same shall be considered in the design and payment for the additional necessary pipeline and chambers etc. shall be made as per the conditions of the contract.

The contractor shall procure and install informatorily board's displaying Name of work at the location given by KMC at his own cost.

(25) VEHICLES FOR CONSTRUCTION SUPERVISION

The contractor shall arrange two four wheeled vehicle including Driver &POL (XUV, INNOVA or equivalent) for field Engineers of Municipal Corporation Korba for the Project period which will be deployed on work for supervision. The average run per-vehicles will be 3000 Km. / month.

The vehicle to be provided within one month of work order. If not arranged the vehicle by the contractor, the vehicle charges at Rs 50000/- per month per vehicle shall be recovered from the bill for the period of non-compliance.

(26) TESTING LABORATORY AT CONSTRUCTION SITE

The contractor shall arrange a testing laboratory with all testing equipment and trained staff required for proper testing of construction material likely to be used in execution of work. at his own cost.

(27) SITE OFFICE

The contractor shall provide two site offices one each at Parri&Singdai STPs site consisting of two rooms with AC, Furniture and other equipment along with one attendant for Municipal Corporation Korba field Engineers.

(28) OFFICE EQUIPMENT ON SITE OFFICE

The contractor shall provide minimum two number desktop and two number Laptops with latest configuration including one number laser printer to KMC for monitoring of execution and maintenance work.

(29) ACCESS ROAD TO SITE OF WORK

Access Road has to be provided by the contractor at his own cost for transportation of construction material and equipment and manpower.

(30) LABOUR REPORT

Contractor will submit a report of daily labours engaged and copy of the same be attached with the running account bill, failing which no payment will be made to the contractor.

The Contractors shall make his own arrangement at his own cost for housing his staff and stores for the work and C.G. Model Rules relating to layout, water supply and sanitation shall be followed.

Observance of Law - The contractor shall conform to the regulations and by-laws of any local authority and/or of any water or power (electricity) companies, with whose system the structure is proposed to be connected from work site, except with the written permission of the Engineer-in-Charge.

Contractor will submit a report on labour engaged to local employment office and copy of same may be attached with the running account bill, failing which Rs.50/- will be deducted from each running bill. Total recovery on this account may be effected on the final bill.

(31) LABOUR LICENCE

Every contractor who employs on any day of the preceding 12 months, twenty or more workers on contract is required to obtain license from the Licensing Officer or the Contract as per provision contained under Sub-section 4 (b) of section 2 of the Contract Labour (Regulation and Abolition) Act 1970 as per provision contained in Section 12 of Act. No, contractor shall execute any work without obtaining licence, contravention of above is punishable and contractor is liable to be prosecuted. The successful tenderer is liable to produce licence as and when demanded by the Executive Engineer, obtained from labour Department as laid down in chapter 4 of Contract labour (Regulation and abolition) Act 1970. The labour license shall be insisted upon to be obtained by the Contractor after the award of contract.

(32) NOTICE TO BE GIVEN BEFORE WORK IS COVERED UP

The contractor shall give not less than five day's notice in writing to the Engineer- in- Charge or his subordinate in charge of the work before covering up or otherwise placing beyond the reach of measurement any work in order that the same may be measured and correct dimensions thereof be taken before the same is so covered up or placed beyond the reach of measurement and shall not cover up or place beyond the reach of measurement any work without the consent in writing of the Engineer-in-Charge or subordinate-in-charge of the work, and if any work shall be covered or placed beyond the reach of measurement without such notice having been given or consent obtained the same shall be uncovered at the contractor's expense or in default thereof no payment or allowance shall be made for such work or materials with which the same was executed.

(33) SITE ORDER BOOK

An order book, to be called, as site order book shall be kept at the Site office of Municipal Corporation Korba. As far as possible, all orders regarding the work are to be entered in this book. All entries shall be signed and dated by Municipal Corporation Korba officers in direct charge of the work and noted by the contractor or his accredited representative. The site order book shall not be removed from work site, except with the written permission of the Engineer-in-Charge.

(34) CONTRACTORS PROJECT MANAGER AND CONTRACTORS STAFF

The contractor shall, in his own absence keep constantly on the works a competent and well qualified and experienced Project Manager, and any direction or explanations given by the Engineer in charge or his staff to Contractor's Project Manager shall be held to have been given to the contractor. The contractor shall further provide all staff that is necessary for the supervision, execution and measurement of the work to ensure full compliance with the terms of contract.

(35) INSURANCE

The Contractor shall take such insurance in connection with the work in accordance with the tender condition as acceptable to the Municipal Commissioner Korba& Submit the copy of the Insurance within two weeks of issue of work order without which no payments shall be made to contractor. It will be the responsibility of the contractor to renew the insurance timely and submit the policy to KMC till the finalization of the work.

The cost of the insurance premium shall be paid by the Contractor.

The risk insurance coverage shall be as follows :

- Third party vehicle liability insurance as required under India's Motor Vehicle Act, 1988 by the Contractor or its personnel Sub Contractor or their personnel for the period of contract.
- Third Party liabilities insurance, with a minimum contract of equal to amount of contract.
- Professional liabilities insurance with a minimum coverage equal to amount of contract.
- Employer's liabilities & workers compensation insurance in respect of the Personnel of the Contractor, in accordance with the relevant provisions of the Applicable Laws of India, as well as with respect to such personnel any such life, health, accident, travel or other insurance as may be applicable
- Any other laws / rule applicable in India.

(36) LEGAL JURISDICTION

All the disputes regarding this contract will be subjected to the Chhattisgarh High CourtJurisdiction.

(37) DEWATERING

The lump-sum offer shall include dewatering, bailing out water in foundation, river water and rain water if any (Unless & otherwise specified in the schedule), which shall be required to be done by the contractor at his own cost and for which no payment will be admissible under any circumstances. The tenderer shall assess the work of dewatering that may be required for execution of work and include in his lump-sum offer. No dewatering shall be payable separately under any circumstances whether natural, artificial or man-made.

(38) ACCIDENT -HOARDINGS - LIGHTING OBSERVATIONS

When there is any Likelihood of accidents, the contractor shall comply with any requirements of law on the subject, and shall provide suitable hoarding, lighting and watchman as necessary or directed by Engineer-in charge.

It shall be contractor's sole responsibility to protect - the public and his employees against accident from any cause and he shall indemnify Municipal Corporation Korba, against any claims for damages for injury to person or property, resulting, from any such accidents; and shall where the provision of the workmen's compensation Act apply, take steps to properly insure against any claims there under.

On the occurrence of an accident which results in the death of any of the workman employed by the contractor or which is so serious as to be likely to result in the death of any such workman, the contractor shall, within 24 hours of the happening of such accident, intimate in writing to the Municipal Corporation Korba /Police the facts of such accident. The contractor shall indemnity Municipal Corporation Korba against all loses or damage sustained by Municipal Corporation resulting directly or indirectly from his failure to give intimation in the manner aforesaid including the penalties or fines if any payable by Municipal Corporation Korba as consequence of failure to give notice under the Workmen's Compensation Act.

In the event of an accident in respect of which compensation may become payable under the workman's compensation act VIII of 1923 whether by the contractor or by the Government as principal it shall be lawful for the Engineer-in-Charge to entertain out of monies due and payable to the contractor such sum or sums of money as may in the opinion of the said Engineer-in-Charge be sufficient to meet such liability. The opinion of Municipal Commissioner Korba shall be final in regard to all matters under this clause.

(39) KMC may ask contractor to carry out the work, part of work or additional work anywhere in Project Area under the provisions in schedule for which payment shall be proposed on measure and paid basis.

(40) Concrete Design Mix to be used shall be got designed by Govt Engineering College, C.G./National Institute of Technology [NIT], keeping in mind the Target Mean Strength as per clause 9.2 of IS-456/2000]

Clause 9.2.2 of IS-456[2000]: The mix shall be designed to produce grade of concrete having the required workability & a characteristic strength not less than appropriate values given in Table-2. The Target Mean Strength of Concrete Mix should be equal to characteristic strength plus 1.65 times the Standard Deviation.

Ready Mixed Concrete: The contractor shall use Ready Mixed Concrete prepared at established Concrete Batching & Mixing Plant Batching and Mixing Plant with a minimum 20 cum/hour capacity shall be used to comply with the compressive strength criterion given in clause 16 of IS-456[2000].

Clause 16 ACCEPTANCE CRITERIA of IS-456[2000].

(41) Compressive Strength

The concrete shall be deemed to comply with the strength requirements when both the following condition are met:

a. The mean strength determined from any group of four consecutive test results compiles with the appropriate limits in col 2 of Table 11 of IS-456-2000.

b. Any individual test result complies with the appropriate limits in col 3 of Table 1 of IS-456-2000).

The contractor can use KMC OR mixing of concrete can be done in a mechanical mixer (proportioning of aggregates to be used shall be done using a weigh batcher at site) as per the site conditions on prior approval of Engineer-In-incharge.

Appendix-1

Qualification Information

1.1	*Constitution or legal status of Bidder/attach* copy]				
	Place of registration of Firm/ Company (in case of other than individuals)				
	Principal place of business:				
	Name of Power of attorney holder of signatory of Bid (bidder)/«//ac7? copy]				
1.2	*Total annual volume of civil engineering construction work executed and payments received each year in the immediate five years preceding the year in which tenders are invited. (Attach certificate from Chartered Accountant)- indexed @ 10% (ten percent) compounded per year*	*Financial Year*	*(Rs. in crores)*		
			"Civil engineering construction work" Turn over in the year	*Add for indexing*	*Total*
		2019-20			
		2020-21			
		2021-22			
		2022-23			
		2023-24			

Note :

1.1 *Proprietary firm, partnership firm with the certificate of registration by register/article and Memorandum of Association with Certificate of Incorporation.*

1.2 Mention and highlights the year, which the tenderer considers for evaluation for the Committee

Appendix - 2

Information regarding minimum one similar work

(i) One Work completed as similar work during last seven years

(ii) Or being executing one such similar work

Sno	Project	Name of Employer	Value of Contract	Contract No.	Date of Issue of Work Order	Stipulated Date of Completion	Actual Date Of Completion	Value of Work Done	RemarksExplaining reasons for Delay, if any and the amount of Deductionsdue to delay. Also, mention if anyClaim or dispute isPending in any forum.
1	2	3	4	5	6	7	8	9	10

Note :-

(i) Attach certificates from the Engineer in charge not below the rank of Executive Engineer of Govt. Department/Under Taking Govt. Department or equivalent.

(ii) Tendered may attach certified copies of work order and completion certificate issued by Engineer in charge not below the rank of Executive Engineer of Govt. Department/Under Taking Govt. Department or equivalent.

Appendix - 3

Work Performed on all classes of Civil Engineering Construction Works over the last seven years

S. no.	Project Name	Name of Employer	Description of Work	Value of Contract	Contract No.	Date Of Issue Work Order	Stipulated Date of Completion	Actual Date Of Completion	Year wise value of work done as per certificate of employer Rs. In Lacs						Remarks explaining Reasons for Delay ifAny and the amountOfdeductions due toDelay Also,mention ifAny claim or dispute is pending in any Forum.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Note :-

(i) Attach certificates from the Engineer in charge not below the rank of Executive Engineer of Govt. Department/Under Taking Govt. Department or equivalent.

(ii) Tenderer may attach certified copies of work order and completion certificate issued by Engineer in charge not below the rank of Executive Engineer of Govt. Department/Under Taking Govt. Department or equivalent.

Appendix - 4

Existing commitments and ongoing all classes of civil engineering construction works.

S.no.	Project Name	Description of Work	Contract No & Year	Name& Adderss Of the Employer	Value of Contract (Rs. Lakhs.)	Date of Issue of Work Order	Stipulated Date of Completion	Stipulated period of Completion in Months	Anticipate A date of Completion	Value of Work done Up to date Of issue Of N.I.T (Rs. Lakhs)**	Probable value of Works Remaining To be Completion (Rs. Lakhs) **	Anticipate Months Required Completion Of balance works	Value of Claims Or Dispute If Any pending
1	2	3	4	5	6	7	8	9	10	11	12	13	14

Note –

1. ** Enclose certificates from Engineer in charge (Not below the rank of Executive Engineer or equivalent) for value of work remaining to be completed, value of work done, anticipated date of completion.
2. Tendered may attach certified copies of work order issued by Engineer in charge not below the rank of Executive Engineer

Appendix - 5

Availability of Major items of Contractor's Equipment proposed for carrying out the Works. List all information requested below.

Item of equipment	Total number available	Description n, make, and age (Years), and capacity	Condition (new, good, poor) and number available	Nos. (i) Owned, (ii) leased, or (iii) to be purchased	If these are in use in some work, mention the details.	No. of equipments proposed to be utilized *in this work* (Out of total Nos.)
1	2	3	4	5	6	7

Appendix – 6

Qualifications of consultants /each technical personnel proposed for the Contract.

Position	Name	Qualify action	Date from which they are working in the bidder's organization	Years of experience				Remark
				Sewer Laying	Construction of STP	Building Works	SCADA & E&M works	
1	*2*	*3*	*4*	*5(a)*	*5(b)*	*5(c)*	*5(d)*	*6*

Note :

I. If any personal is proposed to be engaged, furnish details here under:- (if necessary use separate sheet for each -for C. V.) (Enclose certificates)

II. If any technical persons are to be changed during the construction periods, then it can be changed with prior intimation to the Engineer in charge.

Appendix – 7

Financial reports for the immediate previous five years: balance sheets, profit and loss statements, audited auditors' reports, etc., list below and attach copies shall be signed by statutory auditor, charted accountant

Year	Income Tax Clearance Certificate (optional)	Balance Sheet	Profit & loss statement	Reserve brought forward in any	Net credit Balance if any [for debit show (-)]	Auditors Report	Other information if the bidder wishes to submit
1	2	3	4	5	6	7	8
2019-20							
2020-21							
2021-22							
2022-23							
2023-24							

UDIN No. .....

Appendix – 8

Information on current claims, arbitration, litigation in which the Bidder is involved.

SI. no.	Name of Other party(s)	Agt. No. date year and Deptt.	Brief of cause of claims, arbitration /dispute (give reference of contract details)	Where Litigation pending (in the department/Court/arbitration) (mention Deptt./Court /Arbitration)	Amount Involved/ claimed

Can use separate sheets for each agreement if necessary.

Appendix – 9

List of key plant & Equipment available with the contractor to be filled by the Contractors

SI.	Type of Equipment	Maximum age as on 1.04.24 (years)	Contract Package Size
			From Rs.50 Crores, above
1	2	3	4
	Total		

Appendix – 10

List of key plant & Equipment to be deployed on Contract Work

SI.	Type of Equipment	Maximum age as on 1.04.24 (years)	Contract Package Size
			From Rs Rs.50 Crores, above
1	2	3	4
	Total		

Note: - The list &other Details of the equipment and plants as mentioned above are tentative. S.E. of the Nagar Nigam/Commissioner KMC/ Directorate can modify the above list of the plant and equipment as per their requirements.

Appendix – 11

List of Technical person to be deployed on Contract work

SI.	Personnel	Qualification	Contract Package Size			
			From Rs. 3 Crores toRs.10 Crores	From Rs. 1 1 Crores to Rs.30 Crores	From Rs. 31 Crores to Rs.50 Crores	From Rs. Rs.51 Crores & above
1	2	3	4	5	6	7
1	Project Manager	B.E. Civil+15years Exp in Water Supply Scheme. (5 years as manager)		1	1	1
2	Site Engineer	B.E. Civil+ 10 years Exp. (5 years in Water Supply.)	1	1	2	4
3	Plant Engineer	B.E. Mech.+ 10 Years Exp. or Dip. Mech+15 years Exp.	1	1	1	2
4	Electrical Engineer	B.E. Electrical with +07 years Exp. Or Dip. Electrical + 10 Years Exp.	1	1	1	2
5	Quantity Surveyor	B.E. Civil+7 Years Exp. or Dip. Civil+ 10 Years Exp.	1	1	1	2
6	Environmental Expert	B.E. Civil +10 years Exp.	1	1	1	2
7	Survey Engineer	B.E. Civil +5 years Exp. or Dip. Civil+8 years Exp.	1	1	1	2
		Total				

Note' - The list of (he technical persons Qualification &Experience as mentioned above are tentative. S.E. of the Nagar Nigam/Commissioner KMC/ Directorate can modify the above list as per their requirements.

Appendix – 12

Contact persons under whom work has been executed by the contractor

SI No.	Name of Executive Engineer of the Division	Divisional Head Quarter	Official Mail ID	Phone No. Office/ Mobile No.	Name District
1	2	3	4	5	6

Appendix – 13

Affidavit on Non-Judicial stamp of Rs. 500

Affidavit

I..... S/o.....

Aged..... .years.....resident..... ..of.....

.....(address.....

.....)

(For and on behalf of.....), do

hereby and herewith solemnly affirm / state on oath that: -

1. All documents and Information's furnished are correct in all respects to the best of my knowledge and belief.
2. I have not suppressed or omitted any information as is required.
3. **I am/ we are neither blacklisted nor debarred by Govt. of India / Other State Govt. Departments/ Chhattisgarh State Govt. Departments/Urban Local Body.**
4. Not Being CDR by any bank.
5. I hereby authorize the Nagar Nigam/Nagar Palika/Urban Local Body Officials to get all the documents verified from appropriate source(s) and in case of any ambiguity found in any of the information provided or documents submitted at any stage during the currency of project, department is at liberty to take any action, either by penalizing or blacklisting for next at least 3 years, in exercise of above action the department can engage other contractor/agency to complete the balance works at my Risk & Cost and the costs and the charges incurred in any way in carrying on and completing the balance work are to be paid to the department by me.

(……
…….……)
Authorized signatory / for and on behalf of
……
(**Affix Seal**)

Verification

I..... S/o..... do here by affirm that the contents stated in Para 1 to 5 above are true to the best of my knowledge and believe and are based on my / our record. Verified that this ..... date of ..... 2024... at (Place).....

Deponent

Seal of attestation by a Public
Notary with date Authorized signature / for and on behalf of.....

Appendix – 14

Declaration (on non-judicial stamp of Rs. 500) (for main bidder)

Affidavit

I, the undersigned, do hereby declare /solemnly affirm / state on oath that on the behalf of M/s……. that I/We have visited and inspected the site …… (project name and System tender no) carefully and have acquainted myself/ourselves with full and complete knowledge and understanding of the Project/site, prevailing conditions, complete scope of work and other Employer's requirements.

I/We, hereby also affirm that if any items/components which may not be mentioned in the tender but are necessarily required for successful commissioning of the Plant/system/scheme with desired outputs and complete functions in all respects are inclusive in our quoted Price and no further extra charges consequent on misunderstanding or otherwise will be claimed.

Deponent (……..

..……)

Authorized signatory for and on behalf of

……..

(Affix Seal)

Verification

I……. S/o……. do here by affirm that the contents stated above are true to the best of my knowledge and believe and are based on my/our record.

Verified that this ……..date of ……..2024…. at (Place)…….

Deponent

Seal of attestation by a Public

Notary with date Authorized signature/for and on behalf of.....

MUNICIPAL CORPORATION KORBA

Korba Sewage Master Plan (Online only)

Tender for a Lump - Sum Contract

FORM – F

"We do hereby tender to execute the whole of the work described in the Drawing Nos.---------- and according to the annexed specifications signed by ---------- ---------- and dated ---------- for the sum of Rs. ---------- (Rupees ----------) as given below:

(To be submitted online in Envelope-C on Bidder's Letter head with seal and signature)

Sr. No.	**Particulars**	Lump – Sum Cost
A	Lump Sum offer for construction of Proposed Korba Sewage Master Plan with all Components (Capital works as specified in scope of work and detailed specifications). Investigation, Survey, Design & Construction of all the components of project such as Diversion weirs, interceptor chambers, RCC Interceptor sewer, raw sewage pumps, raw sewage pumping main, PLC-SCADA and all pipeline monitoring and control system [covering all the proposed components of the entire scheme as per the specifications attached in respective chapters of the NIT including replacement and warranty].	Rs.
B	Lump Sum offer for 15 Years O & M of 33 MLD STP , Diversion weirs, interceptor chambers, RCC Interceptor sewer, raw sewage pumps, raw sewage pumping main, PLC-SCADA and all pipeline monitoring and control system [covering all the proposed components of the entire scheme (PART A) as per the specifications attached in respective chapters of the NIT including replacement and warranty].	Rs.

Grand total 'C' = A + B = Rs……
(Rupees…….)

Note: Offer is inclusive of GST and all other applicable taxes etc
For Evaluation purpose sum total of A+B shall be considered
Online offer shall be considered only

"We do hereby tender to execute the whole of the work described in the Scope of work and according to the annexed specifications for the sum of Rs. ---------- (Rupees ----------) as per breakup given above:
and should this tender be accepted I/We do hereby agree and bind myself/ourselves to abide by and fulfil all the conditions annexed to the said specification or in default thereof to forfeit and pay to the Urban Local Body_____, the penalties of sums of money mentioned in the said conditions, viz.

Dated: Tenderer`s Signature

Witness: Address:

Address:

The above tender is hereby accepted by me on behalf of the Korba Municipal Corporation_____.
The _____/20__
Signature of the authority by whom the tender has been accepted."

11. CONDITIONS OF CONTRACT

11.1. Definitions

i. The contract means the documents, forming the notice inviting tenders and tender documents submitted by the tenderer and the acceptance thereof including the formal agreement executed between the **COMMISSIONER, Korba municipal corporation** and the **Contractor.**

ii. In the contract the following expressions shall unless otherwise required by the context have the meanings hereby respectively assigned to them: -

(a) The expression “works” or “work” shall unless thereby mean something either in the subject or context repugnant to such construction be construed and taken to mean the works or by virtue of the contract contracted to be executed whether temporary or permanent and whether original, altered, substituted or additional.

(b) The “site” shall mean the land and/or other places on, into or through which work is to be executed under the contract or any adjacent land path or street through which work is to be executed under the contract or any adjacent land, path, or street which may be allotted or used for the purpose of carrying out the contract.

(c) The “COMMISSIONER” means Commissioner of Korba Municipal Corporation.

(d) The “Engineer-in-Charge” means the Executive Engineer or equivalent who shall supervise and be in charge of the work and who shall sign the contract on behalf of the Commissioner.

(e) Competent Authority means COMMISSIONERofKorba municipal corporation where work is going to be executed.

(f) The PMC means Sewage master Plan Preparation & Management Consultant the representative of KMC.

(g) The term “Chief Engineer” means the Competent Authority from Korba MUNICIPAL CORPORATION/UADD.

(h) The term "Superintending Engineer" means the Superintending Engineer of the concerned Korba MUNICIPAL CORPORATION / UADD

(i) The term "Executive Engineer"/"Engineer-in-Charge"/"Divisional Officer" means the Executive Engineer of Korba MUNICIPAL CORPORATION.

(j) The term "Assistant Engineer" means the Assistant Engineer Korba MUNICIPAL CORPORATION.

(k) The word "Sub Engineer" shall mean "Section Officer" of the Korba MUNICIPAL CORPORATION.

NOTE: “Words” importing the singular number include plural number and vice-versa,

11.2 CONDITIONS OF CONTRACT

1. The person(s) whose tender may be accepted (hereinafter called the contractor(s), which expressions shall unless excluded by or repugnant to the context include his heirs executors, administrators' representatives and assigns) shall permit Govt at the time of making any payments to him for the value of work done under the contract to deduct Security deposit as under.

   The Security Deposit to be taken for the due performance of the contract under the terms & conditions printed on the tender form will be the earnest money plus a deduction of 5 percent from the payment made in the running bills, till the two together amount to 5 percent of the cost of work put to tender or 5 percent of the cost of the works executed when the same exceeds the cost of work put to tender. TheKorba MUNICIPAL CORPORATION at any time can forfeit the security deposit if it seems to their opinion that the contractor is making any prejudice with the essence of the contract. The decision of the Commissioner in this regard shall be final and binding on the contractor.

2. The Contractor(s) is/are to provide every-thing of every sort and kind (with the exception noted in the schedule attached) which may be necessary and requisite for the due and proper execution of the several works included in the contract according to the true intent and meaning of the drawings and specifications taken together, which are to be signed by Engineer in Charge/COMMISSIONER and the contractor(s) whether the same may or may not be particularly described in the specification or shown on the drawings, provided that the same are reasonably and obviously to be inferred there-from and in case of any discrepancy between the drawings and the specification the Engineer in Charge/ COMMISSIONER is to decide which shall be followed.

2 (a) The Contractor(s) is/are to set out the whole of the works in conjunction with an officer to be deputed by the Executive Engineer/COMMISSIONER and during the progress of the works to amend on the requisition of the Executive Engineer/COMMISSIONER any errors of which may arise therein and therein and provide all the necessary labour and materials for so doing. The contractor(s) is/are to provide all plant, labour and materials (with the exceptions noted in the schedule attached) which may be necessary and requisite for the works. All materials and workmanship are to be the best of their respective kinds. The contractor(s) is/are to leave to works in all respects clean and perfect at the completion thereof.

2(b) All inspection charges will be payable by the Contractor.

3. Complete copies of the drawings and specification signed by the SE/EE of concerned regional office are to be furnished by him to the contractor(s) for his/their own use, and the same or copies thereof are to be kept on buildings in charge of the Contractor(s) agent who is to be constantly kept on the ground by the contractor(s) and to whom the instructions can be given by the COMMISSIONER. The Contractor(s) is/are not to sublet the works.

4. The Engineer in Charge/COMMISSIONER is to have at all times access to the works which

are to be entirely under his control. He may require the contractor(s) to dismiss any person in the Contractor(s) employ upon the works that may be incompetent or misconduct himself and contractor(s) is/are forthwith to comply with such requirements.

5. The Contractor(s) is/are not to vary or deviate from the drawings or specifications or execute any extra work of any kind whatsoever unless upon the authority of Executive Engineer to be sufficiently shown by any order in writing by any plan or drawings expressly given and signed by him as an extra or variation or by any subsequent written approval signed by him. In cases of daily labour all vouchers for the same are to be delivered to the Engineer in Charge/COMMISSIONER at least during the week following that in which the work may have been done and only such day work is to be allowed for as such as may have been authorized by the COMMISSIONER to be so done unless the work cannot from its character be properly measured and valued. The drawings in respect of which this contract is drawn up provide for a minimum depth of foundations for good soil. Any extra depth will not be measured as an extra when the foundation trenches have been opened up and will not be paid for in addition to the sum contracted for the completed work. The contractor has to ascertain the foundation strata in advance and shall prepare the designs as per actual site conditions.

6. Any authority given by the COMMISSIONER for any alterations or additions in or to works is not to vitiate the contract, but all additions, omission or variations made in carrying out the works are to be measured and valued and certified by the Engineer in Charge/COMMISSIONER and added to or deducted from the amount of the contract, as the case may be, at rates in force in the CGPWD/UADD/CGPHED Department. In such cases in which rates do not exist, the COMMISSIONER will fix the rates to be paid.

7. All work and materials brought and left upon the ground by the Contractor(s) or his/their orders for the purpose of forming part of the works are to considered to be the property of Korba Municipal Corporation and the same are not to be removed or taken away by the Contractor(s) or any other without the special license and consent in writing of the COMMISSIONERofKorba Municipal Corporation is not to be in any way answerable for any loss or damage which may happen to or in respect of any such work or materials either by the same being lost or stolen or injured by weather or otherwise.

8. The COMMISSIONER has full power to require the removal form the premises of all materials which, in his opinion, are not in accordance with the specification and in case of default the COMMISSIONER is to be at liberty to employ other persons to remove the same without being answerable or accountable for any loss or damage that may happen or arise to such materials. The COMMISSIONER is Also, to have full power to require other proper materials to be substituted and in case of default the COMMISSIONER may cause the same to be supplieded and all costs which may attend such removal and substitution are to be borne by the contractor(s).

9. If in the opinion of the Engineer in Charge /COMMISSIONER any of the works are executed with improper materials or defective workmanship, the contractor(s) is/are when required by the COMMISSIONER forthwith to re-execute the same and to substitute proper materials and

workmanship and in case of default of the contractor (s) is so doing within a week the COMMISSIONER is to have full power to employ other persons to re-execute the work and the cost thereof shall be borne by the contractor(s).

10. Any defects, shrinkage or other faults which may appear within 12 months performance period, from the completion of the work arising out of defective or improper materials or workmanship are upon the direction of the COMMISSIONER/ Engineer in Charge to be amended and made good by the contractor(s) at his/their own cost unless the COMMISSIONER/ Engineer in Charge shall decide that he/they ought to be paid for the same and in case of default the COMMISSIONER may recover from the contractor(s) the cost of making good the works.

11. From the commencement of the works to the completion of the same they are to be under the contractor's(s) charge. The contractor(s) is/are to be held responsible for and to make good all injuries, damages and repairs, occasioned or rendered necessary to the same by fire/ Natural Calamity or other causes and they are to hold the Korba Municipal Corporation/Govt of C.G harmless from any claims for injuries to persons or for structural damage to property happening from any neglect, default, want of proper care of misconduct on the part of the contractor(s) or any one in his/their employ during the execution of the works

12. The COMMISSIONERis to have full power to send workmen upon the premises to execute fittings and other works not included in the contract for whose operation the contractor(s) is/are to afford every reasonable facility during ordinary working hours, provided that such operations shall be carried in such a manner as not to impede the progress of the work included in the contract but the contractor(s) is/are not to be responsible for any damage which may happen to or be occasioned by any such fittings or other works.

13. The works comprised in this tender are to be commenced immediately upon receipt of order of commencement given in writing by COMMISSIONER. The whole work, including all such addition and variations as aforesaid (but excluding such, if any, as may have been postponed by an order from the COMMISSIONER) shall be completed in every respect within **27 months** from the reckoned date (The period will be reckoned from the 15 days after the date of Work order in case of completion period is up to six months and 30 days in case of completion period is more than six months). The work shall throughout the stipulated period of contract be proceeded with all due diligence, keeping in view that time is the essence of the contract. The contractor shall be bound in all cases, in which the time allowed for any work exceeds one month, to complete 1/8th of the whole work before 1/4th of the whole time allowed under the contract has elapsed, 3/8th of the work before 1/2 of such time has elapsed and 3/4th of the work before 3/4th of such time has elapsed. In the event of the contractor failing to comply with the above conditions, the Executive Engineer shall levy on the contractor, as compensation an amount equal to: 0.5% (zero-point five percent) of the value of work (contract sum) for each week of delay, provided that the total amount of compensation under the provision of the clause shall be limited to 6% (six percent) of the value of work. (Contract sum)

Provided further that if the contractor fails to achieve 30% (thirty percent) progress in 1/2

(half) of original or validly extended period of time the contract shall stand terminated after due notice to the contractor and his contract finalised.

If the contractor shall desire an extension of time for completion of work on the ground of his having been "UNAVOIDABLY" hindered in its execution or on any other ground, he must apply giving all and complete details of each of such hindrances or other causes in writing, to the Executive Engineer/COMMISSIONER positively within 15 days of occurrence of such hindrance(s) and seek specific extension of time (period from…….to……..). If in the opinion of Executive Engineer, such reasonable grounds are shown, the Executive Engineer shall himself grant extension of time, if the extension of time sought by the contractor is for one month or 10% (ten percent) of the stipulated period of completion, whichever is more. If the extension of time sought is more than above period mentioned, then the Executive Engineer shall refer the case to the Superintending Engineer with his recommendation and only after his decision in this regard, the Executive Engineer shall sanction extension of such time as decided by the Superintending Engineer.

Once the COMMISSIONER has decided the case of extension of time with reference to the particular application of the contractor, it will not be competent for them to review/change such a decision later on. However, the Superintending Engineer shall give the contractor an opportunity to be heard (orally and or in writing), before taking any final decision either of granting extension of time or permitting the contractor to complete the work by the delayed date or before refusing both.

Provided further where the COMMISSIONER has recommended grant of extension of particular time of the contract or has refused to recommend extension of time but has recommended permitting the contractor for delayed completion, the contractor shall continue with the work till the final decision by Superintending Engineer of the concerned zone.

Failure on the part of the contractor for not applying extension of time even within 30 days of the cause of such a hindrance, it shall be deemed that the contractor does not desire extension of time and that he has "Waived" his right if any, to claim extension of time for such cause of hindrance.

Once the COMMISSIONER has heard (oral and or in writing) the contractor on this subject matter of extension of time and if COMMISSIONER/Superintending Engineer fails to communicate his decision within a period of 30 days of such hearing, it shall be deemed that the contractor has been granted extension of time for the period as applied by him. Provided that the Contractor(s) shall not be entitled to any extension of time in respect of the extra work involved in the extra depth of foundation mentioned clause 5.

13.1 Compensation Events for consideration of extension of time without penalty: -

The following mutually agreed Compensation Events unless they are caused by the contractor would be applicable;

(a) The COMMISSIONER does not give access to a part of the site.
(b) The COMMISSIONER modifies the schedule of other contractor in a way, which affects the work of the contractor under the contract.
(c) The COMMISSIONER orders a delay or does not issue drawings, specification or

instructions /decisions/approval required for execution of works on time.

(d) The COMMISSIONER instructs the contractor to uncover or to carry out additional tests upon work, which is then found to have no defects.

(e) The COMMISSIONER gives an instruction for additional work required for safety or other reasons.

(f) The advance payment and or payment of running bills (complete in all respect) are delayed.

(g) The COMMISSIONER unreasonably delays issuing a Certificate of Completion

(h) Other compensation events mentioned in contract if any

14. Action when the work is left incomplete abandoned or delayed beyond the time limit permitted by the COMMISSIONER.

(i) The COMMISSIONER may terminate the contract if the contractor causes a fundamental breach of the contract.

(ii) Fundamental breach of contract shall include, but not be limited to, the following: -

a) The contractor stops work for four weeks, when no stoppage of work is shown on the current programme or the stoppage has not been authorised by the Executive Engineer.

b) The Executive Engineer gives notice that failure to correct a particular defect is a fundamental breach of contract and the contractor fails to correct it within reasonable period of time determined by the Executive Engineer in the said notice.

c) The contractor has delayed the completion of work by the number of weeks [12 (Twelve) weeks] for which the maximum amount of compensation of 6% of contract sum is exhausted.

d) If the contractor has not completed at least thirty percent of the value of construction work required to be completed in half of the completion period (Including validly extended period if any).

e) If the contractor fails to appoint the technical staff and if appointed do not function properly for 4 weeks even after due written notice by the Executive Engineer.

f) If he violates labour laws.

g) Any other deficiency which goes to the root of the contract Performance

(iii) If the contract is terminated, the contractor shall stop work immediately, make the site safe and secure and leave the site as soon as reasonably possible.

(iv) The Engineer in Charge shall cause recording and checking of measurements of all items of work done (taking in to account quality and quantity of items actually executed) and prepare the final bill after adjusting all pervious outstanding dues. Such recording of measurements shall be done after due notice regarding time and date of recording measurement and directing the contractor to either remain present himself or his authorised representative so as to satisfy himself that the recording of measurement is just and proper. Failure on his parts either to attend and or refusing to acknowledge the measurement so recorded in the department measurement book, shall be at his sole risk and responsibility.

The COMMISSIONER shall forfeit the earnest money and or security deposit and further recover/deduct/adjust a compensation @ 10% (ten percent) of the balance value of work left incomplete either from the bill, and or from available security/performance guarantee or shall

be recovered as "Arrears of land revenue"

15. Deleted

16. A certificate of the COMMISSIONER or an award of the referee hereinafter referred to, as the case may be showing the final balance due or payable to the contractor(s) is to be conclusive evidence of the works having been duly completed and the contractor(s) is/are entitled to receive payment of the final balance, but without prejudice to the liability of the contractor(s) provision of clause 10.

17. ARBITRATION CLAUSE: Except as otherwise provided in this contract all question and dispute, relating to the meaning of the specifications designs, drawings and instructions herein before mentioned and as to thing whatsoever, in any way, arising out of or relating to the contract, designs, drawings, specifications, estimates, concerning the works, or the execution or failure to execute the same, whether arising during the progress of the works or after the completion abandonment thereof shall be referred to the COMMISSIONER shall give his written instructions and/or decisions within a period of 60 days of such request. This period can be extended by mutual consent of the parties.

Upon receipt of written instructions of decisions, the parties shall promptly proceed without delay to comply such instruction or decision, If the COMMISSIONER fails to give his instructions or decisions in writing with in a period of 60 days or mutually agreed time after being requested or if the parties are not satisfied with the decision of the COMMISSIONER, they may within 60 days refer and appeal to the Competent Authority appointed by State. who shall afford an opportunity to the parties of being heard and to offer evidence in support of his appeal. The Competent Authority appointed by State will give his decision within 90 days. If any party is not satisfied with the decision of the Competent Authority appointed by State, he can, refer such dispute for arbitration governed as per "The ChhattisgarhMadhyasthaAbhikaranRaipur"

18. If at any time before or after the commencement of the work, COMMISSIONERKorba Municipal Corporation shall for any reason whatsoever: -

18.1 Cause Alterations, omissions or Variation in the drawings and specification involving any curtailment of the works as originally contemplated; OR

18.2 Not required the whole of work as specified in the tender to be carried out,

The contractor(s) shall have no claim to any payment or compensation whatsoever on account of any profit or advantage which he/they might have derived from the execution of the work in full as specified in the tender but which he/they did not derive in consequence of the curtailment of the works by reason of alterations, omissions or variations or in consequence of the full amount of the work not having been carried out.
But the contractor(s) shall be entitled to compensation for any loss sustained by him/them by reason of his/their having purchased or procured any materials or entered into any

engagements or made any advances to labour or taken any other preliminary or incidental measures on account of or with a view to the Execution of the works or the performance of the contract.

19. Death or permanent invalidity of the contractor-If the contractor is an individual or a proprietary concern, partnership concern, dies during the currency of the contract or becomes permanently incapacitated, where the surviving partners are only minors the contract shall be closed without levying any damages/ compensation as provided for in clause 14 of the contract agreement. However, if the competent authority is satisfied about the competence of the surviving, then the competent authority shall enter into a fresh agreement for the remaining work strictly on the same terms and conditions, under which the contract was awarded.

11.3 SPECIAL CONDITIONS OF CONTRACT

1. The Addresses are :
2. (i) "Employer" : The Commissioner Municipal Corporation, Korba Attention:

(2) Tax will be deducted at source as per prevailing Income Tax Rules

(3) The risk insurance coverage shall be as follows :

a) Third party vehicle liability insurance as required under India's Motor Vehicle Act, 1988 by the Contractor or its personnel Sub Contractor or their personnel for the period of contract.
b) Third Party liabilities insurance, with a minimum contract of equal to amount of contract.
c) Professional liabilities insurance with a minimum coverage equal to amount of contract.
d) Employer's liabilities & workers compensation insurance in respect of the Personnel of the Contractor, in accordance with the relevant provisions of the Applicable Laws of India, as well as with respect to such personnel any such life, health, accident, travel or other insurance as may be applicable
e) Any other laws / rule applicable in India.

(4) The arbitration proceedings shall take place in Korba, Chhattisgarh.

(5) The performance Securities amount is 5% of the contract value

Dated:
Signature of the Contractor

Dated:

Commissioner
Korba Municipal Corporation
District-Korba (CG)

LIST OF ANNEXURES

Annexure- "A"

Model Rules relating to Labour, Water Supply and Sanitation in Labour Camps

NOTE:

These model rules are intended primarily for labour camps which are not of a permanent nature. They lay sown the minimum desirable standard which should be adhered to standards in permanent on semi-permanent labour camps should not obviously be tower than for temporary camps.

LOCATION:

The camp should be located in elevated and well drained ground in the locality. Labour huts to be constructed for one family of 5 persons each. The layout to be shown in the prescribed sketch.

HUTTING:

The huts to be built of local materials. Each hut should provide at least 20 sqm. of living space.

SANITARY FACILITIES:

Latrines and urinals shall be provided at least 15 metres. away from the nearest quarters separately for men and women and specially so marked in the following scale.

LATRINES:

Pit provided at the rate of 10 user of families per seat. Separate are required as the privacy can Also, be used for this purpose.

DRINKING WATER:

Adequate arrangements shall be made for the supply of drinking water. If practicable filtered and chlorinated supplies shall be arranged when supply is from intermittent sources overhead storage tank shall be provided with a capacity of five Liters a per son per day. Where the supply is to be made from a well is shall confirm to the sanitary standard laid down in the report of the rural sanitation committee. The well should be at least 30 meters away from any latrine or other source of pollution. If possible the pump should be installed for drawing the water from well. The well should be effectively disinfected one every month and the quality of the water should be got tested at the Public Health Institution between each work of disinfecting.

BATHING AND WASHING:

Separate bathing and washing plan shall be provided for men and women for every 25 persons in the camp. There shall be one gap and space of 2 sq. for washing and bathing Proper drainage for waste water should be provided.

WASTE DISPOSAL:

Dustbin shall be provided at suitable places in camp and the residence shall be directed to throw all rubbish into those dustbins. The dustbin shall be provided with cover. The contents shall be removed every day and disposed off by trenching.

MEDICAL FACILITIES:

a) Every camp where 1000 or more persons reside shall be provided with whole time doctor and dispensary. If there are women in the camp a whole time Nurse shall be employed.

b) Every camp where less than 1000 but more than 250 persons resides shall be provided with a dispensary and a part time, Nurse/Midwife. If there are less than 250 persons in any camp a first aid kit shall be maintained in charge of whole time persons trained in first side. All the medical facilities mentioned above shall be for the all residents in the camp, including a dependent of workers, if any, free of costs. For each labour camp there should be qualified sanitary inspector and sweepers should be provided in the following scales:-

For camps with strength over 200 but not exceeding 500 persons - One sweeper for every 75 persons above the first 200 for which 3 sweepers will be provided.

For camps with strength over 500 persons - One sweeper for every 100 persons above first 500 for which 6 sweepers should be provided.

Annexure- "B"

Contractors Labour Regulations

The contractor shall pay not less than fair wage to labours engaged by him in the work:

EXPLANATION:

A. "FAIR WAGES" means whether for time of piece work as notified on the date of inviting tenders and where such wages have not been so notified the wages prescribed by the competent authority for division in which the work is done.

The contractor shall, notwithstanding the provision of any contract to the contrary, cause to be paid a fair to labours indirectly engaged on the work including any labour engaged by his sub-contractor in connection with the said work as if labourers had been immediately employed by him.

In respect of all labour directly or indirectly employed on the works or the performance of his contract, the contractor shall comply with or cause to be complied with the labour Act. Enforce.

The Executive Engineer/Assistant Engineer shall have the right 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 the workers non-payment of the wages or of deductions made from his or their wages which are not justified by their terms of contract or non-observance of regulations.

The contractor shall be primarily liable for all payments to be made under and for the observance of the regulations aforesaid without prejudice to his right to claim indemnity form his sub-contractor.

The Regulations aforesaid shall be deemed to be a part of this contract and any breach thereof shall be deemed to be a breach of this conduct.

The contractor shall obtain a valid license under the contract (Regulation & Abolition) Act, in force and rule made there under by the competent authority from time to time before commencement of work and continue to have a valid license until the completion of the work.

Any failure to fulfil this requirement shall attract the penal provisions of this contract arising out of the resulted non-execution of the work assigned to the contractor.

Special Additional Condition

- Cess@1% (one percent only) shall be deducted at source, from every bill of contractor by Executive Engineer under "Building and other Construction for workers welfare, cess Act-1996"

It is mandatory for the contractor(s) to get himself/themselves registered with "Chhattisgarh Building and other Construction Welfare Board" for work amounting to Rs. 10.00 Lacs (Ten Lacs) and above and enclose a true copy of such registration certificate within one month of award of contract.

Annexure-"C"

Drawings enclosed with NIT for understanding of bidder

ANNEXURE – "D"

Statement showing the Lead of Materials

S.No.	Description	Lead
1.	**NOT APPLICABLE**……	
2.	……	
3.	……	
4.	……	
5.	……	

Note - This statement is only for guidance of the contractor. The tenderer should satisfy himself regarding the availability of the required quality and quantity of materials.

ANNEXURE 'E'

TECHNICAL SPECIFICATION

SALIENT FEATURES AND SCOPE OF THE PROPOSED PROJECT

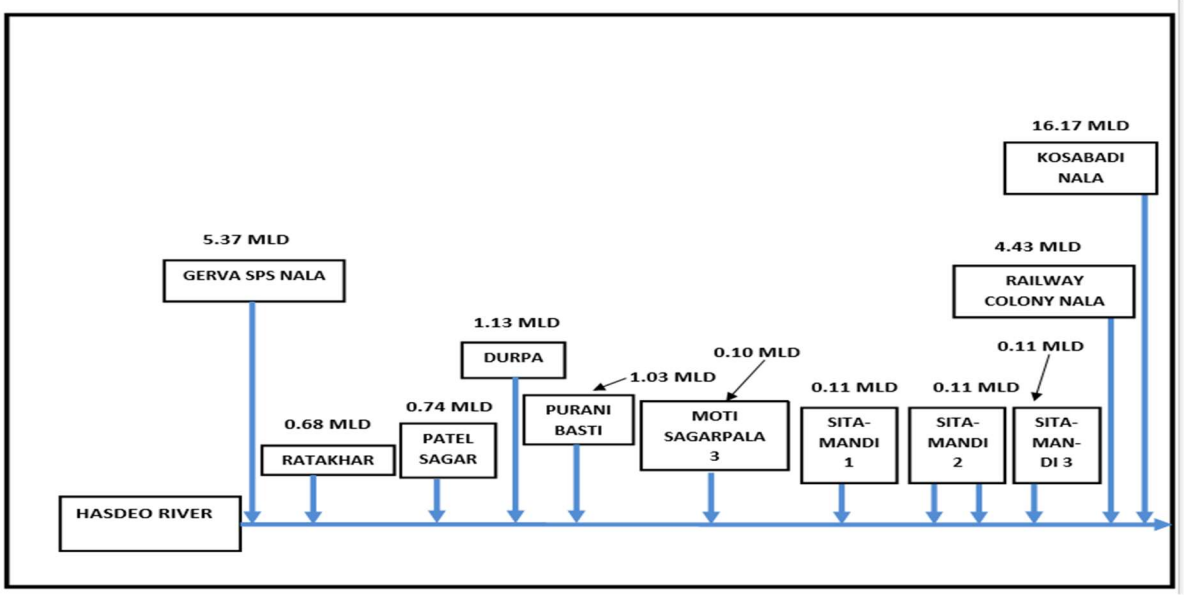
1.0 Demand& Discharge Computationsof Nallas

As per Population census data of KMC, The Growth rate for the Korba City has been taken and Population is forecasted. Based on the Population& demand data the Discharges are calculated for 11 Nos. of Nallas are mentioned below: -

Table 2: DISCHARGE (WARD WISE)

DISCHARGES NALLAWISE				
S.no	**Nallas**	**2025**	**2040**	**2055**
1	Kosabadi	16.17	18.09	24.25
2	Railway Colony	4.43	4.88	6.59
3	Sitamadi 3	0.11	0.11	0.21
4	Sitamadi 2	0.11	0.11	0.21
5	Sitamadi 1	0.11	0.11	0.21
6	Durpa Nalla	1.13	1.13	1.65
7	Moti Sagarapala Nalla 3	0.10	0.11	0.21
8	Purani Basti	1.03	1.03	1.51
9	Patel Sagar Nalla	0.74	0.76	1.14
10	Ratakhar Nalla	0.68	0.69	1.05
11	Gerva SPS	5.37	5.98	8.00
	Total: -	**29.98**	**32.99**	**45.02**

FIGURE 1: FLOWCHART OF DISCHARGES OF NALLA



2.0 Pı

Table 3: Components of the Project

S.N	Particulars
K-1	**KT Weir at Kosabadi Nalla**
K-2	**Inlet Chamber, Screen Chamber & Grit Settlement Chamber at 11 locations**
K-3	**Construction of Wet Well with Pumphouse at Kosabadi**
K-4	**Providing and installing 1500 KVA Substation at Kosabadi Wet Well & 1500 KVA substation at STP**
K-5	**Raw Sewer Pumping Machinery Wet Well on Kosabadi Nalla**
	1) For Lean flow, Q -190.92 lps, H- 30.2 m
	2) For Average flow, Q -381.83 lps, H- 38.71 m
	3) For Peak flow, Q -859.12 lps, H- 79.75 m
K-6	**Raw Sewer Rising Main from Wet well 1 at Kosabadi Nalla to STP (DI K9- L= 9124m D= 700mm&Mild Steel – L=770 m D= 700mm)**
K-7	**Interceptor Sewer Pipe Line from All Nallahs to Wet well (L= 5960 meters varying from 450mm to 1100mm diameters)**
K-8	**Construction of MS cum RCC truss bridge across Hasdeo river 750 m for laying MS pipe**
K-9	**33.00 MLD SBR STP with Mechanical, Electrical Work PLC SCADA and Land Development work including construction of road, storm water drain and compound wall.**
K-10	**Allied civil works for STP comprising of G type H type quarters and Guard room.**
K-11	**Land development works for Wet Well including compound wall, internal road & storm water drain.**
K-12	O & M for the complete scheme from Kosawadi Nalla to STP at Pragati Nagar.

❖ KT Weir

RCC KT weir of 20 m (Or As Required) width is considered near Kosabadi Nalla to arrest the incoming wastewater. The weir is proposed with Radial crest gates to monitor the incoming flow accordingly.

❖ Inlet Chamber & Screen Chamber

Total 11 nos. of Inlet Chambers along with Screen Chambers of various sizes are provided for Kosabadi, Railway Colony, Sitamadi 3, Sitamadi2, Sitamadi1, Durpa, Moti Sagarpara, Purani Basti, Patel Sagar, Ratakhar& Gerva Nallas(11 Nos.) The chambers are to be designed in such a way that during rainy season the storm water runoff shall directly overflow in the river without disturbing the stability of the structures.

❖ Wet well

1 nos. of Wet Wells are provided for **Kosabadi Nalla**. The capacities of the same are to be computed by the contractor, the wet well shall be with overhead pumphouse with all the amenities and accessories. The construction shall be in RCC M30.

❖ Electrical Substation

Electrical Substations at Kosabadi Wet Well of 1500 KVA capacity&1500 KVA capacity at 33 MLD STP are proposed as per the design.

❖ Raw Water Pumping Machinery

1) For lean flow, Q- 190.92 lps, H-30.2 m pump in duplicate set
2) For Average flow, Q- 381.83 lps, H-38.71 m pump in single set
3) For Peak flow, Q- 859.12 lps, H-79.75 m Quart Duplicate set
3 nos. of pump for different flow and head shall be designed by the contractor for capacity of pump.

❖ Raw Sewer Rising Main

Raw water rising main of 9.89km approx. length, 700 mm diameter **(DI K9- L= 9124 m & Mild Steel Pipe – L=770 m)** from Kosabadi Wet well to proposed sewer treatment plant is provided for raw sewer transmission. Raw sewer transmission is designed for the ultimate stage of the demand. It is proposed to cross the Hasdeo River by constructing MS truss bridge with RCC Piers for the length of 750M and providing laying jointing of 770M MS pipeline including interconnection to DI pipes at both the end.

Table 4: Sewer Rising Mains

Diameter (mm)	Length(m)
700mm Dia. DI K-9	9124
700mm Dia. Mild Steel	770

❖ Interceptor pipes

Interceptor pipes to be provided for tapping the sewer water from 11 nos. of Nallas and delivering it to Wet Well proposed at Kosabadi for a length of 5.96 km approx. length & various sizes varying from 450mm to 1100 mm diameter RCC Pipes.

Table 5: Interceptor Mains

Diameter (mm)	Length(m)
450 mm	154
500 mm	1744
600 mm	1585
700 mm	83
800 mm	750
900 mm	1501
1000 mm	119
1100 mm	24

❖ Hasdeo Bridge

The RCC cum MS truss bridge shall be constructed on across the Hasdeo river for laying of MS pipeline 700 mm Dia total length 750 m. Before construction of bridge the same shall be design by the contractor and shall be got approved from technical authority as per instruction of Engineer in charge.

❖ Sewage Treatment Plant

A Sewage treatment plant of**33.00 MLD with SBR Technology** is proposed for Korba City demand of

Intermediate stage for the 2040 year. Land development,Electrical Works & SCADA Automation systems are Also, considered in the same.

Table: STP details

Sr no.	Location	Capacity	Khasara No.	Available land
1	Pragati Nagar NTPC	33 MLD	NTPC Land	2.4 Ha

❖ Allied Civil Work at STP

The work includes 6 nos. H type & 2 nos.G type quarters and one guard room at STP Location shall be constructed along with water supply arrangement sanatory arrangement etc.

❖ Land Development works at Wet Well Kosawadi

The work comprises of Compound wall, Concrete Road and storm water drain.

❖ O & M Work for entire scheme

The work includes 15 years operation and Maintenance of entire scheme for the period of 15 years.

The information given in the scope of work has been taken from the approved DPR. However,, the contractor shall re-ascertain all the informationfor their design purpose. No claim in this regard shall be entertained.

KMC may ask contractor to carry out the work, part of work or additional work anywhere in Project Area under the provisions in schedule for which payment is proposed on measure and paid basis.

ANNEXURE - "E-I"

(Specifications for Item of works involved shall be followed as per Detailed Specification Chapter - 1 to Chapter 14)

1.0 Diversion Weir Across Kosabadi Nalla:

1. *GPS Location:676110.64 E 2470095.53 N approx.*
2. *Minimum length of weir: 20.00 m*
3. *Minimum height of Weir above Nallah Bed :1.30 m*
4. *Weir key in to the side banks : Not less than 2.80 m*
5. *Minimum top width of weir : 1.00 m*
6. *Minimum depth of foundation below lowest bed RL: 3.00 m or 2.00 Mtr depth*
7. *Piers shall be provided with clear opening not more than 2.15 m. 2 piers shall be at the two banks as well.*
8. *Width of Pier shall be minimum 0.50M; weir shall be oval shaped facing the flow and downstream face as well.*
9. *Height of pier shall be above highest runoff wave level +30 cm free board*
10. *Controlling Walkway of width equal to pier width and 300 mm thick shall be provided.*
11. *Side walls to be on along both banks and on both Upstream & Downstream of Weir*
12. *Sidewall shall be of such width to accommodate the width of Inlet Cum Screen Chamber*
13. *Highest Rainfall to be taken for runoff :58.31 mm in 1 Hour*
14. *Dry Weather flow to be added to the runoff: 5.86 MLD. Average flow is 24.25 MLD.*
15. *Average Nallah Bed and Bank Levels to be as per Agency's survey Data*
16. *Upstream, Downstream apron concrete weir foundation, side wall foundation & wing wall foundations shall be designed as monolith foundation. IS11130 1984 will be followed while designing and anchor bars of sufficient minimum spacing shall be drilled / hammered into ground below foundation.*
17. *FRP/ Cast iron sluice gate square type cast iron wall thimble mounted, manually operated, CL-PL : 5.50 meter, class-I, flush bottom closure as per IS 13349 duly tested shall be proposed. The gates shall be provided in planks of 0.50m each so as to obstruct only required flow for the operation purpose. It is expected that the flow in normal as well as in dry season shall be completely stopped from entering in the river.*
18. *Structural designs have to be done as per the actual soil strata met on the construction site. Grade of the concrete shall be minimum M 30. Design to be got approved by IIT/ NIT at agency's own cost.*
19. *The top of the weir shall be provided with RCC pathway Min. 2.0m with approach road (WBM) on both the sides.*

ANNEXURE - "E-II"

SPECIFICATIONS FOR INLET CHAMBER, SCREEN CHAMBER AND GRIT CHAMBER

(Specifications for Item in works shall be followed as per Detailed Specification Chapter - 1 to 14)

1.Inlet Chamber, Screen Chamber and Grit Chamber Connecting Diversion Weir Across Kosawadi Nallah

1.0	**DESIGN BASIS**				
1.1	**FLOW**				
	Average Sewage Dry Weather Flow for Ultimate Stage	=	24.25	MLD	
			24251.52	M3/day	
	Peak Factor for Design	=	2.25		
	Peak Flow	=	54565.92	M3/day	
		=	0.63	m3/s	
1.2	**INLET CHAMBER, SCREEN CHAMBER, GRIT CHAMBER**				
	Detention Period	=	5	sec	May vary as per actual observations by the agency for suitability of regular flow
	No. of Units	=	3+1 additional screen	No.	
	Minimum size of chamber	=	As per design and site condition	m	
	Rectangular in shape with Length to Breadth Ratio 1.5 for making Travel of water longitudinal				
	Side Water depth	<	0.8	m	
	Free Board	=	0.3	m	
	EACH CHAMBER WILL HAVE CONTROLLING SLUICE GATE, THE WIDTH OF GATE SHALL HAVE OFFSET OF 200 mm ON BOTHSIDE				
1.3	**SCREEN CHAMBER**				
	Peak design Flow	=	0.63	m3/s	
	Velocity Range ahead of Screen	=	0.60 to 0.80	m/s	
	Side Water Depth	<	Side water depth in Inlet Chamber		
	Thickness of Flats	=	0.01	m	
	Angle of Inclination of Screen	=	60 to 70	deg	
	Detention period in Screen	<	6	sec	
	Head loss through screen in normal conditions	<	0.15	m	
	Head Loss on 50% clogging	<	0.30	m	
1.4	**GRIT SETTLING TANK**				
	The Inflow shall have the settling detention time of sufficient traversing length to achieve settlement of Grit with a drop of floor level by at least 300 to 500 mm with sloping against the direction of flow for accumulating settling grits. This chamber will have 2 MS Gates of the equivalent sizes as in Inlet Chamber. The Gate will lead to another Outflow Chamber with flow direction perpendicular to Inlet & Screen flow and will have outlet to Intercepting SEWER LINE (Follow the Illustrative Drawing which is Part of the NIT				

Important Note (applicable for all inlet chambers) : -

All the sizes of inlet chambers which are directly intercepting the nalla shall be designed considering the peak surface runoff. All the protection measures such as concrete lining / pitching shall Also, be provided for attaining the stability of structure. Grade of concrete shall be minimum M30.

The design of the inlet chambers shall be in a such a way that it should allow the high flood discharge during the rainy season directly to the river and only design discharge shall enter into the interceptor.However,, arrangement for complete isolation with sluice gate shall Also, be provided for cleaning and maintenance.

1.6 Receiving Chamber

The deep gravity outfall sewers after interception & diversion will discharge the raw sewage into a Receiving chamber. The function of the Receiving chamber is to distribute the flow for process units. The Receiving Chamber shall be designed for peak flow. The Receiving chamber shall consist of sluice gates on upstream and downstream for flow regulation. In the sidewall of the Receiving chamber, sluice gates shall be installed such that it is possible to operate them manually, inspection as well as operation by standing on a platform constructed at a suitable elevation adjoining and circumventing the inlet chamber. There shall be a provision of one bye pass channel along with gates. Alternatively, plant bypass can be provided from existing / proposed manhole before pumping station. The inlet chamber shall be of adequate size to meet the requirements of workability inside it. The receiving chamber shall be open to sky and shall be water tight to prevent seepage of the sewage out of the inlet chamber. The entire construction is in M30 grade concrete and as per IS 3370. RCC access platform minimum 1.2m wide with railing as per specifications shall be provided on one side of the chamber:

1.7 Coarse Screen Channels

Two mechanical screens and one J type manual screen of 20mm are proposed in the screen chamber. Each screen channels shall be designed for 50% of peak flow. The manual bar screens shall be made of 10 mm thick Stainless Steel (SS 304) flats. The mechanical Coarse screens shall be of Bar Type of 20mm opening as per the specifications detailed elsewhere in the tender. Conveyor Belt and chute arrangement shall be provided to take the screenings to the screenings dropped from chute will be collected in a container (to be supplied by contractor) of approx. 0.5 m3 capacity. This container will be housed in a roofed enclosure with proper access, screen washing arrangement and drain. Manually operated aluminium gates are provided at the upstream and downstream ends to regulate the flow. RCC Platforms shall be provided at the upper level to enable operation of the railings shall be provided around the entire periphery of the as well as for the platform. The entire structure is to be as per IS 3370 including the platform for the gates. RCC staircase min. 1.2m wide shall be provided for access from the ground level to the top of the unit & to the operating platforms.

All other accessories, whether specified or not, but required for completeness of contract shall be in contractor’s scope.

1.8 Grit Chambers

Two Mechanical Grit Chamber (Working) along with one Manual Bypass Channel (Standby) shall be provided after Fine Screen Channels. The Grit Chamber shall be designed for 50% of Peak Flow and the Bypass Channel shall be designed for 50% of Peak Flow.

The entire construction shall be in M30 grade reinforced cement concrete and as per IS 3370. RCC Platform/Walkway, minimum 1.20 m wide with Hand Railing as per specifications shall be provided. RCC Staircase, minimum 1.20 m wide with Hand Railing as per specifications shall be provided for access from Finished Ground Level to the top of the Unit & to the Operating Platform/Walkway.

Each Grit Chamber shall have the following features:

- One tapered Inlet Channel running along one side with adjustable Influent Deflectors for entry of sewage into the Grit Chamber.
- One tapered Outlet Channel for collecting the de-gritted sewage, which overflow over an adjustable Weir into the Outlet Channel. It shall be designed in such a way that no settling takes place in it.
- One sloping Grit Classifying Channel in to which the collected grit shall be classified.
- The grit from Classifier shall be collected in a Wheeled Trolley.
- A Grit Scraping Mechanism.
- Screw Classifier or Reciprocating Rake Mechanism to remove the grit.
- One Organic Matter Return Pump

Manually operated CI Sluice Gates shall be provided at entrance of the Inlet Channel of the Grit Chambers as well as Bypass Channel to regulate the flow.

All other accessories, whether specified or not, but required for completion of Contract shall form the part of Bidder's Scope for the STP.

Inlet Chamber, Screen Chamber and Grit Chamber on Railway Nallah

2.0	**DESIGN BASIS**				
2.1	**FLOW**				
	Average Sewage Dry Weather Flow for Ultimate Stage	=	6.59	MLD	
			6587.84	M3/day	
	Peak Factor for Design	=	2.25		
	Peak Flow	=	14822.64	M3/day	
		=	0.17	m3/s	
2.2	**INLET CHAMBER, SCREEN CHAMBER, GRIT CHAMBER**				
	Detention Period	=	5	sec	May vary as per actual observations by the agency for suitability of regular flow
	No. of Units	=	3+1 additional screen	No.	
	Minimum size of chamber	=	As per design and site condition	m	
	Rectangular in shape with Length to Breadth Ratio 1.5 for making Travel of water longitudinal				
	Side Water depth	<	1.2	m	
	Free Board	=	0.3	m	
	EACH CHAMBER WILL HAVE CONTROLLING SLUICE GATE, THE WIDTH OF GATE SHALL HAVE OFFSET OF 200 mm ON BOTHSIDE				
2.3	**SCREEN CHAMBER**				
	Peak design Flow	=	0.17	m3/s	
	Velocity Range ahead of Screen	=	0.60 to 0.80	m/s	
	Side Water Depth	<	Side water depth in Inlet Chamber		
	Thickness of Flats	=	0.01	m	
	Angle of Inclination of Screen	=	60 to 70	deg	
	Detention period in Screen	<	6	sec	
	Head loss through screen in normal conditions	<	0.15	m	
	Head Loss on 50% clogging	<	0.30	m	
2.4	**GRIT SETTLING TANK**				
	The Inflow shall have the settling detention time of sufficient traversing length to achieve settlement of Grit with a drop of floor level by at least 300 to 500 mm with sloping against the direction of flow for accumulating settling grits. This chamber will have 2 MS Gates of the equivalent sizes as in Inlet Chamber. The Gate will lead to another Outflow Chamber with flow direction perpendicular to Inlet & Screen flow and will have outlet to Intercepting SEWER LINE (Follow the Illustrative Drawing which is Part of the NIT				

3 Inlet Chamber, Screen Chamber and Grit Chamber on Sitamadi Nallah3

3.0	**DESIGN BASIS**				
3.1	**FLOW**				
	Average Sewage Dry Weather Flow for Ultimate Stage	=	0.21	MLD	
			207.36	M3/day	
	Peak Factor for Design	=	2.25		
	Peak Flow	=	466.56	M3/day	
		=	0.01	m3/s	
3.2	**INLET CHAMBER, SCREEN CHAMBER, GRIT CHAMBER**				
	Detention Period	=	5	sec	May vary as per actual observations by the agency for suitability of regular flow
	No. of Units	=	3+1 additional screen	No.	
	Minimum size of chamber	=	As per design and site condition	m	
	Rectangular in shape with Length to Breadth Ratio 1.5 for making Travel of water longitudinal				
	Side Water depth	<	0.8	m	
	Free Board	=	0.3	m	
	EACH CHAMBER WILL HAVE CONTROLLING SLUICE GATE, THE WIDTH OF GATE SHALL HAVE OFFSET OF 200 mm ON BOTHSIDE				
3.3	**SCREEN CHAMBER**				
	Peak design Flow	=	0.01	m3/s	
	Velocity Range ahead of Screen	=	0.60 to 0.80	m/s	
	Side Water Depth	<	Side water depth in Inlet Chamber		
	Thickness of Flats	=	0.01	m	
	Angle of Inclination of Screen	=	60 to 70	deg	
	Detention period in Screen	<	6	sec	
	Head loss through screen in normal conditions	<	0.15	m	
	Head Loss on 50% clogging	<	0.30	m	
3.4	**GRIT SETTLING TANK**				
	The Inflow shall have the settling detention time of sufficient traversing length to achieve settlement of Grit with a drop of floor level by at least 300 to 500 mm with sloping against the direction of flow for accumulating settling grits. This chamber will have 2 MS Gates of the equivalent sizes as in Inlet Chamber. The Gate will lead to another Outflow Chamber with flow direction perpendicular to Inlet & Screen flow and will have outlet to Intercepting SEWER LINE (Follow the Illustrative Drawing which is Part of the NIT				

4 Inlet Chamber, Screen Chamber and Grit Chamber on SitamadiNallah 2

4.0	**DESIGN BASIS**				
4.1	**FLOW**				
	Average Sewage Dry Weather Flow for Ultimate Stage	=	0.21	MLD	
			207.36	M3/day	
	Peak Factor for Design	=	2.25		
	Peak Flow	=	466.56	M3/day	
		=	0.01	m3/s	
4.2	**INLET CHAMBER, SCREEN CHAMBER, GRIT CHAMBER**				
	Detention Period	=	5	sec	May vary as per actual observations by the agency for suitability of regular flow
	No. of Units	=	3+1 additional screen	No.	
	Minimum size of chamber	=	As per design and site condition	m	
	Rectangular in shape with Length to Breadth Ratio 1.5 for making Travel of water longitudinal				
	Side Water depth	<	0.8	m	
	Free Board	=	0.3	m	
	EACH CHAMBER WILL HAVE CONTROLLING SLUICE GATE, THE WIDTH OF GATE SHALL HAVE OFFSET OF 200 mm ON BOTHSIDE				
4.3	**SCREEN CHAMBER**				
	Peak design Flow	=	0.01	m3/s	
	Velocity Range ahead of Screen	=	0.60 to 0.80	m/s	
	Side Water Depth	<	Side water depth in Inlet Chamber		
	Thickness of Flats	=	0.01	m	
	Angle of Inclination of Screen	=	60 to 70	deg	
	Detention period in Screen	<	6	sec	
	Head loss through screen in normal conditions	<	0.15	m	
	Head Loss on 50% clogging	<	0.30	m	
4.4	**GRIT SETTLING TANK**				
	The Inflow shall have the settling detention time of sufficient traversing length to achieve settlement of Grit with a drop of floor level by at least 300 to 500 mm with sloping against the direction of flow for accumulating settling grits. This chamber will have 2 MS Gates of the equivalent sizes as in Inlet Chamber. The Gate will lead to another Outflow Chamber with flow direction perpendicular to Inlet & Screen flow and will have outlet to Intercepting SEWER LINE (Follow the Illustrative Drawing which is Part of the NIT				

5 Inlet Chamber, Screen Chamber and Grit Chamber Sitamadi Nallah 1

5.0	**DESIGN BASIS**				
5.1	**FLOW**				
	Average Sewage Dry Weather Flow for Ultimate Stage	=	0.21	MLD	
			207.36	M3/day	
	Peak Factor for Design	=	2.25		
	Peak Flow	=	466.56	M3/day	
		=	0.01	m3/s	
5.2	**INLET CHAMBER, SCREEN CHAMBER, GRIT CHAMBER**				
	Detention Period	=	5	sec	May vary as per actual observations by the agency for suitability of regular flow
	No. of Units	=	3+1 additional screen	No.	
	Minimum size of chamber	=	As per design and site condition	m	
	Rectangular in shape with Length to Breadth Ratio 1.5 for making Travel of water longitudinal				
	Side Water depth	<	0.8	m	
	Free Board	=	0.3	m	
	EACH CHAMBER WILL HAVE CONTROLLING SLUICE GATE, THE WIDTH OF GATE SHALL HAVE OFFSET OF 200 mm ON BOTHSIDE				
5.3	**SCREEN CHAMBER**				
	Peak design Flow	=	0.01	m3/s	
	Velocity Range ahead of Screen	=	0.60 to 0.80	m/s	
	Side Water Depth	<	Side water depth in Inlet Chamber		
	Thickness of Flats	=	0.01	m	
	Angle of Inclination of Screen	=	60 to 70	deg	
	Detention period in Screen	<	6	sec	
	Head loss through screen in normal conditions	<	0.15	m	
	Head Loss on 50% clogging	<	0.30	m	
5.4	**GRIT SETTLING TANK**				
	The Inflow shall have the settling detention time of sufficient traversing length to achieve settlement of Grit with a drop of floor level by at least 300 to 500 mm with sloping against the direction of flow for accumulating settling grits. This chamber will have 2 MS Gates of the equivalent sizes as in Inlet Chamber. The Gate will lead to another Outflow Chamber with flow direction perpendicular to Inlet & Screen flow and will have outlet to Intercepting SEWER LINE (Follow the Illustrative Drawing which is Part of the NIT				

6 Inlet Chamber, Screen Chamber and Grit Chamber onDurpa Nalla

6.0	**DESIGN BASIS**				
6.1	**FLOW**				
	Average Sewage Dry Weather Flow for Ultimate Stage	=	1.65	MLD	
			1654.40	M3/day	
	Peak Factor for Design	=	2.25		
	Peak Flow	=	3722.40	M3/day	
		=	0.04	m3/s	
6.2	**INLET CHAMBER, SCREEN CHAMBER, GRIT CHAMBER**				
	Detention Period	=	5	sec	May vary as per actual observations by the agency for suitability of regular flow
	No. of Units	=	3+1 additional screen	No.	
	Minimum size of chamber	=	As per design and site condition	m	
	Rectangular in shape with Length to Breadth Ratio 1.5 for making Travel of water longitudinal				
	Side Water depth	<	0.8	m	
	Free Board	=	0.3	m	
	EACH CHAMBER WILL HAVE CONTROLLING SLUICE GATE, THE WIDTH OF GATE SHALL HAVE OFFSET OF 200 mm ON BOTHSIDE				
6.3	**SCREEN CHAMBER**				
	Peak design Flow	=	0.01	m3/s	
	Velocity Range ahead of Screen	=	0.60 to 0.80	m/s	
	Side Water Depth	<	Side water depth in Inlet Chamber		
	Thickness of Flats	=	0.01	m	
	Angle of Inclination of Screen	=	60 to 70	deg	
	Detention period in Screen	<	6	sec	
	Head loss through screen in normal conditions	<	0.15	m	
	Head Loss on 50% clogging	<	0.30	m	
6.4	**GRIT SETTLING TANK**				
	The Inflow shall have the settling detention time of sufficient traversing length to achieve settlement of Grit with a drop of floor level by at least 300 to 500 mm with sloping against the direction of flow for accumulating settling grits. This chamber will have 2 MS Gates of the equivalent sizes as in Inlet Chamber. The Gate will lead to another Outflow Chamber with flow direction perpendicular to Inlet & Screen flow and will have outlet to Intercepting SEWER LINE (Follow the Illustrative Drawing which is Part of the NIT				

7 Inlet Chamber, Screen Chamber and Grit Chamber on Moti Sagarpala Nallah

7.0	**DESIGN BASIS**				
7.1	**FLOW**				
	Average Sewage Dry Weather Flow for Ultimate Stage	=	0.21	MLD	
			207.36	M3/day	
	Peak Factor for Design	=	2.25		
	Peak Flow	=	466.56	M3/day	
		=	0.01	m3/s	
7.2	**INLET CHAMBER, SCREEN CHAMBER, GRIT CHAMBER**				
	Detention Period	=	5	sec	May vary as per actual observations by the agency for suitability of regular flow
	No. of Units	=	3+1 additional screen	No.	
	Minimum size of chamber	=	As per design and site condition	m	
	Rectangular in shape with Length to Breadth Ratio 1.5 for making Travel of water longitudinal				
	Side Water depth	<	0.8	m	
	Free Board	=	0.3	m	
	EACH CHAMBER WILL HAVE CONTROLLING SLUICE GATE, THE WIDTH OF GATE SHALL HAVE OFFSET OF 200 mm ON BOTHSIDE				
7.3	**SCREEN CHAMBER**				
	Peak design Flow	=	0.01	m3/s	
	Velocity Range ahead of Screen	=	0.60 to 0.80	m/s	
	Side Water Depth	<	Side water depth in Inlet Chamber		
	Thickness of Flats	=	0.01	m	
	Angle of Inclination of Screen	=	60 to 70	deg	
	Detention period in Screen	<	6	sec	
	Head loss through screen in normal conditions	<	0.15	m	
	Head Loss on 50% clogging	<	0.30	m	
7.4	**GRIT SETTLING TANK**				
	The Inflow shall have the settling detention time of sufficient traversing length to achieve settlement of Grit with a drop of floor level by at least 300 to 500 mm with sloping against the direction of flow for accumulating settling grits. This chamber will have 2 MS Gates of the equivalent sizes as in Inlet Chamber. The Gate will lead to another Outflow Chamber with flow direction perpendicular to Inlet & Screen flow and will have outlet to Intercepting SEWER LINE (Follow the Illustrative Drawing which is Part of the NIT				

8 Inlet Chamber, Screen Chamber and Grit Chamber on Purani Basti Nallah

8.0	**DESIGN BASIS**				
8.1	**FLOW**				
	Average Sewage Dry Weather Flow for Ultimate Stage	=	1.51	MLD	
			1510.40	M3/day	
	Peak Factor for Design	=	2.25		
	Peak Flow	=	3398.40	M3/day	
		=	0.04	m3/s	
8.2	**INLET CHAMBER, SCREEN CHAMBER, GRIT CHAMBER**				
	Detention Period	=	5	sec	May vary as per actual observations by the agency for suitability of regular flow
	No. of Units	=	3+1 additional screen	No.	
	Minimum size of chamber	=	As per design and site condition	m	
	Rectangular in shape with Length to Breadth Ratio 1.5 for making Travel of water longitudinal				
	Side Water depth	<	0.8	m	
	Free Board	=	0.3	m	
	EACH CHAMBER WILL HAVE CONTROLLING SLUICE GATE, THE WIDTH OF GATE SHALL HAVE OFFSET OF 200 mm ON BOTHSIDE				
8.3	**SCREEN CHAMBER**				
	Peak design Flow	=	0.01	m3/s	
	Velocity Range ahead of Screen	=	0.60 to 0.80	m/s	
	Side Water Depth	<	Side water depth in Inlet Chamber		
	Thickness of Flats	=	0.01	m	
	Angle of Inclination of Screen	=	60 to 70	deg	
	Detention period in Screen	<	6	sec	
	Head loss through screen in normal conditions	<	0.15	m	
	Head Loss on 50% clogging	<	0.30	m	
8.4	**GRIT SETTLING TANK**				
	The Inflow shall have the settling detention time of sufficient traversing length to achieve settlement of Grit with a drop of floor level by at least 300 to 500 mm with sloping against the direction of flow for accumulating settling grits. This chamber will have 2 MS Gates of the equivalent sizes as in Inlet Chamber. The Gate will lead to another Outflow Chamber with flow direction perpendicular to Inlet & Screen flow and will have outlet to Intercepting SEWER LINE (Follow the Illustrative Drawing which is Part of the NIT				

9 Inlet Chamber, Screen Chamber and Grit Chamber on Patel Sagarpara Nallah

9.0	**DESIGN BASIS**				
9.1	**FLOW**				
	Average Sewage Dry Weather Flow for Ultimate Stage	=	1.14	MLD	
			1139.20	M3/day	
	Peak Factor for Design	=	2.25		
	Peak Flow	=	2563.20	M3/day	
		=	0.03	m3/s	
9.2	**INLET CHAMBER, SCREEN CHAMBER, GRIT CHAMBER**				
	Detention Period	=	5	sec	May vary as per actual observations by the agency for suitability of regular flow
	No. of Units	=	3+1 additional screen	No.	
	Minimum size of chamber	=	As per design and site condition	m	
	Rectangular in shape with Length to Breadth Ratio 1.5 for making Travel of water longitudinal				
	Side Water depth	<	0.8	m	
	Free Board	=	0.3	m	
	EACH CHAMBER WILL HAVE CONTROLLING SLUICE GATE, THE WIDTH OF GATE SHALL HAVE OFFSET OF 200 mm ON BOTHSIDE				
9.3	**SCREEN CHAMBER**				
	Peak design Flow	=	0.01	m3/s	
	Velocity Range ahead of Screen	=	0.60 to 0.80	m/s	
	Side Water Depth	<	Side water depth in Inlet Chamber		
	Thickness of Flats	=	0.01	m	
	Angle of Inclination of Screen	=	60 to 70	deg	
	Detention period in Screen	<	6	sec	
	Head loss through screen in normal conditions	<	0.15	m	
	Head Loss on 50% clogging	<	0.30	m	
9.4	**GRIT SETTLING TANK**				
	The Inflow shall have the settling detention time of sufficient traversing length to achieve settlement of Grit with a drop of floor level by at least 300 to 500 mm with sloping against the direction of flow for accumulating settling grits. This chamber will have 2 MS Gates of the equivalent sizes as in Inlet Chamber. The Gate will lead to another Outflow Chamber with flow direction perpendicular to Inlet & Screen flow and will have outlet to Intercepting SEWER LINE (Follow the Illustrative Drawing which is Part of the NIT				

10 Inlet Chamber, Screen Chamber and Grit Chamber on Ratakhar Nallah

10.0	**DESIGN BASIS**				
10.1	**FLOW**				
	Average Sewage Dry Weather Flow for Ultimate Stage	=	1.05	MLD	
			1049.28	M3/day	
	Peak Factor for Design	=	2.25		
	Peak Flow	=	2360.88	M3/day	
		=	0.03	m3/s	
10.2	**INLET CHAMBER, SCREEN CHAMBER, GRIT CHAMBER**				
	Detention Period	=	5	sec	May vary as per actual observations by the agency for suitability of regular flow
	No. of Units	=	3+1 additional screen	No.	
	Minimum size of chamber	=	As per design and site condition	m	
	Rectangular in shape with Length to Breadth Ratio 1.5 for making Travel of water longitudinal				
	Side Water depth	<	0.8	m	
	Free Board	=	0.3	m	
	EACH CHAMBER WILL HAVE CONTROLLING SLUICE GATE, THE WIDTH OF GATE SHALL HAVE OFFSET OF 200 mm ON BOTHSIDE				
10.3	**SCREEN CHAMBER**				
	Peak design Flow	=	0.01	m3/s	
	Velocity Range ahead of Screen	=	0.60 to 0.80	m/s	
	Side Water Depth	<	Side water depth in Inlet Chamber		
	Thickness of Flats	=	0.01	m	
	Angle of Inclination of Screen	=	60 to 70	deg	
	Detention period in Screen	<	6	sec	
	Head loss through screen in normal conditions	<	0.15	m	
	Head Loss on 50% clogging	<	0.30	m	
10.4	**GRIT SETTLING TANK**				
	The Inflow shall have the settling detention time of sufficient traversing length to achieve settlement of Grit with a drop of floor level by at least 300 to 500 mm with sloping against the direction of flow for accumulating settling grits. This chamber will have 2 MS Gates of the equivalent sizes as in Inlet Chamber. The Gate will lead to another Outflow Chamber with flow direction perpendicular to Inlet & Screen flow and will have outlet to Intercepting SEWER LINE (Follow the Illustrative Drawing which is Part of the NIT				

11 Inlet Chamber, Screen Chamber and Grit Chamber on Gerva Nallah

11.0	**DESIGN BASIS**				
11.1	**FLOW**				
	Average Sewage Dry Weather Flow for Ultimate Stage	=	8.00	MLD	
			8002.56	M3/day	
	Peak Factor for Design	=	2.25		
	Peak Flow	=	18005.76	M3/day	
		=	0.21	m3/s	
11.2	**INLET CHAMBER, SCREEN CHAMBER, GRIT CHAMBER**				
	Detention Period	=	10	sec	May vary as per actual observations by the agency for suitability of regular flow
	No. of Units	=	3+1 additional screen	No.	
	Minimum size of chamber	=	As per design and site condition	m	
	Rectangular in shape with Length to Breadth Ratio 1.5 for making Travel of water longitudinal				
	Side Water depth	<	0.9	m	
	Free Board	=	0.3	m	
	EACH CHAMBER WILL HAVE CONTROLLING SLUICE GATE, THE WIDTH OF GATE SHALL HAVE OFFSET OF 200 mm ON BOTHSIDE				
11.3	**SCREEN CHAMBER**				
	Peak design Flow	=	0.19	m3/s	
	Velocity Range ahead of Screen	=	0.60 to 0.80	m/s	
	Side Water Depth	<	Side water depth in Inlet Chamber		
	Thickness of Flats	=	0.01	m	
	Angle of Inclination of Screen	=	60 to 70	deg	
	Detention period in Screen	<	6	sec	
	Head loss through screen in normal conditions	<	0.15	m	
	Head Loss on 50% clogging	<	0.30	m	
11.4	**GRIT SETTLING TANK**				
	The Inflow shall have the settling detention time of sufficient traversing length to achieve settlement of Grit with a drop of floor level by at least 300 to 500 mm with sloping against the direction of flow for accumulating settling grits. This chamber will have 2 MS Gates of the equivalent sizes as in Inlet Chamber. The Gate will lead to another Outflow Chamber with flow direction perpendicular to Inlet & Screen flow and will have outlet to Intercepting SEWER LINE (Follow the Illustrative Drawing which is Part of the NIT				

ANNEXURE - "E-III"

OBLIGATORY CONDITIONS OF WET WELL (SUMP) NEAR KOSAWADI NALLA

(Specifications for Item of works involved shall be followed as per Detailed Specification Chapter - 1 to Chapter 14)

Any Items which have not been specifically mentioned in specifications but are necessary for construction of the Wet well with Pumphouse as per good engineering practice, safety norms and successful operation and guaranteed performance of the entire structure shall be deemed to be included within Scope of Work and shall be provided by the Contractor without any extra cost to the KMC.

1. Peak Sewage flow in MLD 2050 : 45.02 MLD
2. Peak factor : 2.25
3. Liquid depth in wet well assumed (min) : 2.00 m
4. Detention time in Wet well : 5 Minutes
5. Velocity of flow during average flow : 0.60 m/sec
6. Shape of Wet well : Rectangular
7. Pump House : 5.70 m Roof height over wet well Roof
8. Inlet Chamber flow collection settling chamber adjacent to well :5.8 m wide (or as per design)
9. Suitable Gantry girder shall be considered
10. Width of wet well wall : 500 mm minimum
11. Width of Pump House Wall : 250 mm minimum
12. Pump House to Ground shall have at least one staircase
13. Lightening arrestor shall be proposed

1. Receiving Chamber

The deep gravity outfall sewers after interception & diversion will discharge the raw sewage into a Receiving chamber. The function of the Receiving chamber is to distribute the flow for process units. The Receiving Chamber shall be designed for peak flow. The Receiving chamber shall consist of sluice gates on upstream and downstream for flow regulation. In the sidewall of the Receiving chamber, sluice gates shall be installed such that it is possible to operate them manually, inspection as well as operation by standing on a platform constructed at a suitable elevation adjoining and circumventing the inlet chamber. There shall be a provision of one bye pass channel along with gates. Alternatively, plant bypass can be provided from existing / proposed manhole before pumping station. The inlet chamber shall be of adequate size to meet the requirements of workability inside it. The receiving chamber shall be open to sky and shall be water tight to prevent seepage of the sewage out of the inlet chamber. The entire construction is in M30 grade concrete and as per IS 3370. RCC access platform minimum 1.2m wide with railing as per specifications shall be provided on one side of the chamber:

Average Flow	:	45.02 MLD
Peak Factor	:	2.25
Peak Flow	:	101.295 MLD
Number of Units	:	1 (one)
Detention period	:	5Minutes at peak flow.
Min Free board	:	0.5m

h) Coarse Screen Channels

Two mechanical screens and one J type manual screen of 20mm are proposed in the screen chamber. Each screen channels shall be designed for 50% of peak flow. The manual bar screens shall be made of 10 mm thick Stainless Steel (SS 304) flats. The mechanical Coarse screens shall be of Bar Type of 20mm opening as per the specifications detailed elsewhere in the tender. Conveyor Belt and chute arrangement shall be provided to take the screenings to the screenings dropped from chute will be collected in a container (to be supplied by contractor) of approx. 0.5 m3 capacity. This container will be housed in a roofed enclosure with proper access, screen washing arrangement and drain. Manually operated aluminium gates are provided at the upstream and downstream ends to regulate the flow. RCC Platforms shall be provided at the upper level to enable operation of the railings shall be provided around the entire periphery of the as well as for the platform. The entire structure is to be as per IS 3370 including the platform for the gates. RCC staircase min. 1.2m wide shall be provided for access from the ground level to the top of the unit & to the operating platforms.

Average Flow	:	45.02 MLD
Peak Factor	:	2.25
Peak Flow	:	101.295 MLD
Number of Units	:	2 Mechanical (Working) + 1 Manual (Stand by) each of 50% of Peak Flow capacity.
Approach Velocity at Average Flow	:	0.30 m/s
Velocity through Screen at Average Flow	:	0.60 m/s max.
Velocity through Screen at Peak Flow	:	1.20 m/s max.
Free Board	:	0.30 m min.
Wheel Barrow	:	1 No. min.

All other accessories, whether specified or not, but required for completeness of contract shall be in contractor's scope.

i) Manual J type Screen - Tray Screen Specifications

2.0 General Overview: The J type Tray Screen is designed with a fixed frame embedded in the civil wall and can be equipped with one or more screens based on requirements. It is primarily installed in front of raking screens in sewage pumping stations or sewage treatment plants to prevent larger debris, such as wooden logs and oversized rags, which are beyond the removal capacity of raking screens.

3.0 Application: The J type Tray Screen is ideal for use in deeper channels where manual intervention is hazardous or difficult to enter inside the channel for screen collection. It is particularly suitable for raw sewage intake from rivers or nallahs into pumping stations. This screen ensures that large debris does not damage the mechanical rake screen, which could otherwise lead to dislodging of the chain or damage to the rake.

3.1Design Features:

1. Construction Material:
   - The screening medium consists of stainless steel 304 flats.

- The bottom of the screen includes a perforated J type tray to prevent waste from falling into the channel during lifting.

2. Functionality:
- Solid waste larger than the bar spacing is screened out.
- The screen can be removed from the channel using a hoist fixed on top of the working platform.
- Periodic lifting and cleaning of the screen by an operator is required.

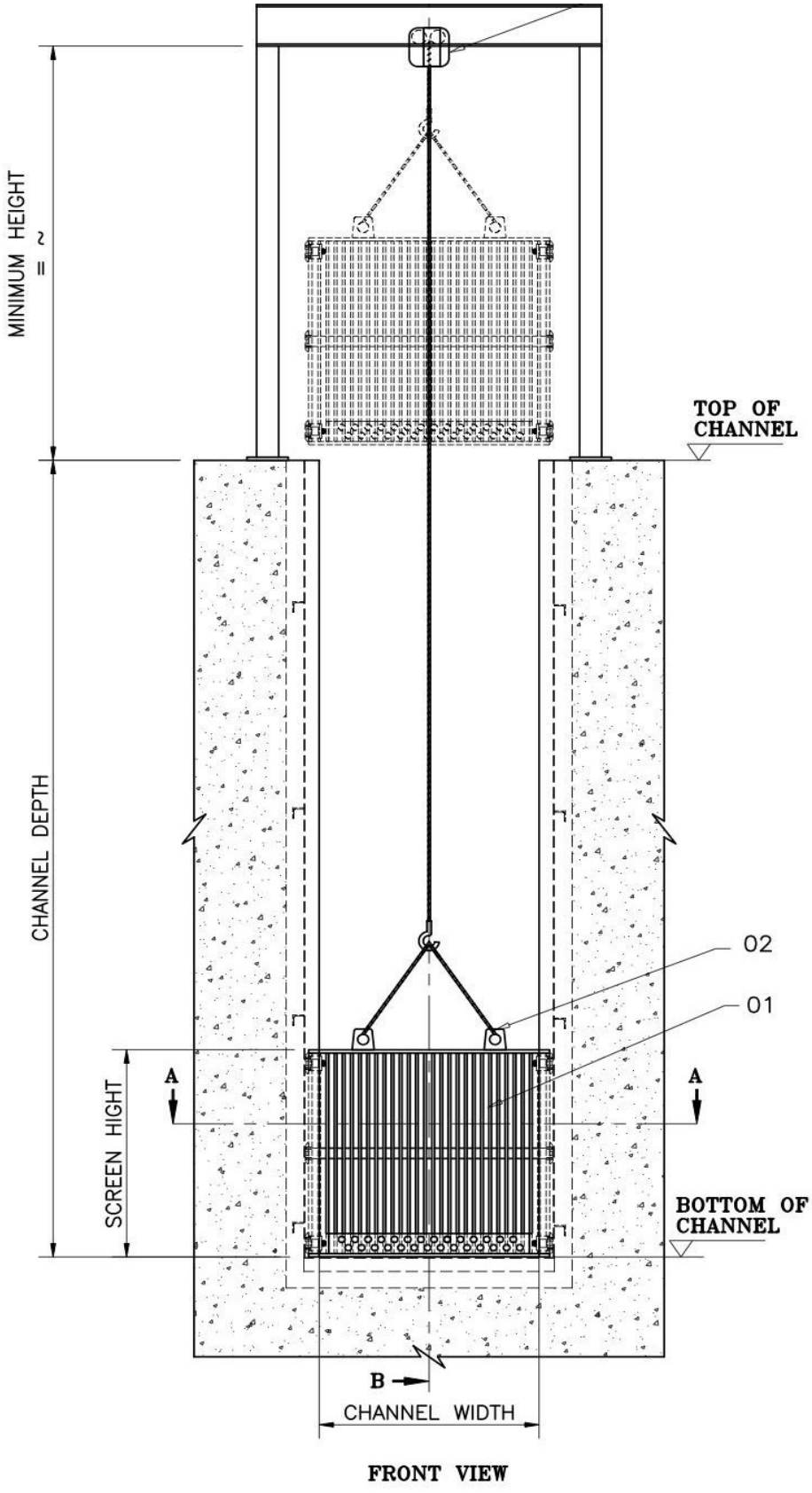
3. Safety and Efficiency:
- Designed for deeper channels to mitigate risks associated with manual intervention.
- The bottom tray ensures waste does not fall back into the channel during the removal process.

4. Mechanical Design:
- Each unit features a set of equi-spaced bars fabricated on stainless steel channels.
- The screen is supported by engineered plastics and rollers to ensure low-friction up and down movement.
- Multiple segments can be installed one above the other based on flow and water level requirements.

3.2Installation and Maintenance:

- The Tray Screen can be customized in size as per channel width & SWD and number of segments (If required) based on the specific needs of the installation site.
- Routine maintenance involves periodic lifting and cleaning of the screen to ensure continued efficient operation.

Figure 2:Tray Screen



4.0 Raw Sewage Pumping Station

Sewage enters into wet well of the pumping station after screening. The wet well shall be circular/rectangular in shape and shall be designed for a peak flow. The volume of wet well shall be provided as per CPHEEO manual.

Following criteria shall be considered to size the sump:

1. That the pump of the minimum duty/ capacity would run for at least 5 minutes considering no inflow or

2. The capacity of the sump is to be so kept that with any combination of inflow and pumping the operating cycle for any pump will not be less than 5 minutes and

3. The arrangement of the submersible pumps as per pump manufacturer's data i.e. spacing between pumps, minimum space between pump and wall etc.

4. The side water depth (live liquid depth) shall be minimum 2.0 meter. In addition to the above liquid depth an additional depression shall be provided to ensure adequate submergence of the pump as per the manufacture's recommendations. Pumping station should have a room adequate for installing electrical panels and EOT crane with sufficient headroom. Suitable arrangement should be provided for lifting of pumps.

5. The effective liquid volume shall be provided below the invert level of the screen chamber after leaving provision for a minimum of 0.3m.

IS: 3370 and IS: 4111 (part 4) shall be followed for the design and construction of wet well. The pumps shall be Submersible raw sewage pumps with centrifugal, non-clog type design. The speed of pump shall be 1000 rpm. The impeller should be of a non-clog design with smooth passage and solid handling capability of 100 mm size. The pumps shall have cutting edges facing the impellor to share the floating and suspended clogging materials like fibers, plastics, etc. The pumps will have automatic coupling arrangement at discharge end for removal and a guide pipe and chain in SS 304 will be provided for removal and lowering of pumps. Pump shall run smooth without undue noise and vibration

Capacity in wet well:

To accommodate peak flow.
Volume of wet well: as per CPHEEO

Wet well Specific Requirement, Material of Construction and Accessories:

i. Number of Units: 1 No. designed for peak flow

ii. Pumping Station Material of Construction Wet well / Sump: RCC M-30

iii. Foundation: Foundation in slushy soil with uplift pressure shall be considered.

The size of the sump shall be suitable to accommodate the number of pumps required for operation with future provisions, easy maneuverability.

Wet well shall be provided with the following accessories:

i. Hoist - comprising of I- Girder and a 5 ton or more chain pulley (the chain pulley block capacity to be 5 Ton or 3 times the maximum single unit/ weight that may be required to be removed for maintenance) with horizontal travel on the I-beam.

ii. Internal and External Electrification: The electrification shall be provided with sufficient number of points inside as well as outside of the well. Heavy duty exhaust fans shall be provided and installed for avoiding suffocation. Sufficient LED Illumination shall be provided.

iii. Internal and External Painting: Anticorrosive Enamel paint from inside and outside in three coats as approved by Engineer in Charge shall be provided.

iv. Railings and Safety equipment: CI railings and safety equipment as required for pumphouse shall be provided.

v. Doors and windows: Two panel heavy class CPVC half glazed door with protective MS Rolling shutter shall be provided. Heavy class CPVC sliding windows with net shall be provided.

vi. The panel required for screens; pumps shall be placed in separate room.

vii. The Wet Well shall be provided with sufficient bank protection such as toe wall pitching to avoid scouring in rainy season.

DG House

The DG house shall be provided to house DG Set of adequate rating capable of running the entire STP at Peak Flow including AMF Panel, Fuel Tank and other Accessories. It shall be RCC (M30) Frame and Brick Masonry Structure equipped with Rolling Shutters, Windows/Ventilators, Exhaust Fans and Safety Equipment including Sand Buckets, Fire Extinguishers and Fire Alarms etc. complete. Also,, it shall be provided with IPS Flooring, Internal and External Plaster with Painting and Plinth Protection along the periphery as per specifications.Separate

ANNEXURE 'E-IV'

Specifications of Electric Substation nearKosawadi nallah& STP premises

DETAILED SPECIFICATION FOR VARIOUS ITEMS FOR SUB- STATION.

1.0 TRANSFORMER:

1.1 GENERAL REQUIREMENT:

Sub-station shall be provided with 2 Nos. (as mentioned in table beneath) double copper wound outdoor type transformer. The transformer of sub-station shall be installed on the specially constructed open to sky. Stage of about 1.0-1.5 M. height above ground level connected hence the entire cable connection arrangements of these transformer shall be closed type.

Transformer Ratings	
Kosawadi Nalla	Min. 1500 KVA / 33/0.415 kV
STP	Min. 1500 KVA Included in STP

Voltage ratio	:	33/0.415 Kv
Vector group	:	Dyn-II and all the transformers shall be filled with mineral oil and ONAN cooling type suitable for out-door installation and for parallel operation.

Each transformer shall be capable of operation continuously at its rated output without exceeding the limits of temperature rise as given below over the ambient temperature of 50°C.

In Oil by thermometers.	:	45°C
In winding by resistance	:	55°C

The loading of the transformer shall conform to IS: 6600/1972.

The transformers shall be so designed as to capable of withstanding without injury to the thermal mechanical effect of short circuits at the terminals of any winding for a period as specified in IS:2026.

The transformer shall be capable of continuous operation at the rated output under the following conditions.

Voltage variation	:	± 7.5% of rated voltage.
Frequency variation	:	± 3% of rated frequency.
Combined voltage and frequency variation.	:	10%

The transformer shall be free from any abnormal noise and vibration and have noise level below the limits prescribed in the relevant standards.

The transformer shall be capable of running in parallel.

CONSTRUCTIONAL FEATURES:

1. TANK:

1. The tank shall be of welded construction and fabricated from sheet steel or adequate thickness. All seams shall be properly welded to withstand requisite impact during short circuit without distortion. The tank wall shall be reinforced by stiffener of structural steel for general rigidity. The tank shall have sufficient strength to withstand without deformation (i) mechanical stock during transportation and (ii) all filling by vacuum.
2. The tank cover shall be bolted on to the tank with weather proof, hut oil resistant, resilient gasket in between for compete oil tightness. If gasket is compressible, metallic stops shall be provided to prevent over compression. Bushing, cover of access holders and other devices shall be designed to prevent any leakage of water into and oil from the tank. The cover shall Also, be provided with 2 Nos. grounding pads for earthing.

3. Oil sampling taps shall be provided with value at top and bottom to collect sample of oil from the tank for testing.

4. To facilitate the oil filtration by streamline filter suitable inlet and outlet taps with valve sat the bottom and at the top of the tank diagonally opposite corners shall be provided. The value at the bottom may be used as drain valve.

5. Thermometer pocket for top oil temperature measurement by mercury thermometer shall be provided.

6. The transformer tank shall be fitted with a double diaphragm type of explosion relief vent at the top having equalizer pipe connection from conservator.

2. CORE AND COILS:

The transformer will be of core type, the core design shall be built up with inter lived high grade non-grain. Low loss, high permeability grain oriented cold rolled silicon steel laminations properly treated for core material. The coils shall be manufactured from electrolytic copper of suitable grade, and should be properly insulated varnished and stacked.

All insulation material shall be of proven design. Coils shall be Also, insulated that impulse and power frequency voltage stresses are minimum. Insulating level of graded insulation shall conform to the relevant standard of IS:2026 Part-III, 1977.

Coil assembly shall be suitable supported between adjacent sections by insulation spacers and barriers. Bracing and other insulation used in assembly of the winding shall be arranged to ensure a free circulation of the oil and reduce the hot spot of the winding.

All leads from the winding to the terminal board and bushing shall be rigidly supported to prevent

injury from vibration or short circuit stresses. Guide tube shall be soused where practicable.

The core and coil assembly shall be securely fixed in position, so that no shifting or deformation accurse during movement of transformer or under short circuit stresses.

3. TAPINGS:

Off load tap changer is to be provided on the high voltage winding. The steps shall be of 1.25% variation required is ± 7.5% Winding including tapping arrangement shall be designed to maintain the electromagnetic balance between HV and LV winding at all voltage rations.

4. CONSERVATOR TANK:

Conservator tank shall be provided with dial type level indicator visible form ground level and fitted with low oil level alarm contact. Plain oil level gauge shall Also, be provided.

Transformer oil shall comply with IS:335-1972.

5. TEMPERATURE INDICATOR:

1 No. Dial type temperature indicator shall be provided in the transformer.

6. TERMINAL ARRANGEMENT.

Since the cables shall be provided for connection with LV systems of transformer, hence the cable terminal boxes shall be provided for the connections to have closed connections.

7. TRANSFORMER BUSHING:

All bushing shall conform to the requirements of the latest revision of relevant IS:2099-1973 & 3347. Bushings shall be so located to provide at least minimum permissible electrical clearance and between phase and ground as per the relevant standard.

8. TRANSFORMER ACCESSORIES:

Transformer shall be equipped with fitting and accessories as listed below complying with IS:3639/1966.

Oil conservator with filter cap and drain plug for each transformer.
Silica gel breather with connecting pipe and oil seal.
Explosion relief vent with double diaphragm and equalizer pipe connection to conservator air space.
Air release plugs.
Direct reading plain oil level gauge – 1 No. for each transformer.
Drain valve with threaded adopter.
Oil sampling valves (top and bottom)
Filter valves with threaded adopter (top & bottom)
Cover lifting eyes.

Jacking pads, handling and lifting lugs.
Skids.
Radiator – These shall be tank (wall) mounted type.
Rating plate and terminal marking plate.
Termination arrangement for cable connection at sides LV.
Neutral bushing.
Off circuit tap charger.
Clamping device with nuts and bolts for clamping the transformer on foundation rails.
Temperature meter.

9. CABLES:

Providing, and laying of be I S I mark LT Cable of 1100 Volts, of Aluminium conductor of 3 - 1/2 core, having PVC Insulated, colour code, wrapped with appropriate filler and core binder and single layer galvanized steel wire armouring for multi-core and overall PVC Jacket. Cable is required from Transformer to Incomer panel.
3½ core x of size as specified in **annexure E-1**–

10. LT PANEL BOARD:

The LT AC Switch board shall be 440 volts 3 phase and neutral, 50 Hz., distribution board, outdoor type, wall/floor mounted comprising of following:

1. 1 Nos. Incoming feeder each incoming feeder comprising of:

(a) 1 Nos. Three pole MCCB of amperes rating as specified in **annexure E-1** with in-built magnetic thermal release, under voltage release and shunt trip release.

(b) 1 Nos. suitable CTs for protection & metering.

The bus bar shall be suitable for 3 phase 4 wire and shall be of amps of MCCB as per rated per phase and 100 amps for neutral. Nominal current density in bus bars shall not exceed 1.5 amps per mm^2. The bus bars shall be with coloured insulated sleeves. The supports shall be suitably spaced to give mechanical rigidity for withstanding stress due to system fault level of 40 KA for 1 second. The bus bar chambers shall be of adequate size to house the stated air insulated bus bars. Panel compartments shall have adequate space for termination of incoming and outgoing feeder cables equipped with compression glands etc.

All MCCB units shall be front operated handle type.

11. LIGHTING ARRESTOR:

Each Sub-Station shall be provided with 30 kV. of L/A.

The lightning arresters (Surge Diverters) shall be single pole, station type, suitable for use in solidly earthed system i.e. 33 kV side short circuit level is considered up to 1500 MAV. The lightning arrester will comply with IEC 99.5 and IS 3070. All ferrous parts shall be hot dip galvanized. It should act as a bypass for the lightning surge and Also, to limit and squash the flow of follow current from the system after the surge has passed. Its rating should be 33 kV, 50 Hz., heavy duty, long duration discharge class with 8/20 wave shape, 10,000 Amp and Also, be of pressure relief class.

12. 33 KV DROP OUT FUSE –

Each Transformer shall be provided with DO Fuse set as per enclosed tentative drawing attached.

13. 33 KV GANG OPERATED A B SWITCH:

Each Transformer & Incoming of electricity board line shall be provided with 33 KV up right mounted Horizontal or Vertical rotating single break A b switch which should be compact in design, operated with manual handle, confirming to IS:9921 (Part I to V) 1981.

14. ACRS CONDUCTOR –.

This shall be used for transmitting line from electricity board connection to Transformer for 33 KV line of 48sq.mm.

15. **33 KV PIN INSULATOR**.

These shall be used in Sub-Station as per requirement.

16. 33 KV DISC INSULATOR:

These shall be used in Sub-Station as per requirement.

17. **HARDWARE FOR ACSR CONDUCTOR**.

Miscellaneous hardware material required to draw ACRS conductor from electricity board line to L/A to DO to AB Switch to Transformer.

18. **Earthing:- Material :-G.I. PLATE**:

Supply & fixing of G.I. Plate of size 600 x 600 x 6mm for additional earthing of Transformer, panel etc.

19. **G.I. STRIP**:

Supply & fixing of G.I. Trip of size 25 x 5mm from earthing pit to various points of earthing

connection of all electrical equipments.

20. **G.I. PIPES**:

Supply & fixing of G.I. 50mm from earthing pit to various points of earthing connection of all electrical equipments.

21. **HARDWARE FOR EARTHING**:

Miscellaneous hardware material such as Galvanized Nut-Bolts, Funnels, Coal/ Charcoal, Salt etc. required to complete the earthing arrangement.

22. **MAIN HOLE COVER**:

Main Hole Cover of size 300 x 300mm for earthing pits chamber protection.

23. D.P. STRUCTURE for each substation/e for Raw water and Clear water:

- 2 Pole Structure for incomer line fabricated out of RS joint of the size 200 x 100 mm of 9 to 11 M. length.

- 100 x 50 x 5mm MS channels of required length for installation of various equipment like LA/ Pin Insulator/ Disk Insulator/ DO Sets/ AB Switch, CT's, PT's, etc.

- MS Flats, MS Angles of 50 x 50 x 6mm, etc. for miscellanies cross support, horizontal and vertical support etc.

24. FENCING:

The boundaries of sub-station shall be fenced with help of M.S. Angles, Chain link fencing, flats, gate, as per requirement.

25. VERTICALS:

The vertical posts of 2.5 M height above G.L. shall be legged by 50 x 50 x 5mm size angle fixed at a distance of 2 M and every corner shall be provided with diagonal struts of 50 x 50 x 5mm angle.

26. **WIRE MESH**:

The boundary shall be covered by G.I. Wire Mesh of 3mm thick netting size 100 x 100mm of height 2.5 M

27. FASTENING FLAT:

The wire mesh will be fastened with the supports by M.S. Flats of 25 x 3mm size for vertical &

horizontal support as required.

28. HARDWARE:

The standard make nut-bolts, G.I. Wire, Wishers, etc., shall be provided for fixing of wire mesh. One Iron Gate of 3.5 M. wide & height of 1.5 M. shall be provided.

29. **METALLING**:

50mm thick metal shall be covered uniformly over the entire surface of sub-station, the metal shall be hard, tough, resistance to abrasion and weathering action, nonporous drainable, and rough surfaces for proper interlocking.

30. **CIVIL WORK FOR ERECTION AND COMMISSIONING OF ENTIRE JOB.**

Transformer platform made of CC M-25 Mix, Foundation work and other mechanical mixed CC M-25 work.

Construction of wall for partition between two transformers.
Construction of earth pit chamber as per I.E. Rules.
Trenches for cable from transformer to panel room with filling by sand.
ACCESSORIES:
Rubber Hand Gloves.
Ball Pin Hammer with Wooden Handle.
Screw Driver 8" & 12"
Shock Treatment Chart.
Danger Notice Board.
Fire Stand with Fire Bucket in sub-station.
Insulated Player.
Fire extinguisher 4.5 Kg.
D.O. Operating rod 33 kV fibre H.D.
Discharge rod with accessories fibre.
Helmet H.D.
Work of erection (as per IE rules) of entire substationequipments and allied works.

Work of drawing preparation, commissioning along with obtain of charging permission from electrical inspector as per IE rules. .Drawing preparation and approval from authority, inspection charges of electrical inspector/ authority shall be in scope of agency.

1500KVA KVA DG SET AT TWO LOCATIONS

Work Also, includes providing 1500 DG set one at Wet Well pumping and at Pragati Nagar STP locationof repute make including all cablingpanelling etc

complete including required connection, commissioning etc complete

ANNEXURE 'E-V'

Specifications for Raw Sewage Pumping Machinery (Pumps and motors) on Wet Well near Kosawadinallah

1 Submersible Sewage Pumps

The contractor shall supply, install and successfully commission following pumps with all ancillary and required accessories at the locations mentioned below

Sr. No.	Location	Ratings
1	Kosawadi nalla	4 x Discharge 859.12 LPS, Head – suitable, 1 x Discharge 381.83 LPS, Head – suitable 2 x Discharge 190.92 LPS, Head – suitable

The Contractor shall provide manufacturer's published pump curves, system curves and the necessary hydraulic calculations to justify the sizes of any pumps selected. The Contractor shall provide the following shop drawings:

- Impeller diameter
- Maximum impeller diameter
- Minimum impeller diameter
- Velocity of liquid in pump suction at duty point
- Velocity of liquid in pump delivery at duty point
- Velocity of liquid in the pump casing or impeller eye at duty point
- Net positive suction head (dry well submersibles only)
- The materials of construction shall be specified in detail and itemized against a sectional drawing of the pump proposed.

After approval of the pump types the Contractor shall submit the test data as required under factory inspection and testing

The Contractor shall submit Operation and Maintenance Manuals and Instructions which shall include all the documentation provided as above and as required in the Specification.

1.1 Pump Requirements

Pumps and drives shall be rated for continuous duty and shall be capable of pumping the flow range specified in the Specification without surging, cavitations, or excessive vibration to the limits specified. All pumps and drives shall be from approved manufacturers.

The pumps shall meet maximum allowable shut-off head.

The pumps shall not overload the motors for any point on the maximum pump speed performance characteristic curve and the pump operating range, within the limits of stable pump operation, as recommended by the manufacturer, to prevent surging, cavitations, and vibration.

To ensure vibration-free operation, all rotative components of each pumping unit shall be statically and dynamically balanced to BS 6861 and the following requirements shall be met:

- The mass of the unit and its distribution shall be such that resonance at normal operating speeds is within acceptable limits
- In any case, the amplitude of vibration as measured - at any point on the pumping unit shall not exceed the below limits
- At any operating speed, the ratio of rotational speed to the - critical speed of a unit, or components thereof, shall be less than 0.8 or more than 1.3.

Vibration levels shall not exceed the levels given in BS 4675 for Class 11 machines, quality bands A and B.
The completed units, when assembled and operating, shall be free of cavitations, vibration, noise, and oil or water leaks over the range of operation.
All units shall be so constructed that dismantling and repairing can be accomplished without difficulty.
The Contractor shall be responsible for proper operation of the complete pumping system, which includes the pump, motor, variable speed drive unit (if designated), and associated controls furnished with the pump.
The Contractor shall ensure that the controls and starting equipment are suitable for use with the pump motor, taking into account all requirements including starting currents and number of starts per hour.
For the performance curve of the selected pump impeller, the head shall continuously rise as flow decreases throughout the entire curve from run out to shutoff head.
The Contractor shall ensure that drive motors, variable speed drive systems (if specified) and pumps shall be supplied and tested together by the pump manufacturer, who shall supply full certification for the proper function of the entire pumping system.
If variable speed drive systems are specified, motor and drive system shall be fully compatible, and shall be of sufficient power and torque, and be capable of sufficient heat transfer for starting, accelerating and continuously operating over the entire range of head/capacity conditions, from minimum to maximum pump operating speed, as designated. The motor shall be de-rated to take into consideration the reduced cooling effect when running at the lowest speed with the variable speed drive.

1.2 Design Conditions

Pumps shall be single stage mono-block type with non-clog design. It should pump all kinds of sewage in particular unscreened sewage containing long fibres, solid admixes, sludges, liquid containing trapped air and gas etc, long fibres, polythene covers, and capable of dealing with sewage of specific gravity 1.5
Profile gasket should be provided in pump casing so as to avoid metal to metal contact between pump and the special designed duck foot bend/ flanged elbow, automatic coupling to ensure leak proof joint with delivery pipe . The profile of pump side flange shall be matched with pump claw so as to automatically lock by virtue of its own weight or an automatic coupling device for easy installation and easy removal.
Pumps shall be designed and constructed to satisfactorily operate and perform within the designated design conditions and the requirements specified herein. They shall be designed for a life of 100,000 hours with service intervals at 20,000 hours.
Castings, fabrications, machined parts and drives shall conform to the industry standards for strength and durability and shall be rated for continuous duty over the entire operating range.
Bearings shall be of the anti-friction type designed for an L10 life in accordance with BS 5512. The maximum operating speed shall not exceed 1450 / 585 rpm and shall be supplied as per BOQ.

Pumps shall be of non-clog design, capable of passing spheres of a minimum diameter unless other diameters are specified. The pump set shall be supplied along with special duck foot bend / flanged elbow, lifting chain, guide wire / guide pipe.
Suitable RCC slab / ISMB (with necessary anti-corrosive painting) to be erected over suction well to fix guide wire / guide pipe holding bracket.
The pump, motor and associated electrical equipment shall be rated for a minimum 10 starts per hour, unless otherwise specified.
The Contractor shall ensure that the pump manufacturer provides certification which guarantees the following:

- Flow rate
- Total head
- Power input
- Efficiency

1.3 Materials

Pumps shall be manufactured of the following materials as a minimum:

Type of pumps	: Submersible type non-clog design
Solid passage size through pumps	: 100 mm max.
Insulation	: Class F
Protection	: IP-68
Liquid	: Raw Sewage
Temperature	: Min. 20° C
Efficiency	: more than 70%
Installation	: Fixed.
Casing	: Cast Iron IS 210 Gr. FG 260
Impeller	: CF8M
Shaft	: AISI 410
Cable gland	: Cast Iron IS 210 Gr. FG 260
Motor Body	: Cast Iron IS 210 Gr. FG 260
Seal cover	: Cast Iron IS 210 Gr. FG 260
Automatic Coupling	: CI
Duck foot bend	: CI
Guide Pipe	: SS-304
Lifting chain	: SS-304
Fasteners	: MS with GI coating

1.4 Fabrication

General. Pumps shall be fabricated in accordance with the following requirements:

- Pumps shall be capable of handling raw, unscreened sewage.
- Pumps should be able to withstand reverse rotation of impeller.
- In the case of submersible installations, no portion of the pump shall bear directly on the floor of the wet well.
- Pumps shall utilise a guide system to permit easy removal and reinstallation without dewatering the pump sump discharge connections shall be made automatically with a simple downward motion

without rotation when the pump is lowered into operating position. The pump shall be capable of being removed without disconnecting any fasteners

- An appropriate length of chain shall be connected to the motor eyebolts to permit raising and lowering of the pump.
- Impellers shall be fabricated according to the rated motor size as follows:
- Non-clog type statically and dynamically balanced, keyed to the shaft
- Provided with pump-out vanes to prevent material from getting behind the impeller and into mechanical seal area
- Impellers shall not be trimmed unless approved by the Engineer. Provision for adjustment of clearance between impeller and casing for restoring the pump efficiency, without dismantling the pump will be an added advantage.

Impellers shall be fabricated according to the rated motor size as follows :

- Non-clog type statically and dynamically balanced, keyed to the shaft
- Provided with pump-out vanes to prevent material from getting behind the impeller and into mechanical seal area.
- Pumps must be equipped with a method of restoring impeller to casing clearance in the axial direction, to restore the pump efficiency, at site, without the need for dismantling of pump and machining for replacement of wear rings.
- Impeller clearance adjustment shall not be done unless approved by the Engineer
- Impellers shall be of closed, Multi vane (three to four sweeping vanes) type.
- Single/multi vane or vortex type, with a cutter impeller in the case of small flows.

Discharge Connection and Guide Rails shall be fabricated as follows:

Sliding guide bracket and discharge connections shall be provided which, when bolted to the floor of the sump and to the discharge line, will receive the pump discharge connecting flange without need of adjustment, fasteners, clamp, or similar devices.
The guide rails shall not support any portion of the weight of the pump.
The pump discharge connections shall incorporate a sealing face and connection yoke to allow for automatic coupling to fixed discharge connection pipe work.
Pump Shafts shall be fabricated as follows:

- Pump shafts shall be of such diameter that they will not deflect more than 0.05 mm measured at the mechanical seal, whilst operating at full driver output
- The shaft shall be turned, round and polished
- The shaft shall be key-seated for securing the impeller.

Shaft Seals shall be fabricated as follows :

- The drive motor and pump/motor bearings shall be sealed along the shaft with tandem mechanical seals operating in an oil filled chamber. The seals shall require neither routine maintenance nor adjustment, but shall be capable of being easily inspected and replaced.
- Two back to back mechanical seals shall seal the motor off from the pump.

- The upper seal shall be oil lubricated with a carbon rotating component and fixed tungsten carbide component.
- The lower seal shall have both parts in tungsten carbide.
- A detector shall indicate when moisture is leaking past the first seal.

Bearings shall be fabricated as follows :

- Bearings shall be capable of taking the static weight of the rotating parts and any thrust generated by the operation of the pump
- The upper bearing(s) shall be of the grease lubricated sealed for life type; the lower bearing(s) shall be lubricated by the internal oil supply
- The bottom bearing(s) shall be of the angular contact ball bearing type in combinations with roller bearing(s)
- If required in the project specification, remote indication shall be provided for bearing high temperature-, using a thermistor at. the lower bearing, to provide a signal at 95 □C.

Motors shall be fabricated as follows :

- Motors shall be 415 V, phase, 50 Hz, rated at 20 % above the maximum power requirement
- Motors shall be squirrel cage, induction, air filled, totally sealed to IP 68, suitable for the maximum immersion depth to be encountered, rated with group 1 gases, to BS 5345
- Motor insulation shall be Class F, limited to a Class B temperature rise
- Motor temperature shall be monitored using a thermistor, in each phase of the winding, set to stop the motor when the monitored absolute temperature reaches 130^0C
- A watertight cable junction box sealed from the motor shall be provided for the motor power and control cables shall be EPR insulated, Niplas sheathed flexible 450/750 volts grade, oil and grease resistant, with tinned annealed copper conductors in accordance with BS 6007. The cable shall be brought directly out of the submersible motor without joints, and shall be of sufficient length, minimum 20 m to be terminated in an IP67 junction box outside adjacent to the wet well. They shall be sized in accordance with the electricity utility regulations and BS 7671. The cable must be leak tight in respect of liquids and firmly attached to the terminal box. They should be laid in a suitable PVC encasing pipe from control panel up to suction well .

- Motors shall be capable of startup and operation in the event of a completely flooded wet well. Motors shall be selected to meet the maximum power required for the selected impeller at all operating conditions
- Motor cooling shall either be by means of the pumped medium or by oil. The use of external cooling water is not acceptable
- Motors shall be derated for dry well and/or variable speed operation
- All parts of the pump and motor shall be 100% holiday free fusion bonded epoxy coated to a minimum thickness of 300 microns.

1.5 Control Panel

The control panel shall be made of 14/16 SWG sheet steel for the front side for bottom and other sides with powder coating for long life. It should have suitable starter. The control panel consists of multi section unit containing one pump and one incomer/control. The sections are interfaced, via, cable way/marshalling

section. All wires and links are of electric grade copper conductor. The control of the pumps viz., Mercury/magnet activated/ any other float switch with auto for duty pump.
Power circuit is operating at 3 phase, 415 Volts, 50 Hz supply and for control circuit it is single phase 230 V, 50 Hz supply.
Type of starter shall be as under:Up to 10 HP - DOL
From 12 Hp to 40 HP - Star - Delta.
50 HP and above – Auto Transformer Starter / Soft Starter
The following protections should be provided in the panel: short circuit protection, over load protection, over temperature protection for motors, single phasing preventor, reverse rotation protection, dry run failure protections to be made. Suitable range ammeter, voltmeter, selector switch, auto-manual switch, pump running lamp, pump fault lamp, fault reset push button, phase indicating lamps, indication of high level in the well, hours run counter should Also, be provided.
The control panel wiring circuit should be furnished in triplicate.
The pump should be controlled by the magnetic/mercury float switches while the pumps run in auto. The floats with switches should be available in the wet wells and the connections from float should be made to the individual control panel through the cable duct. Necessary control sensor wiring should be made to convert the signals of mercury/magnet float switches while the level is high/low so that the pump starts/stops on auto mode.
The necessary push button stations with control wiring should be made on the wells for each pump set each stations as per std. rules.
The control panel, pump set and accessories for pumps should be manufactured by same manufacturer. The pump and motor shall be accordance with the relevant standards.

1.6 Automatic Control

The automatic level control shall be arranged such that when level rises in the well the pumps start successively at the different pre-determined levels. When the level drops the pump sets stop in the same order as that in which they have started. The different start and stop levels for several pumps/single pump have to be chosen according to the sewerage and as desired by the Engineer. Magnetic/mercury float switches have to be used for this purpose.
The tenderer should Also, furnish the list of authorised dealers for the supply of spares for submersible pumps and list of authorized workshops to carry out repairs to the submersible pumps along with the address while tendering.
Labels. Each pump shall have a stainless steel label permanently fixed to the pump and an identical label fixed to the pump starter compartment.

1.7 Factory Inspection and Testing

The Contractor shall secure from the pump manufacturer certification that the following inspections and tests have been conducted on each pump at the factory, and submit to the Engineer prior to shipment:

- The pump casing has been tested hydrostatically to 1.5 times the maximum closed valve pressure
- Impeller, motor rating and electrical connections checked for compliance with the Specifications
- Motor and cable insulation tested for moisture content or insulation defects
- Prior to submergence, the pump has been run dry to establish correct rotation and mechanical integrity

- The pump has been run for 30 minutes submerged under a minimum of 2 m water after the operational test and the insulation tests above and after the performance test below

Each pump shall be tested at the factory for performance according to BS 5316 Part 1, including:

- Flow
- Motor power
- Efficiency

The Contractor shall secure from the pump manufacturer the following certification and submit to the Engineer prior to shipment:

- Certified copies of the pump characteristic curves and reports generated by the tests described above
- Foundry composition certificates for all major castings (pump case, impeller, motor housing) showing exact material composition and tests conducted to ensure compliance with the pump manufacturer's material specifications.

1.8 Site Inspection and Testing

The equipment delivered to the Site shall be examined by the Contractor to determine that it is in good condition and in conformance with the approved working drawings and certifications. All equipment shall be installed in strict conformance with the Specification and the manufacturer's instructions.
The Contractor shall provide the services of the pump manufacturer's representative to supervise the installation, commissioning and start-up of the pumping equipment.
The commissioning tests shall be performance and reliability trials, mainly for the purpose of satisfying the Engineer that the pump sets have been correctly assembled and installed and that their performance matches that obtained during the manufacturer’s works tests. In the event of an unwarranted change in the pump performance characteristics or power consumption, all necessary steps shall be taken as soon as possible to establish the cause and remove the fault. Similar action shall be taken for an undue increase in bearing or gland temperature, increased gland leakage rates, unsatisfactory vibration levels or any other fault or defect in the operation of the pump set.
The site reliability trials shall include the following:

- A record of bearing and coupling clearance and alignments shall be tabulated to show the "as-built" condition of each pump
- A record of all overload, timing relay and oil pressure relays shall be tabulated to show the "as-built" condition of each motor starter
- All cables shall be ‘megger’ tested to confirm the integrity of the insulation. A tabulated record of results shall be made
- The control panel shall be statically tested with motors disconnected to confirm the correct sequence of operation
- Each pump shall be operated individually over the range from closed valve to maximum emergency top water level, on a recirculation basis, using fresh water, and for a minimum of four hours continuously. During this test the following parameters will be recorded: -
- Motor phase currents
- Pump output
- Motor/pump casing temperature (dry well submersible only)
- Power consumed

- Power factor
- Vibration (dry well submersible only)

The commissioning trials shall extend until each pump unit has run 'continuously' for at least 3 days under all operating conditions. The term 'continuously' shall include running at various speeds or on a start/stop basis as determined by the control system

The Contractor's supervisory staff, and the pump manufacturer's representative shall be present during the period of the tests and trials. The Contractor shall be responsible for any failure of the whole equipment or any part thereof, whether such failure shall be determined by the methods detailed herein or otherwise. If the Contractor interrupts the pump test or trial, or through negligence on the part of the Contractors staff, it shall be completely repeated for the pump set concerned.

1.9 Motors

All motors shall be suitable for operation on a 415v, 50 Hz, 3 phase, AC supply.

Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously under the following supply conditions.

i	Variation of supply voltage from the rated motor voltage :		+ / - 10%
ii	Variation of supply frequency from the rated frequency	:	+/ - 5%
iii	Combined voltage and frequency variations	:	+ / - 10%

- All motors shall be capable of starting 6 times per hour. Starting current of motor shall not exceed 200% of the rated full load current for star - Delta starting and 600% of rated full load current for DOL Starting under any circumstances.
- Motor shall be capable of starting and accelerating the load with the applicable method of starting without exceeding the acceptable winding temperatures, when the supply voltage is in the range of 10% above of the rated motor voltage.
- Motor shall be designed to withstand 120% of the rated speed for two minutes without any mechanical damage in either direction or rotation.
- The insulation class of motor winding shall conform to class - F and the maximum temperature rise shall not exceed 950C, when measured by winding resistance method and 85^0C, when measured by thermometer method for an ambient temperature of 45^0C.
- Motor shall be offered for routine and type tests in accordance with IS: 4029 and IS: 325 at the manufacturer's works. Test certificates shall be endorsed to the effect that they are properly balanced and free from vibration. In addition, a test shall be required to establish the maximum transient starting current.
- Pump motors shall be of the squirrel cage submersible type, protected to IP. 58 and rated at 10 per cent above the calculated maximum power required on site.
- The motor shaft shall be of large diameter, lightly stressed to ensure rigidity, with impeller and bearing location shoulders and a keyway for location of the impeller.

- The motor windings shall be protected with a waterproof material and shall incorporate a thermistor in each phase to safeguard against high winding temperatures. The thermistor shall be connected into the control circuit of the starter and arranged for hand reset only.
- The motor shall incorporate a cut-out device to detect the presence of any liquid in the motor enclosure.
- The motor frame shall incorporate lifting points and shall be fitted with a galvanised lifting chain, reaching to, and secured at the access point.
- The terminal connections for the power and protective circuits shall be housed in a completely sealed and waterproof junction box, complete with all external corrosion resistant cable glands. The pump units shall be provided with power and protection circuit cables of sufficient length to reach from the motor junction box to the local isolator, located at the access level.
- The power cable shall be 600/1000V grade flexible stranded copper wire, insulated and overall sheathed with under-water grade compound flexible insulation. The cable shall be rated to take the full motor current under the prevailing liquid and ambient temperature conditions.

1.10 Characteristic Curves

Characteristic and system curves for the pumps shall be supplied to a reasonably large scale which shall show the capacity of the pumps under single and multi-pump operation at the duty point.
When tested through their complete range of workable heads at the maker's works, all the pumps shall give results which conform to the curves submitted with the Tender. Curves showing pump efficiency and kW. loading shall Also, be included.

1.11 Performance Test

Each pump shall be tested at the manufacturer’s premises for the full operating range of the pump. Pump performance shall be within the tolerance limits specified in the relevant standards. The contractor shall furnish the guaranteed values of discharge and efficiency for the total head at duty point for each pump.
Discharge Connection and Guide Rails shall be fabricated as follows :

- Sliding guide bracket and discharge connections shall be provided which, when bolted to the floor of the sump and to the discharge line, will receive the pump discharge connecting flange without need of adjustment, fasteners, clamp, or similar devices.
- The guide rails shall not support any portion of the weight of the pump.
- The final connection between the pump discharge flange and discharge elbow (duck foot bend) shall ensure zero leakage by means of a Neoprene seal,(no profile gaskets) fixed on to the pump discharge flange, thereby avoiding a metal-to-metal contact.
- The pumps shall be provided with proprietary monitoring and control units for inclusion in the motor controls. Analog inputs shall include the following:
- Winding temperature
- Bearing temperature
- Digital inputs shall include the following :
- High winding temperature
- High bearing temperature (upper & lower)
- Seal Monitoring

- Over temperature
- Motors shall be capable of startup and operation in the event of a completely flooded wet well. Motors shall be selected to meet the maximum power required for the selected impeller at all operating conditions.
- Motor cooling must be achieved by a cooling jacket, using the pumped media to cool the motor. The pump impeller must be equipped with a system to ensure a pumped flow of liquid through the cooling jacket and also, incorporate a device to prevent the liquid channels from blocking with hair and foreign material.

Coatings and Protection shall be provided as follows

- All parts of the pump and motor shall be 100% holiday free fusion bonded epoxy coated to a minimum thickness of 300 microns.

1.12 Control Panel for Sewage/Drainage pumps:

Design, fabrication, assembling, wiring, supply, installation, testing and commissioning of control panel fabricated out of 14-gauge CRCA sheet steel in with reinforcement of suitable size angle iron, channel 'T' sections irons and/or flats wherever necessary. Cable gland plates shall be provided on top as well as at the bottom of the panels. Panels shall be treated with all anticorrosive process before painting as per specifications with 2 coats of red oxide primer and final approved shade of powder coated paint. 2 Nos. earthing terminals shall be provided for 3 phases, 4 wire, 50 Hz supply system. Lifting hooks shall Also, be provided in case of large panels. Approval shall be taken for each panel before fabrication. Cadmium Plated hardware shall be used in fabrication of panels.

Panel should have the following features/components as minimum:
1. Auto – Manual selection of the pumps. In case of Auto mode pumps shall run on the basis of float level switches. Each pump will have its own float level switch.
2. Single-phase preventer.
3. Changeover of pumps to ensure equal wear and tear of all the pumps.
4. 0-500 volts square digital or analogue voltmeter with selector switch protected by 2 amps TP MCB- 1 Set
5. 0-300 amps square digital or analogue ammeter with selector switch and 300/5 amps 10 VA CL: 1 CTs. –1 Set
6. Phase indicating lamps protected by 2-amp SP MCB - 3 Sets
7. Starters with overload relays, MCB`s etc as per the rating and quantity of the selected pumps.
8. Push buttons for manual start of the pumps. Quantity should be as per the BOQ/number of pumps.
9. Indicating lamps for phase, start/stop/trip and high-level indication.
10.Potential free contacts for start, stop and trip of the pumps through BMS (in Manual mode).
11.Necessary internal wiring, interlocking, earthing for all equipment shall Also, included
Panel should be complete in all respect.

ANNEXURE 'E-VI'

Specifications of Raw Sewer Pumping Wet Well (Sump) near Kosabadinalla to STPat Pragati Nagar

The schedule for proposed DI K-9 sewage pumping mains shall be as mentioned in the table below:

Sr. No.	Rising main and Gravity main pipeline		Distance	Diameter	Material and class
	From	To	In m	In mm	
1	Kosawadi SPS	STP at Pragati Nagar	9174M	700mm	DI K-9
2	MS Truss Bridge with RCC Piers	Hasdeo River Crossing	750M	700mm Dia	MS pipe wall thickness 12 mm
Total length (In M) =			----------		

1.0 SCOPE OF WORK :

The scope of work shall be as below :

1.1 The work of providing, laying DI pipeline in Raw Sewer Rising Main from Wet Well adjacent to KosawadiNallah to STP; including excavation cutting concrete road, tar road and restoring to the original shape after lowering the pipes **including protecting public services and making good if damaged,** including valves, pressure relief valves, DI and MS specials, fixing of all the appurtenances such as Manholes, all the road crossings, if any, hydraulic testing of pipe line to rated capacities and trial run including all cost etc complete

The materials shall be of ISI mark socket and spigot centrifugally cast (spun) Ductile Iron Pressure pipes class K-9 with inside cement mortar lining conforming to IS:8329-2000 with suitable rubber gasket (Push on) joints as per IS:5382-1985 duly inspected by DGS&D/SGS/RITES with all ductile iron fittings and ISI marked sluice valve conforming to IS 9523-2000 including testing and commissioning.

1.2 Excavation in trenches in all types of strata for laying & jointing of above pipe line with required depth and width as per specification.

1.3 Providing and fixing D.I. D.F. sluice valve including testing & jointing with cost of nut, bolts, rubber insertion duly inspected by DGS&D/SGS/RITES (Make - Kirloskar/IVC/Vag/Durga/Upadhaya& Comparable)

1.3.1 Providing and fixing following Ductile iron double flange ISI mark sluice valve fitted with DI cap including jointing and testing with cost of jointing materials (Make - Kirloskar/IVC/Vag/Durga/Upadhaya& Comparable) duly inspected by DGS&D/SGS/RITES.

1.3.2 Providing, laying & jointing D.I./ MJ fittings conforming to IS 9523:2000 duly inspected by DGS&D/SGS/RITES

1.4 Providing & fixing following kinetic Air valve duly inspected.

(Make - Kirloskar/IVC/Vag/Durga/Upadhaya& Comparable)

1.5 Construction of RCC valve chambers in all the places where sluice valve, Air valve and non-return valve are provided, Anchor Blocks, Pedestal etc. as required as per specification. The internal dimension of R.C.C. chamber shall have clear space of 500 mm all around in valve. This clearness can be modified only after with instruction issued by the Engineer in charge looking to the site conditions.

1.6 Back filling of trench as per IS:12288-1987.

1.7 Providing and making all interconnections as required to charge the laid pipe lines under scope of work.

1.8 In case, the shifting of any existing, water pipe line/sewage line is considered necessary by the Deptt./Municipal Corporation, such service lines will have to be shifted by the contractor for which the payment shall be made for the actual work done as per approved rate of this contract.

1.9 The firms/contractors are directed to submit the details plan and elevation of all the pipelines showing the dimensions of all components and other details.

The contractor shall set up an office with an access to KMC official with proper seating arrangements. All the valves and electromechanical fittings shall be SCADA & PLC compatible.

2.0 D.I. PIPES

2.1 MANUFACTURE :-

The pipes shall be ISI Mark and confirming to IS:8329:2000. The pipes should be duly inspected by D.G.S. & D./SGS/RITES before supply.

2.2 HYDROSTATIC TEST

2.2.1 Pipes shall be tested hydrostatically at a pressure as prescribed in CPHEEO Manual. To perform the test, pressure shall be applied internally and shall be steadily maintained for a period of minimum 15 seconds during which pipes may be struck moderately with a 700 grams hammer. The pipes shall withstand the pressure test and shall not show any sign of leakage, seating or other defects of any kind.

2.3 TOLERANCES :

2.3.1 The tolerance shall be permissible as per IS:8329-2000.

2.4 **COATING :**

2.4.1 All the D.I. pipes should be internally in lined with cement mortar and externally out coated with metallic zinc coating having finishing layer as indicated in Annexure A, as per IS 8329-2000.

2.5 **MARKING :**

2.5.1 Each pipe shall have cast, stamped or indelibly painted on it the following appropriate marks :

a) Indication of the source of manufacture.
b) The nominal diameter.
c) Class reference
d) Mass of Pipe, and
e) The last two digits of the year of manufacture.

Marking may be done :

a) On the socket faces of pipe centrifugally cast in metal mould, and
b) On the outside of the socket or on the barrel of pipe centrifugally cast in sand mould.

2.5.2 Any other marks required by the purchaser may be painted on.

3.0 DUCTILE IRON FITTINGS :

3.1 The Ductile Iron fittings shall be ISI mark conforming to IS 9523-2000.

3.2 **COATING :**

3.2.1 Fittings and accessories shall be normally delivered internally and externally coated.

3.2.2 The external coatings shall be applied with zinc rich paint with finishing layer as included in Annexure "A" of IS 9523:2000.

3.2.3 The internal Linings shall be applied with Portland cement mortar (with or without additions) as included in Annexure "B" of IS 9523:2000.

3.3 **MARKING :**

3.3.1 Each fittings shall have as cast, stamped or indelibly painted on it, the following appropriate marks :

a) Indication of the source of manufacture,
B) The nominal diameter,
C) The last two digits of the year of manufacture,
d) PN rating flanges when applicable, and
e) Any other mark required by the purchaser.

3.3.2 Marking may be done on the barrel of castings or on the outside of the sockets.

3.4 **BIS CERTIFICATION MARKING**

The fittings may Also, be marked with the Standard Mark

4.0 LAYING AND JOINTING :

4.1 SITE PREPARATION :

4.1.1 Preliminary work required to be done before laying of pipe lines includes pegging out, clearing and disposal of all shrubs, grasses, large and small bushes, trees, hedges, fences, gates, portions of old masonry, boulders, and debris from the route.

4.1.2 Where trees have been felled, the resulting timber shall be stacked properly and disposed of as directed by the authority. Tree roots within a distance of about 0.5 metre from either side of the pipeline should be completely removed before laying pipe lines.

4.1.3 All other serviceable materials, such as wood, bricks and stones, recovered during the operation and clearing the site, shall be separately stacked and disposed of as directed by the authority.

4.2 FORMATION :

4.2.1 **GENERAL :** Before pipe line is laid, proper formation be prepared for pipe line

4.3 Excavation and Preparation of Trenches for Laying Underground Pipe Lines.

4.3.1 The width of the trench at bottom between the faces of sheeting shall be such as to provide not less than 300 mm clearance on either side of the pipe except where rock excavation is involved. Trenches shall be of such extra width, when required, as will permit the convenient placing of timber supports, strutting and planking, and handling of specials.

4.3.2 Special consideration should be given to the depth of the trench. In agricultural land, the depth should be sufficient to provide a cover of not less than 900 mm so that the pipe line will not interfere with the cultivation of the land. In rocky ground, rough grazing or swamps, the cover may be reduced provided the water in the pipe line is not likely to freeze due to frost.

4.3.3 It may be necessary to increase the depth of pipe line to avoid land drains or in the vicinity of roads, railways or other crossings.

4.3.4 Care should be taken to avoid the spoil bank causing an accumulation of rain water.

4.3.5 Where pipes are to be bedded directly on the bottom of the trench, it should be trimmed and levelled to permit even bedding of the pipe line and should be free from all extraneous matter which may damage the pipe or the pipe coating. Additional excavation should be made at the joints of the pipe so that the water main is supported along its entire length.

4.3.6 Where excavation is through rocks or boulders or at locations of B.C. soils the pipe line should be bedded on concrete bedding or on at least 150 mm of fine grained material, or other proper means are used to protect the pipe and its coating. Material harmful to the pipe line should not be used.

4.3.7 Temporary under pining, supports and other protective measures for building structures or apparatus in or adjacent to the trench should be of proper design and sound construction.

4.4 **ROCK EXCAVATION -** The term “rock” wherever used in this standard, shall have the same meaning as given in terminology in IS:1200 (Part 1)- 1974.

4.4.1 **Blasting** - Blasting for excavation shall be permitted only after securing the approval of the authority and only when proper precautions are taken for the protection of persons and property. The hours of blasting shall be fixed by the authority. The procedure of blasting shall conform to

the requirements of the authority.

4.5 **STACKING EXCAVATED MATERIAL -** All excavated material shall be stacked in such a manner that it will not endanger the work or workmen and it will avoid obstructing footpaths, roads and driveways. Hydrants under pressure, surface boxes, fire or other utility controls shall be left unobstructed and accessible during the construction work. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural water-courses shall not be obstructed.

4.6 **BARRICADES, GUARDS AND SAFETY PROVISIONS -** To protect persons from injury and to avoid damage to property, adequate barricades, construction signs, torches, red lanterns and guards, as required, shall be placed and maintained during the progress of the construction work and until it is safe for traffic to use the roadways. All materials, piles equipment and pipes which may serve as obstruction to traffic shall be enclosed by fences or barricades and shall be protected by illuminating proper lights when the visibility is poor. The rules and regulations of the local authorities regarding safety provisions shall be observed.

4.7 **MAINTENANCE OF TRAFFIC AND CLOSING OF STREETS -** The work shall be carried including closing of road/street in such a manner which will cause the least interruption to traffic. Where it is necessary for traffic to cross the open trenches, suitable bridges shall be provided.

4.7.1 Suitable signs indicating that a street is closed shall be placed and necessary detour signs for the proper maintenance of traffic shall be provided.

4.8 **PROTECTION OF PROPERTY AND STRUCTURES**- Trees, shrubbery, fences, poles, and all other property and surface structures shall be protected unless their removal is shown on the drawings or authorized by the authority. When it is necessary to cut roots and tree branches, cutting shall be done under the supervision and direction of the authority.

Temporary support, adequate protection and maintenance of all underground and surface structures, drains, sewers and other obstructions encountered in the progress of the work, shall be provided under the direction of the authority. The structures, which may have been disturbed, shall be restored after completion of the work.

4.9 **PROTECTION OF THE EXISTING SERVICE -** As far as possible, the pipe line shall be laid below existing services, like water and gas pipes, cables, cable ducts and drains but not below sewers which are usually laid at greater depth. Where it is unavoidable, pipe line should be suitably protected. A minimum clearance of 150 mm shall be provided between the pipe line and such other services. Where thrust or auger boring is used for laying pipe line across roads, railways or other existing utilities, large clearance as required by the existing utilities, as required shall be provided. Adequate arrangements shall be made to protect and support the existing services during the laying operations. The pipe line shall be so laid as not to obstruct access to other services for inspection, repair and replacement. When such utilities are met with during excavation, the authority concerned shall be intimated and arrangements should be made to support and protect the utilities in consultation with them and in case of such damaged services will be repaired at the cost of contractor himself.

4.10 **BACK-FILLING -** For the purpose of back-filling, the depth of the trench shall be considered as divided in to the following three zones from the bottom of the trench to its top :

a) Zone A : From the bottom of the trench to the level of the centre line of the pipe.
b) Zone B : From the level of the centre line of the pipe to a level 300 mm above the top of the pipe, and
c) Zone C : From a level 300 mm above the top of the pipe to the top of the trench.

4.10.1 Back-filling in Zone A shall be done by hand with sand, fine gravel or other approved material placed in layers of 80 mm and compacted by tamping. The back-filling material shall be deposited in the trench for its full width of each side of the pipe, fitting and appurtenances simultaneously.

4.10.2 Back-filling in Zone B shall be done by hand or approved mechanical methods in layers of 150 mm special care being taken to avoid injuring or moving the pipe. The type of back-fill material to be used and the method of placing and consolidating shall be prescribed by the authority to suit individual locations.

4.10.3 Back-filling in Zone C shall be done by hand or approved mechanical methods. The types of back-fill material and method of filling shall be as prescribed by the authority.

4.10.4 Back-fill under permanent Pavement - Where the excavation is made through permanent pavements, curbs, paved footpaths, or where such structures are undercut by the excavation, the entire back-fill to the sub grade of the structures shall be made with sand in accordance with 5.10.4.1 Paved footpaths and pavements consisting of stone, gravel, slag or cinders shall not be considered as being of a permanent construction. Method of placing and consolidating the back-fill material shall be prescribed by the authority.

5.0 **LAYING OF PIPES :**

5.1 **LAYING UNDERGROUND**- Pipes should be lowered in to the trench with tackle suitable for the weight of pipes. For smaller sizes, up to 250 mm nominal bore, the pipe may be lowered by the use of ropes but for heavier pipes, either a well-designed set of shear legs or mobile crane should be used. When lifting gear is used, the positioning of the sling to ensure a proper balance, should be checked when the pipe is just clear of the ground. If sheathed pipes are being laid, suitable wide slings or scissors dogs should be used.

All construction debris should be cleared from the inside of the pipe either before or just after a joint is made. This is done by passing a pull-through in the pipe, or by hand, depending on the size of the pipe. When laying is not in progress, a temporary end closure should be securely fitted to the open end of the pipe line. This may make the pipe buoyant in the event of the trench becoming flooded, in which case the pipes should be held down either by partial re-filling of the trench or by temporary strutting. All persons should vacate any section of trench in to which the pipe is being lowered.

5.2 **PIPE LINE ANCHORAGE -**

This shall be provided as per relevant BIS 5330:1984 with up to date amendments.

6.0 **TRANSPORTATION, HANDLING AND INSPECTION :**

6.1 **GENERAL –** Ductile iron pipes are less susceptible to cracking or breaking on impact but the precautions set out should be taken to prevent damage to the protective coating and brushing or damage of the jointing surfaces.

6.2 **TRANSPORTATION -** Pipes should be loaded in such a way that they are secured and that no

movement should take place on the vehicle during transit.

6.3 **OFF-LOADING -** Cranes should be preferred for off-loading. However,, for pipe up to 400 mm nominal bore, skid timbers and ropes may be used.

7.0 **HYDRAULIC TESTING :**

7.1 After a new pipe line is laid and jointed, testing shall be done for :
mechanical soundness and leak tightness of pipes and fittings ;
leak tightness of joints; and
soundness of any construction work, in particulars that of the anchorages

7.2 The completed pipe line shall be tested for a pressure given in IS 8329:2000, Annexure "E" .

3% amount of complete work shall be withheld till the successful hydraulic testing of the pipeline

7.3

8.0 **FLUSHING AND DISINFECTION OF MAINS BEFORE COMMISSIONING :**

8.1 The pumping main & distribution mains shall be disinfected before commissioning as per provisions given in CPHEEO manual and IS 5822:1970.

9.0 **REMOVAL, RESTORATION AND MAINTENANCE OF PAVED FOOTPATHS ETC. AFTER LAYING OF PIPE :**

9.1 **ALLOWABLE REMOVAL OF PAVEMENT -** Pavement and road surfaces may be removed as a part of the trench excavation, and the amount removed shall depend upon the width of trench specified for the installation of the pipe and the width and length of pavement area required to be removed for the installation of gate valves, specials, manholes or other structures. The width of pavement removed along the normal trench for the installation of the pipe shall not exceed the width of the trench specified by more than 150 mm on each side of trench. The width and the lengths of the area of pavement removed from the installation of gate valves, specials, manholes or other structures should not exceed the maximum linear dimensions of such structures by more than 150 mm on each side. Wherever, in the opinion of the authority, existing conditions make it necessary or advisable to remove additional pavement, it shall be removed as directed by the authority.

9.2 **RESTORATION OF DAMAGED SURFACE AND PROPERTY -** Where any pavement, shrubbery, fences poles or other property and surface structures have been damaged, removed or disturbed during the course of work, such property and surface structures shall be replaced or repaired after completion of work. The permanent pavement shall not be restored to a condition equal to that before the work began but the top surface of the removed pavement shall be levelled and finished in such a manner as the traffic may pass smoothly. After proper compaction and settlement only, it shall be made to original as per the type of road top is existing

9.3 **CLEANING-UP :**All surplus materials, and all tools and temporary structures shall be removed from the site as directed by the authority. All dirt, rubbish and excess earth from the excavation shall be hauled to a dump and the construction site left clean to the satisfaction of the authority.

10.0 **APPURTENANCES :**

The following appurtenances shall be suitable designed and fixed on the suitable points on the conveyance main.

10.1 **SLUICE VALVES :**

The sluice valve shall be installed as per direction of engineer - in- charge. The sluice valve shall be class PN 1.6 up to 600 mm Dia& class PN 1.0 above 600 mm Dia conforming to IS 3896:1985 (Part II) duly inspected by DGS & D/SGS/RITES & shall be of IVC/Kirloskar/VAG/DURGA/UPADHAYA & Comparable make.

10.2 **KINETIC AIR VALVES :**

Single chamber DI tamper proof Kinetic Air Valves shall be fixed coupled with isolating sluice valve and at the suitable points based on detailed design. The Air valves shall conform to IS 14845-2000. The valves shall be IVC/Kirloskar/VAG/DURGA/UPADHAYA &Comparable make duly inspected by DGS & D/SGS/RITES.

10.3 **BRANCH CONNECTIONS :**

"T" outlet with manually operated sluice valves shall be provided in the distribution pressure Main for Branch connections.

10.4 The appurtenances shall be located in such a way that these are clearly and easily accessible for operation and maintenance.

11.0 **CONSTRUCTION OF CHAMBERS FOR APPURTENANCES :**

11.1 **CHAMBER FOR APPURTENANCES :**

The suitable RCC chambers shall be constructed around the appurtenances and valves fixed on the line, the minimum working space shall be 500mm on all sides. The chamber shall have Pre cast RCC cover conforming to IS:456-2000 suitable for heavy traffic loads.

11.2 **CIVIL WORKS :**

All the allied civil works necessary for laying and jointing of pipeline shall be a part of this contract; therefore, the contractor shall design and carry out the necessary civil works such as thrust blocks, anchor blocks, chambers for appurtenances and necessary earth work. All the civil works shall be designed and carried out as per the relevant Indian Standard Code of practice. All the materials used on civil work should be of a quality approved by Executive Engineer. Rejected material shall be removed from the site immediately at the cost of contractor.

12.0 **TESTING, COMMISSIONING OF PIPE LINE,TRAIL RUN AND DEFECT LIABILITY PERIOD :-**

After completing the job of laying and jointing of pipe line the contractor will do testing, commissioning and operation & maintenance for a period of one year including training of personnel. The repairing of bursting and leakage of pipeline during this period shall be done by the contractor at his cost including cost of all materials. The water for testing and commissioning of pipe line will be made available by the Deptt. free of cost at the time when convenient to the dept. In case of delay in making available the water for testing the time extension will be given

to the contractor without penalty for such period. Defect liability period shall be six months from the date of completion of work.

13.0 **INSPECTION OF PIPES, VALVES & FITTINGS**

Inspection of the pipes, valves & fittings will be done by the DGS&D/SGS/RITES. The departmental officials may Also, inspect at factory site.

14. THRUST BLOCKS

14.1 Thrust blocks are required to transfer the resulting hydraulic thrust from the fitting or pipe on to a larger load bearing soil section & shall be designed as per ISS.

14.2 Thrust blocks shall be installed wherever there is a change in the direction of the pipe line, size of the pipe line or the pressure-line diagram, or when the pipe line ends at a dead end. If necessary, thrust blocks may be constructed at valves Also,.

14.3 Thrust blocks shall be constructed taking into account the pipe size, water pressure, type of fitting, gravity component shell when laid on slopes and the type of soil. The location of thrust blocks for various types of fittings is given.

14.4 When a fitting is used to make a vertical bend, it shall be anchored to a concrete thrust block designed to have enough weight to resist the upward and outward thrust. Similarly at joints, deflected in vertical plane, it shall be ensured that the weight of the pipe, the water in the pipe and the weight of the soil over the pipe provide resistance to upward movement. If it is not enough, ballast or concrete shall be placed around the pipe in sufficient weight to counteract the thrust.

14.5 When the line is under pressure there is an outward thrust at each coupling. Good soil, properly tamped is usually sufficient to hold pipe from side movement. However,, if soft soil conditions are encountered, it may be necessary to provide side thrust blocks or other means of anchoring. In such cases only the pipe on each side of the deflected coupling shall be anchored without restricting the coupling.

14.6 Pipes on slopes need be anchored only when there is a possibility of the backfill around the pipe sloping down the hill and carrying the pipe with it. Generally, for slopes up to 30^0 good well drained soil, carefully tamped in layers of 100 mm under and over the pipe, right up to the top of the trench will not require anchoring.

14.7 For steeper slopes, one out of every three pipes shall be held by straps fastened to vertical supports anchored in concrete.

ANNEXURE - "E-VII"

PARTICULAR SPECIFICATIONS FOR INTERCEPTOR SEWER RCC NP3 PIPES & FOR ALLIED CIVIL WORKS

SPECIFICATIONS FOR INTERCEPTOR SEWER LINE RCC NP3 PIPE

Sr. No.	Rising main and Gravity main pipeline		Distance	Diameter	Material and class
	From	To	In m	In mm	
1	Gerva Nallah	Kosawadi SPS	5960 M	450 to 1100mm	RCC NP3
		Total length (In M) =	**5960 m**		

1.1 SCOPE

Tenders scope shall broadly include but not restricted to "Manufacture, supply,lowering, laying, jointing, testing and commissioning of RCC NP3class pipes of varying diameters" given in tender documents. Entire work shall be carried out under overall supervision of KMC to their full satisfaction.

1.2 DESCRIPTION OF WORK

The major works covered under this tender are given below:

1. Earthwork excavation for trenches of pipe line along the sewer alignment.
2. Manufacture, supply, laying, jointing, testing and commissioning of RCC NP3 class pipes following diameter (with internal Polyurea/Polymer based protective Elastomeric coating) as per requirement.
3. Construction of RCC concrete manholes, anti-floatation blocks. RCC manholes etc., and anchor blocks, thrust blocks wherever required.
4. Bedding as per design needs
5. Connecting the existing mains/sub mains/laterals
6. Remove of existing pipe wherever applicable
7. Cement concrete encasement for sewers that may come above ground or in slushy conditions.
8. Refilling the trenches with good quality gravel and carting surplus excavated earth from site.
9. Construction of temporary diversion structures such as cofferdams.
10. Field test of pipe line.
11. Any other works to be carried with the approval of Engineer in charge

1.3 SPECIFICATION DRAWINGS

The specification drawings are incorporated in tender documents. These drawings are made for tender's guidance only. "Released for construction" drawings will be issued to the contractor during progress of the work. "Released for" construction" drawings may be revised and revised copies may be issued to the contractor wherever necessary during execution of the work. It shall be appreciated that for work of this nature included in this contract, there are limitations for issuing construction drawings at tender stage and hence" "Released for Construction" drawings progressively issued during construction broadly conforming to the basic scheme as shown in the tender drawings, shall form a part of the contract. No claim will be entertained on the score that details shown on "Released for Construction" drawings are different from those shown on the tender drawings, unless the drawings indicate such items of work

which are not a part of the Bill of Quantities.

1.4 ENVIRONMENTAL IMPACT

The contractor should comply with state and national environmental standards and guidelines.

1.5 MATERIALS

a. The term "Materials" shall mean all materials, goods and articles of every kind whether raw, processed or manufactured and equipment and plant of every kind to be supplied by the Contractor for incorporation in the works.

b. Except as may be otherwise specified for particular parts of the Works the provision of Clauses in "materials and workmanship" shall apply to materials and workmanship for any part of the works.

c. All materials shall be new and of the kinds, qualities described in the Contract and shall be at, least equal to approved samples.

d. Materials shall be transported, handled and stored in such a manner as to prevent deterioration, damage or contamination failing which such damaged materials will be rejected and shall not be used on any part of the Works under this contract.

1.6 SAMPLES AND TESTS OF MATERIALS

a. The Contractor shall submit samples of such materials including FRC manhole covers, pre-cast concrete blocks, RCC NP3 or pipes as may be required by the Engineer and shall carry out the specified tests directed by the Engineer at the Site, at the supplier's premises or at a laboratory approved by the Engineer.

b. Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by the Engineer.

c. The Contractor shall give the Engineer seven days' notice in writing of the date on which any of the materials will be ready for testing or inspection at the supplier's premises or at a laboratory approved by the Engineer. The Engineer shall attend the test at the appointed place within seven days of the said date on which the materials are expected to be ready for testing or inspection according to the Contractor, failing which the test may proceed in his absence unless instructed by the Engineer to carry out such a test on a mutually agreed upon date in his presence. The Contractor shall in any case submit to the Engineer within seven days of every test such number of certified copies (not exceeding six) of the test readings as the Engineer may require.

d. Approval by the Engineer as to the placing of orders for materials or as to samples or tests shall not prejudice any of the Engineer's powers under the Contract particularly as to the provisions of under the Conditions of Contract. The provisions of this clause shall Also, apply to materials supplied under any nominated sub-contract.

1.7 STANDARDS

a. The special attention of the Contractor is drawn to the relevant Sections and Clauses of the National Building Code of India 1984 and Karnataka State Standard Specifications & latest IS Specifications (latest editions as amended) and should follow all the specifications and conditions strictly.

b. Materials and workmanship shall comply with the relevant Indian Standards (with amendments) current at the thirty-first day of December, 1989, unless a more recent amendment is specified hereinafter, or with the requirements of any other authoritative standard approved by the Engineer which shall be no less exacting in the opinion of the Engineer than the corresponding standard quoted herein.

c. Where the relevant standard provides for the furnishing of a certificate to the Employer, at his request, stating that the materials supplied comply in all respects with the standard, the Contractor shall obtain the certificate and forward it to the Engineer.

d. The specifications, standards and codes listed below are made a part of this specification. All standards, tentative specifications, specifications, codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

e. If no standard is indicated, the relevant Indian Standard, if any, shall apply. Indian standards are published by:

ii) Codes of Practice

Indian Standards Institution
ManakBhavan, 9, Bahadur Shah
Zafar Marg NEW DELHI - 110002

f. In case of discrepancy between the Specification and the Standards referred to herein, the Specification shall govern.

i) <u>Materials</u>

Code	Description	Remarks
'IS:269-1989	Specification for ordinary Portland cement	
IS 383-1970	Specification for coarse and fine aggregates from natural sources for concrete.	
IS: 432	Specification for mild steel and medium tensile steel	
IS: 650-1971	Specification for standard sand used for testing of cement (up to 40-mm diameter) for structural purposes	
IS: 4111-1986	Code of practice for auxiliary structures in sewerage system (Manholes). Part.1	
IS: 1239 (part-I)	Code for Steel tubes	
IS:651- 1992	Specification for salt-lazed stoneware pipes and fittings	

IS: 458-2003	Specification for recast concrete pipes (with and without Reinforcement).	
IS: 783-1985	Code of Practice for Laying of concrete pipes	
IS: 5382-1985	Specification for Rubber Sealing Rings for Gas Mains, Water Mains and Sewers	
IS: 5455-1969	Specification for Cast Iron steps for manholes	
IS: 4127-1983	Code of practice for laying of glazed stoneware pipes.	
IS: 1786	Specification for steel high strength deformed bars for concrete reinforcement.	
IS: 4990	Specification for plywood for concrete shuttering works	
IS: 12330-1988	Specification for Sulphate Resistance Portland Cement	

ii) Tests

Code	Description	Remarks
IS: 516-1959	Method of test for strength of concrete.	
IS: 1199-1959	Method of sampling and analysis of concrete	
IS: 2386-1963 (Parts I-VIII)	Methods of test for aggregate for concrete.	
IS: 2720 (Parts I-XLI)	Methods of test for soils	
IS: 3025 (Parts1-59)	Method for sampling and test (physical and chemical) for water used in industry	
IS: 456-2000	Code of practice for plain and refined concrete	
IS: 800	Code of practice for use of structural steel in General building construction.	
IS:919	Recommendation for limits and fits for engineering	
IS:'1597 (Parts I & II)	Construction of stone Masonry	
IS:2502	Code of practice for bending and fixing of bars for concrete.	
IS:2571	Code of practice for laying in situ cement concrete flooring	
IS:3558	Code of practice for use of immersion vibrator for consolidating concrete.	
IS:3935	Code of practice for composite concrete	
IS:4014 (Parts I & II)	Code of practice for steel tabular scaffolding	
IS:10005	SI units and recommendations for the use of their multiples and of certain other units.	

ANNEXURE - "E-VIII"

PARTICULAR SPECIFICATIONS FOR CONSTRUCTION OF M.S. CUM RCC TRUSS BRIDGE 750 M LONG ACROSS THE HASDEO RIVER FOR LAYING MS PIPE LINE

Design and constructing of R.C.C. Cum M.S. truss bridge across the Hasdeo river 750 m long for laying of M.S. pipe 700 mm Dia (rate analysis).

1. The work includes required survey of alignment, necessary hydrological and geotechnical investigation, confirmation of HFL from WRD and all the necessary investigation required for preparation and approval of structural design.
2. The contractor shall coordinate with the KMC and PWD for getting the best suitable alignment to cross Husdeo river and carry out the geotechnical investigations such as trial bores for foundations and flood assessment survey to finalise the deck level of the bridge.
3. The scope of work includes preparation of Structural drawing of bridge (steel) including of RCC foundation, abutment & piers & cap etc to be submitted along with design calculation for approval. The drawings shall be got vetted from NIT/ IIT and approved from competent authority of KMC.
4. The work includes construction of coffer dam for foundation of piers, dewatering, necessary excavation for piers/ piles, pile cap or any suitable foundation according to actual strata, construction of pier, pier cap, pedestal for resting trusses etc. All PCC work shall be minimum grade of concrete M15. All RCC work shall be with minimum M 30 grade concrete.
5. Truss bridge shall be fixed on insert plates with foundation bolts to the to the top of RCC piers. The M.S. pipes shall rest perfectly on the M.S. chairs. The truss bridge shall be provided with sufficient tie members.
6. The width of the bridge shall be kept in such a way to accommodate the pipe of 1.0M Dia with additional width of 0.6m for the inclined height for the chairs on which the pipes shall rest. In addition to this there shall be at least 1.20M wide walkway provided with chequrred plates of minimum 8mm thickness. A projection shall be kept at every joint with railing for attending the leakage of joints if occurred in future.
7. One third diameter of the pipe shall be rest on chair with 75x8 mm flat. Top shall be clamped with 63 x 6 mm clamp. Bottom of pipe line shall be 300 mm up from platform level.
8. Platform level shall be minimum 1 m above HFL and level shall be got approved from KMC before designing.
9. Design of truss and members shall be got approved by engineer-in-charge before starting offabrication erecting & execution.
10. Providing epoxy painting to all steel work over prime coat. Work includes providingI Hand Railing 1.0 m high on both sides of platform.All relevant BIS codalprovisions has to be scrupulously followed for designing the Bridge.
11. Scope of work Also, includes Construction of approach road on both ends from the existing BT road up to entry and exit of bridge.
12. The contractor shall design the size of piles, pile caps, piers, pier caps, spans and the structural steel truss bridge aesthetically as well as structurallyalong with the specifications of the

materials to be used and get it vetted form Govt. Engineering college/ NIT and submit the same to BMC and PWD for approval.

13. The bridge bottom shall be kept at least 1.0M above the HFL and the span shall be kept as per the site requirement.
14. The protection and locking arrangement shall be provided at both the ends for restricted entry of O & M staff.
15. One information board of 1m x 2m shall be fixed on each side of bridge.
16. Complete structure shall be painted with three coats of weatherproof enamel paint of approved quality and colour.
17. Provision of cathodic protection and lightning arrestor shall be made in the bridge.
18. All the works shall be completed as per the instructions and to the satisfaction of Engineer in charge.

The contractors offer shall be for 750 m long bridge. In case of increase or decrease in length, payments shall be increased or decrease as per RMT basis.

ANNEXURE - "E-IX"

SPECIFIC CONDITIONS FOR SEWAGE TREATMENT PLANT OF SEQUENTIAL BATCH REACTOR TECHNOLOGY

Scope of work & Specifications for Sewage Treatment Plant 33.00 MLD based on SBR Technology inclusive of all civil works, providing & installation of all Mechanical & Electrical Equipment including trial run for Three months followed by 15 years of complete Operation and Maintenance including replacement and warranty including 12 months of defect liability period.

(A) SCOPE OF WORK: DESIGN, CONSTRUCTION, SUPPLY,INSTALLATION, TESTING & COMMISSIONING OF STP

1.0 LOCATION OF PLANT

The proposed STP of 33 MLD capacity is based on the Sequential Batch Reactor (SBR) Technology. It is an advanced version of CPHEEO's proven Activated Sludge Process in which biological process shall be carried out in sequential batch mode using PLC/SCADA control.

STP 33 MLD (with septage load of 100 Cum/ day) capacity at Pragati Nagar inside the NTPC Campus

The Scope of Work includes but not limited to the following Units:

Part A – 33 MLD Sewage Treatment Plant :-

- Sewage Treatment Plant of abovementioned Capacity including following;
- Primary Treatment Units comprising Inlet Chamber, Fine Screen Channels and Grit Chambers.
- Biological Treatment Units based on Sequential Batch Reactor (SBR) technology Minimum 4 Basins.
- Disinfection (Chlorination) Units comprising Chlorination Tank and Chlorinator cum Chlorine Tonner House.
- Sludge Dewatering Units comprising Sludge Sump and Pump House, Centrifuge House /Filter Press house and Dewatering Polymer Dosing System.
- Buildings including SBR Air Blower cum Admin cum MCC & Control Building, Electrical HT Substation, DG House, Security Cabin etc.
- Other Ancillary Structures including Roads & Pathways, Plant Drains & Storm Water Drains, Boundary Wall etc.
- Landscaping.
- O & M of 15 years including defect liability period of 12 months

2.0 SCOPE OF WORK:

2.1 BRIEF SCOPE OF WORK

The Contractor shall ensure the technical feasibility of his Offer submitted after visiting the Site. **It must be clearly understood that as the Contract is a "Turnkey Contract", the Contractor shall design and execute every such Item(s) of Work(s) which are considered required or**

necessary for the satisfactory completion and functioning of the entire Plant including Operation & Maintenance of the plant even if such Item(s) of Work(s) are not specified in the Bid documents, but are essential to complete the Plant.

The contractor shall consider in his offer, STP of 33 MLD Capacity based on SBR Technology.

- The scope of the work shall include but not be limited to the following:
- Design, construction, supplying, erection, testing and commissioning STP of 33 MLD Capacity average flow. Topographical and Geotechnical Survey including Subsoil Investigation for Water Table and Safe Allowable Bearing Capacity& highest flood levels of the nallas and Hasdeo River. All the Investigation shall be carried out by the Contractor through a reputed and specialist firm approved by Engineer in charge for confirmation of Geotechnical data.
- The flow of inlet raw sewage shall enter in the stilling chamber in upward direction
- Site Development including but not be limited to the following works:
- Cutting of unwanted Tress, Plants, Bushes and Shrubs etc. and removing the same form Site. **However, necessary approval for the same shall be arranged by the KMC.**
- Demolishing the existing Structures if any and removing the debris from Site.
- Shifting of Pipe Lines, Cables and Poles etc. if required.
- Construction of approach road from the existing BT road up to the site of construction.
- **Site filling by means of suitable earth, if required, as per site condition. Finished ground Level shall be above HFL.**
- Levelling and grading to improve the aesthetics and to facilitate the vehicular movement.
- Construction of Site Offices (One for KMC's Staff and one for Contractor's Staff) with required Furniture, Air-conditioners, Personal Computers and Printers, Wi Fi/ Internate facilityetc.
- Arranging Construction Power & Water.
- Pilling work/Area improvement work including stone columns if any.
- Construction of temporary Labour Shelters nearby Site.
- Preparation of Process, Hydraulic, Civil, Mechanical, Piping, Electrical and Instrumentation Design and Drawings including Construction, Architectural and As-built Drawings.
- Construction of Civil Engineering Works for all the Process Units, Buildings, Roads & Pathways, Plant Drains, Storm Water Drains, Boundary walls along periphery of plot etc. as detailed in Civil Specifications. Layout shall be made in such a way that all Process Units and Buildings are interconnected and can be accessed from one Point.
- Providing Plinth Protection with DPC and termite proofing along the periphery of all the Process Units & Buildings shall be provided as detailed in Civil Specifications.
- Providing Internal and External Plaster to Buildings as detailed in Civil Specifications.
- Providing Internal Black Anti Corrosive Bitumastic Paint and External synthetic emulsion paint to all Process Units.

- Providing Internal Acrylic Washable emulsion Paint and External Acrylic Smooth Exterior Paint to all Buildings.
- Providing Rolling Shutters, Doors, Windows and Ventilators in all Buildings.
- Providing External Epoxy Paint to all Steels Works made of MS or GI.
- Providing CI Hand Railing along all the Stairs and Walkways of all Process Units
- Providing Coloured GI Sheet Roofing over all the Stairs and Walkways of all Process Units.
- Supply, Erection, Testing & Commissioning of all the Mechanical Equipment as detailed in Mechanical Specifications.
- Obtaining incoming HT Power Supply from State Electricity Authority from nearby Source to the STP Site. **However,necessary Deposits and Documents shall be arranged by the KMC.**
- Supply, erection, testing & commissioning of all the Piping, Gates & Valves as detailed in Mechanical Specifications.
- Supply, Erection, Testing & Commissioning of all the Electrical Equipments including HT and LT Equipments as detailed in Electrical Specifications.
- Supply, Erection, Testing & Commissioning of all the Instrumentation Equipments as detailed in Electrical & Instrumentation Specifications.
- PLC/ SCADA based Automation System for the entire Plant as detailed in Specifications.
- Supply, Erection, Testing & Commissioning of Safety Equipments at required locations including Safety Showers, Sand Buckets, Fire Extinguishers, Fire Alarms, smoke detectors etc.
- Providing Laboratory with required Laboratory Equipments, Instruments, Chemicals & Reagents and Furniture.
- Landscaping and lawn covering the front area of building. Planting of Trees and Plants on the remaining area including area for future expansion.
- Trial Run of the constructed & hydraulically tested Plant along for a period of three (3) months and Operation & Maintenance (O&M) of STP for 15 years after Trial Run as per Tender specifications.
- Supply of all Spares, Tools & Tackles required during Performance Run and O & M Period.
- Repairing & reconditioning of all the Equipments in the concluding year of the Operation & Maintenance Period to such a condition that they are in running condition with regular preventive and recommended maintenance.
- Providing “on the job” training to the KMC’s personnel.
- Defects Liability Period of 12 months from the date of successful completion of trial Run.
- Preparation and submission of As-Built Drawings and Operation & Maintenance Manuals for Mechanical, Electrical & Instrumentation Items.
- Providing demonstrations to the guests and students within the O&M period and displaying of models and actual working of STP.

- Preparation of working 3D model of all STPs with proper display at each STP
- **Online Real time monitoring system of all the STP's and one combined display as per requirement of State/ Central Pollution Control Board at Municipal office indicating crucial parameters Integration with central SCADA monitoring at state Headquarters Raipur with allied connectivity and networking accessorieson iOT using cloud tunnel. Remote monitoring shall also have to be provided on static IP.**
- One Battery operated Golf Car of 9 person seating capacity
- Elevator of Minimum 6 person capacity for Admin Building
- Aesthetic treatment such as Aluminium cladding to the external faces of admin building.
- Analyzer unit at each STP with Digital Display of raw and Treated Sewage for the parameters such as BOD, COD, TSS & Ph with additional LED digital display board of appropriate size at the front side of STP Entrance.
- Rain water Harvesting of All the Buildings.
- There shall be RCC approach bridge from Admin building to SBR basin. The bridge shall be minimum 2m wide with upper cover and side railing. Similarly grit chamber and SBR basin shall also have an interconnection approach bridge.
- The contractor shall prepare the layout of various component of STP keeping in mind the future provision of TTP sump and pumphouse. The space required for TTP sump and pumphouse shall be clearly marked in the general layout drawing of STP.

Any other Items which have not been specifically mentioned in specifications but are necessary for construction of the Plant as per good engineering practice, safety norms and successful operation and guaranteed performance of the entire Plant shall be deemed to be included within Scope of Work and shall be provided by the Contractor without any extra cost to the KMC.

The Bidders are to adopt the same nomenclature used for various treatment units in their design report as used in the Tender documents. Bidder is required to fill up/complete the technical schedules presented in Technical Bid as a part of Tender submission. Any Bid without filled in the technical schedules shall be considered as non-responsive and will be summarily rejected.

The Bidders are advised to visit the STP site before quoting for the proposed STP.

The above works shall be completed within 24 months (including Monsoons) from the commencement date followed by 3 months of Trial & Run and Operation & Maintenance (O&M) for 15 years.

2.2 PROPOSED TREATMENT SCHEME SEWAGE TREATMENT PLANT OF 33 MLD CAPACITY

2.2.1 Inlet Chamber

Inlet Chamber of STP shall receive the average flow from Raw Sewage Pumping Station at Kosabadi Nalla. From Inlet Chamber it will be taken into downstream Fine Screen Channels.The flow of inlet raw sewage shall enter in the stilling chamber in upward direction. The function of the Inlet Chamber is to reduce the incoming velocity. It shall be of adequate size to meet the

requirements of workability inside it. It shall be water tight to prevent seepage of the sewage outside.

2.2.2 Fine Screening

Fine Screens Channels shall be provided upstream of Grit Removal Units. Fine Screens should be capable to screen out most of the small floating materials above 6 mm size. It shall be of Mat/perforated plate type. The screenings shall be dropped in the bin installed at the top of the Fine Screens Channels. The screening material as collected will drop automatically into wheel Barrows for its disposal.

2.2.3 De-gritting

Screened sewage shall gravitate to Grit Separator Tanks for removal of grit and small inorganic particulate matter of specific gravity above 2.65 and particle size above 150 microns. The Grit Separator Tanks shall be of RCC complete with Detritus Mechanism comprising Scraper, Classifier and Organic Return Pumps. The grit separated shall be properly collected and transferred for disposal.

2.2.4 Flow Measurement

Flow measurement shall be done online using an ultrasonic flow meter on the rising main of raw sewage transfer pumps or Parshall flume shall be constructed for flow measurement.

2.2.5 Sequential Batch Reactor (SBR) Units

Primarily treated sewage shall be fed into the Sequential Batch Reactor (SBR) Process Basins for biological treatment to remove BOD, COD, Suspended Solids, Biological Nitrogen and Phosphorous.

Sequential Batch Reactor (SBR) shall work in Cyclic / Batch mode in single step. It shall perform biological Organic Removal, Nitrification, De-nitrification and Biological Phosphorous Removal and shall be capable of simultaneous sludge stabilization. The oxygen required shall be supplied through fixed type Fine Bubble Diffused Aeration System with auto control of oxygen level in the Basins. The system shall have a SVI < 120 for higher settling rates and should be designed in such a way that growth of filamentous bacteria is restricted. The complete operation including Filling of Sewage, Aeration, Sludge Recirculation, Decanting and Wasting of Excess Sludge shall be controlled by PLC. Treated Sewage from SBR Process units shall be collected in Chlorination tank for its disinfection.

Minimum four SBR basins has to be provided for STP.

2.2.6 Chlorination Tank

Treated sewage from SBR basin shall be collected in a Chlorination Tank where disinfectant will be added for disinfection at suitable dosing rate. Baffle walls shall be provided in the Tank to facilitate hydraulic mixing of treated sewage. Adequate reaction time shall be provided to ensure proper disinfection of treated sewage. Treated Sewage after chlorination shall be disposed off into nearby water body or nallah.

2.2.7 Sludge Dewatering Units

Excess Sludge from SBR Basins shall be withdrawn through Sludge Withdrawal System and collected in the Sludge Sump. Sludge Sump shall be equipped with suitable submersible mixers to

ensure homogeneous mixing.

The sludge shall be then pumped to centrifuge for dewatering using positive displacement type Screw Pumps. Dewatering Polyelectrolyte Dosing System comprising one Solution Preparation and One Solution Dosing Tank equipped with slow speed Agitator and mechanically actuated diaphragm type Metering Pumps shall be provided to dose Dewatering Polyelectrolyte Solution online.

The dewatered sludge in the form of wet cake from Centrifuge shall be collected whereas Concentrate shall be transferred back to inlet chamber.

2.2.8 Septage Treatment

Septage received at STP shall be stored in septage storage sump. The sump shall be equipped with mixer to keep the solids in suspension. Septage Transfer Pumps shall be provided to pump this septage at the inlet chamber.

2.3 DETAILED SCOPE OF WORK

1.3.1 Design Basis:

Sr. No.	Design Parameters	STP
A	**SEWAGE TREATMENT PLANT**	
1	Average Flow	33 MLD + 100 m3/day
2	Peak Factor	2.25
3	Peak Flow	74.25 MLD + 100 m3/day septage flow
4	Average Ground Level (AGL) at Site	283.00 m (To be confirmed by agency after survey)
5	Finished Ground Level (FGL) at site	283.50 m (To be confirmed by agency after survey)
6	High Flood Level at	--- m
	HFL of nearby Nallah	To be confirmed from WRD/PWD
8	Invert level of incoming sewer at pumping station	278.303 m (To be confirmed by agency after survey)
9	Approximate length of Disposal Pipe	To be confirmed after survey
10	Soil Bearing Capacity	10 T/m2 at 1.5 m below AGL
11	Ground Water Table	3 m below AGL

Note: Bidder to carry out necessary soil investigation to ascertain the type of foundation before

quoting his rates. Bidder shall carryout the detailed topographical survey with study of HFL, the design and formation level shall be proposed accordingly. The same shall be approved by Engineer in charge/consultant.

2.3.2 Raw Sewage Quality:

An abstract of Raw Sewage Characteristics is indicated in the following Table:

Sr. No.	Design Quality of Raw Sewage	Unit	Raw Sewage Quality	Septage Quality
1.	BOD (mg/l)	mg/l	250.0	7000.0
2.	COD (mg/l)	mg/l	425.0	15000.0
3.	TSS (mg/l)	mg/l	375.0	15000.0
4.	TKN (as N) (mg/l)	mg/l	45.0	700.0
5.	TP (as P) (mg/l)	mg/l	7.0	250.0
6.	Fecal Coliform (MPN/100ml)	MPN/100ml	1 x 10^6	-
7.	Total Coliform (MPN/100ml)	MPN/100ml	1 x 10^7	-

The Bidder shall carry out the sampling tests of raw sewage by themselves to ascertain the raw sewage quality for treatment process. The KMC will not be responsible for the above and no relaxation will be given to the guarantee conditions of desired treated sewage quality. For design purposes the lower parameters than the above mentioned parameter will not be allowed.

2.3.3 Treated Sewage Quality at outlet of Chlorine Contact Tank:

The Contractor shall design the process in such a way that the treated sewage quality attains the following limits or even better:

Sr. No.	Parameters / Pollutants		Values after secondary treatment
1	pH	:	6.5 to 9.0
2	Biochemical Oxygen Demand (BOD_5)	:	≤ 10 mg/l
3	Chemical Oxygen Demand (COD)	:	≤ 50 mg/l
4	Total Suspended Solids (TSS)	:	≤10 mg/l
5	Total Phosphorous (TP)	:	≤ 1 mg/l
6	Total Nitrogen (TN)	:	≤ 10 mg/l
7	Ammonical Nitrogen (NH3-N)	:	≤ 5 mg/l
8	FecalColiform	:	≤ 100 MPN/100 ml

2.3.4 Technical Specifications

A. Sewage Treatment Plant of 33 MLD Capacity

1.0 Primary Treatment Units

Primary Treatment Units comprising Inlet Chamber, Fine Screen Channels and Grit Chambers shall

be designed for Peak Flow.

1.1 Inlet Chamber

Inlet Chamber of STP shall receive the flow from Raw Sewage Pumping Station. Inlet Chamber shall be designed for Peak Flow. The entire construction shall be in M30 grade reinforced cement concrete and as per IS 3370. RCC Platform/Walkway, minimum 1.20 m wide with Hand Railing as per specifications shall be provided. RCC Staircase, minimum 1.20 m wide with Hand Railing as per specifications shall be provided for access from Finished Ground Level to the top of the Unit & to the Operating Platform/Walkway.

Average Flow	:	33 MLD
Peak Factor	:	2.25
Peak Flow	:	74.25MLD
Number of Units	:	1 No. each
Hydraulic Retention Time	:	30 Sec at Peak Flow
Free Board	:	0.50 m minimum

All other accessories, whether specified or not, but required for completion of Contract shall form the part of Bidder's Scope for the STP.

1.2 Mechanical & Manual Fine Screen Channels

Two Mechanical Fine Screens (Working) and one Manual J type Fine Screen (Standby) shall be provided in Fine Screen Channels. Each Fine Screen Channel shall be designed for 50% of Peak Flow. Mechanical screen shall be of Mat/perforated plate type.

The entire construction shall be in M30 grade reinforced cement concrete and as per IS 3370. RCC Platform/Walkway, minimum 1.20 m wide with Hand Railing as per specifications shall be provided. RCC Staircase, minimum 1.20 m wide with Hand Railing as per specifications shall be provided for access from Finished Ground Level to the top of the Unit & to the Operating Platform/Walkway.

The clear opening shall be 6 mm for Mechanical Fine Screen and 10 mm for Manual Fine Screen. The Mechanical and Manual Screens shall be made of SS 304 flats(3 mm for Mechanical and 8 mm for Manual Screen). Bin and Chute arrangement shall be provided to take the screenings. Screenings dropped from Chute shall be collected in a wheel Burrow. Manually operated CI Sluice Gates shall be provided at the upstream and downstream ends to regulate the flow.

Average Flow	:	33 MLD
Peak Factor	:	2.25
Peak Flow	:	74.25 MLD
Number of Units	:	2 Mechanical (Working) + 1 Manual (Stand by) each of 50% of Peak Flow capacity.
Approach Velocity at Average Flow	:	0.30 m/s
Velocity through Screen at Average Flow	:	0.60 m/s max.
Velocity through Screen at Peak Flow	:	1.20 m/s max.
Free Board	:	0.30 m
Wheel Barrow	:	1 No. minimum

All other accessories, whether specified or not, but required for completion of Contract shall form the part of Bidder's Scope for the STP.

1.3 Grit Chambers

Two Mechanical Grit Chamber (Working) along with one Manual Bypass Channel (Standby) shall be provided after Fine Screen Channels. The Grit Chamber shall be designed for 50% of Peak Flow and the Bypass Channel shall be designed for 50% of Peak Flow.

The entire construction shall be in M30 grade reinforced cement concrete and as per IS 3370. RCC Platform/Walkway, minimum 1.20 m wide with Hand Railing as per specifications shall be provided. RCC Staircase, minimum 1.20 m wide with Hand Railing as per specifications shall be provided for access from Finished Ground Level to the top of the Unit & to the Operating Platform/Walkway.

Each Grit Chamber shall have the following features:

- One tapered Inlet Channel running along one side with adjustable Influent Deflectors for entry of sewage into the Grit Chamber.
- One tapered Outlet Channel for collecting the de-gritted sewage, which overflow over an adjustable Weir into the Outlet Channel. It shall be designed in such a way that no settling takes place in it.
- One sloping Grit Classifying Channel in to which the collected grit shall be classified.
- The grit from Classifier shall be collected in a Wheeled Trolley.
- A Grit Scraping Mechanism.
- Screw Classifier or Reciprocating Rake Mechanism to remove the grit.
- One Organic Matter Return Pump

Manually operated CI Sluice Gates shall be provided at entrance of the Inlet Channel of the Grit Chambers as well as Bypass Channel to regulate the flow.

Average Flow	:	33.00 MLD
Peak Factor	:	2.25
Peak Flow	:	74.25 MLD
No. of Units	:	2 Mechanical (Working) each of 50% of Peak Flow capacity
Type	:	Mechanical
Size of grit particle	:	0.15 mm
Specific gravity of grit	:	2.65
Maximum Surface Overflow Rate	:	960 m3/m2/day
Free Board	:	0.30 m
Side Water Depth	:	0.90 m
Wheel Barrow	:	1 No. minimum

All other accessories, whether specified or not, but required for completion of Contract shall form the part of Bidder's Scope for the STP.

1.4 Flow Measurement

Flow measurement shall be done online using an ultrasonic flow meter on the rising main and a Parshall flume shall also be constructed for the flow measurement. An ultrasonic type flow meter shall be provided for measurement of the flow in Parshall flume at STP.

Average Flow	:	33.00 MLD
Peak Factor	:	2.25
Peak Flow	:	74.25 MLD

3.0 Sequential Batch Reactor (SBR) Units

3.1 General

The Sequential Batch Reactor (SBR) Process shall be an advanced activated sludge process with in-built nitrification, de-nitrification and biological phosphorous removal. The process shall utilize a Fill-and-Draw Reactor with complete-mix regime and operating in true-batch mode. The complete process shall be divided into Cycles with each Cycle is of duration of 2.5 – 4 hours. All the subsequent treatment Steps – Fill/Aeration, Settling and Decanting must take place sequentially and independently without overlapping. During Fill/Aeration phase, the sewage shall be filled into SBR Basins and part of the treated sewage along with activated sludge shall be recycled with the help of Recycle Pumps. Air shall be supplied for aeration with the help of Air Blowers. During settling phase, the Filling/Aeration shall be stopped and the mixed content shall be allowed to settle under perfect settling conditions. During Decanting phase, the supernatant shall be removed form top with the help of Decanters and excess sludge shall be wasted with the help of Waste Pumps. Cycle acceleration / overlapping during Peak flow shall not be allowed. Bidder shall provide DO sensor, in each aeration zone of SBR basin /preferably on header of RAS Pump, level transmitter & MLSS meter in each reactor.

3.2 Process Design

- Sequential Batch Reactor (SBR) Units shall be installed and equipped for average flow of 33.00 MLD for the STP.
- Minimum 4 numbers of SBR basins are required with average flow discharge.
- The SBR Process shall have following independent steps without overlapping each other:
  - Fill & Aeration
  - Settling (Sedimentation/Clarification)
  - Decanting (Draw)
- Filling, during Settling or Decanting will not be acceptable.
- The complete biological system shall be designed for handling peak flow.
- Suitable Nos. of SBR Basins with adequate volume shall be provided. In addition, 0.50 m Free Board shall be provided to each Basin.
- The entire construction shall be in M30 grade reinforced cement concrete and as per IS 3370. RCC Platform/Walkway, minimum 1.20 m wide with Hand Railing as per specifications shall be provided. RCC Staircase, minimum 1.20 m wide with Hand Railing as per specifications shall be provided for access from Finished Ground Level to the top of the Unit & to the Operating Platform/Walkway. Plinth protection along periphery shall be provided as per technical specifications.
- The system should work on a gravity influent condition. No influent / sewage Equalization

Tanks or flash filling is accepted.

- The system should be designed for maximum F/M ratio of 0.18 Kg BOD/Kg MLSS day.
- MLSS maintained in the Basin should range from 3500 to 5000 mg/l.
- Cycle times shall be selected adequately by the Bidder considering min. 12 hrs/day Basin of aeration and not exceeding decanting of 2.40 m liquid depth at any time with preferred cycle times containing max. 50% not aerated portion.
- The excess sludge produced shall be fully digested. Sludge production (including percipients) rate shall be about 0.60 – 1.20 Kg / Kg of BOD removed.
- A minimum total SRT of 10 days shall be maintained to ensure digested sludge.

3.3 Decanting Device

- The Decanting Device shall be Moving Weir Arm Device of SS 304 with top mounted Gear Box, Electric Drive, Scum Guard, Down comers, Collection Pipe, Bearings. The following type of decanter assemblies are not acceptable: Rope Driven Decanters, Floating Decanters, GRP Products, Valve Arrangement.
- The maximum design travel rate shall be 60 mm/min with proven hydraulic discharge capacity of the decanter proportional to the selected Basin area.
- The hydraulic design based on design flow rate as given above shall not exceed flow speed of 1.30 m/s.
- Flexible rubber hose kind of decanter Sealing is not acceptable.
- One or more decanters shall be provided in each basin which functions under a controlled lowering rate to withdraw treated water out of SBR Basins.
- The decanting mechanism shall be designed for a variable speed mode of operation. Decanter shall be capable to travel at varying speeds. The rate of travel of the decanter shall be adjustable during its travel in air and into the liquid surface, at which point the rate of travel of the decanter shall be automatically adjusted to a calculated rate of operation. The maximum design travel rate shall be restricted to 60 mm/min. Rope driven or Fixed subsurface arrangements will not be acceptable.
- The rate of operation shall be calculated for each cycle and shall be determined by the volume of treated effluent to be discharged per cycle. The calculation of decanter travel shall ensure that the volume of treated effluent shall be discharged throughout the designated decant phase of the process cycle. The travel of the decanter shall be limited and controlled by limit switches which shall communicate with the PLC. Upon reaching the designated BWL, the decanter shall return to its parked position.
- During non-decanting cycles, the decanter collection weir shall be parked above the top water level of the basin during aeration and settling phases, thereby eliminating any possibility of solids carryover during these phases. Therefore, weirs or entry ports of the Decanters shall not be submerged below the top water level of the basin during non-decant phase. Each decanter shall be fitted with a scum retention mechanism to prevent surface scums and floatable from exiting with the treated effluent.

- In addition, at park position, the decanter shall also provide fail safe overflow protection in the event of a power failure by allowing clear supernatant to flow via gravity, under the scum guard, over the weir, and into the decanters and out of the basins.
- If more than one decanter is provided per basin, operation of all decanters shall be synchronized precisely using synchronization panel to achieve even distribution of flow through each decanter.
- Weir loading for each decanter shall not exceed 140 m3/hr/m of the inlet weir. During Decanting Phase, decanter weir shall always be visible from the basin walkway to provide the operator with a visual check of the effluent quality. Maximum velocity down comer shall not exceed 1.3 m/sec. at the designed decant flow.
- All components of the decanter except seals and bearings shall be constructed of stainless steel 304. The decanter seals and bearings shall be constructed of maintenance free, synthetic materials for longest possible service life. All seals and bearings shall be shipped factory assembled, simplifying installation. All fasteners shall be constructed of 304 stainless. Site fabrication of decanters shall not be allowed.
- Drive mechanism or actuator shall be equipped with variable frequency drive connected to PLC to facilitate its operation at varying flow rates to ensure controlled and seamless operation at varying flow rates. Complete Drive Mechanism shall be mounted on the walkway to provide easy access for maintenance and service purposes.
- All critical decanter components that may require routine inspection or maintenance shall be easily accessible from an access platform at basin coping level without taking a basin out of service or draining or partially draining the basin. It shall be possible to carry out decanter maintenance activities without interrupting normal operation of the basin while the decanter is at its parked position during non-decant phases of the process cycle.
- The SBR blowers, Automatic Air supply Valves, RAS Pumps/Mixers, switching mechanism shall be interlocked with the decanter controls so that aeration/mixing is prevented in a basin which is settling or decanting.
- Bidder shall provide the evidence along with his bid that the proposed decanter provided by the Technology provider are provided and installed for at least 15nos of STP's in India, which are commissioned and successful operation for last 5 years.

3.4 Aeration System

- The aeration facility shall be installed for average flow.
- Only Fine Bubble Type, EPDM / PU Membrane Diffusers shall be acceptable with minimum Membrane Diffusers to Floor Coverage Area of 5%. Combination of aeration techniques using Aerators/Submersible Mixers etc. is not acceptable. Diffusers shall be submerged, fine bubble / fine pore, high transfer efficiency, low maintenance and non-buoyant type. Diffusers shall be panel / tubular type. In case tubular type Diffusers are used, only top half surface area of the Diffuser shall be considered for supply of air. Material of construction for entire under water system including accessories shall be of non-corrosive. Complete Diffuser as a unit shall be assembled at the manufacturing factory level. The grid supports shall of adjustable type made of SS 304.

- The Air Blower Arrangement shall be capable of handling Total Water Level and Bottom Water Level operation conditions controlled by process sensors such as DO, Temperature and Level.

- Each set of blower shall have at least one dedicated standby. Minimum One working air blower in each set shall operate via VFD while others may be operating at a fixed constant speed on soft starter configuration.
- The blowers for air diffuser system shall be positive displacement (roots) type, and head for blowers shall be decided on the basis of efficiency of diffusers and maximum liquid depth in tank duly considering the losses governing point of delivery (diffusers) and the blowers. Blowers shall be complete with motor and accessories like base frame, anti-vibratory pad, silencer, non-return valve, air filter etc. as per requirements. Vibration due to operation of blowers shall be to avoid damage to structures. Further, blowers shall have acoustics to ensure that the noise level at 1.86 m from blowers is below 80-db. The blower room shall have sufficient ventilation, lighting and working space. The room will be equipped with sufficient capacity EOT (Min 2 T or 1.5 times the weight of blower, whichever is more) to facilitate removal of blower/ motor etc. for repairs. The room will also have rolling shutter.
- The blower and air diffuser system shall include PLC based control for diffuser operation. Theoperation and speed of blowers shall be automatically adjusted using parameters like Oxygen Uptake Rate, Dissolved Oxygen and Temperature, Incoming flow and liquid level in the basin such that the DO is supplied as per demand and power utilisation for operation of blowers is optimised.
- The main air header/ring main shall be in MS as per relevant IS painted both outside and inside with corrosion resistant paint as per manufacture's recommendations. The header / ring main shall be supported on saddles at suitable intervals or will be protected against external corrosion in case they are laid below ground. The header shall have auto valves to facilitate switch over aeration cycle from one basin to other by PLC operation. The header shall supply air to fixed type diffuser grids at various locations through air supply pipes. Air supply pipe above water level shall be in MS and below water level it shall be in uPVC as per relevant standards. All under water lateral pipes shall be of uPVC. Junction between air header and air supply pipe shall be suitably protected against corrosion due to dissimilar materials.

- All other accessories, whether specified or not, but required for completeness shall form part of contractor’s scope. An Air cooler shall be provided, if required at the common discharge blowers to ensure that the air temperature at the inlet of diffusers is less than 80 deg. C

- All other accessories, whether specified or not, but required for completeness shall form part of Contractors scope.

3.5 Return Sludge and Excess Sludge Pumps

Dedicated Return Sludge and Excess Sludge Pumps shall be provided in each SBR Basin. The Pumps shall be of submersible / horizontal centrifugal type suitable for handling biological sludge of 0.8 – 1% solids consistency. Capacity and Heads shall be decided based on process requirements. Each Basin shall be provided with suitable lifting arrangements to facilitate lifting of these Pumps if required for maintenance.

a. Return Sludge Pumps

Capacity and Head : As per requirements

Type	:	Submersible / Horizontal Centrifugal
Liquid	:	Biological Sludge of 0.8 – 1% solids consistency
Specific gravity	:	1.05
Solid size	:	40 mm (Maximum)
Temperature	:	Min. 25° C
Efficiency	:	more than 50%
Quantity	:	1 No. per Basin + 1 No. Store Standby

b. Excess Sludge Pumps

Capacity and Head	:	As per requirements
Type	:	Submersible / Horizontal Centrifugal
Liquid	:	Biological Sludge of 0.8 – 1% solids consistency
Specific gravity	:	1.05
Solid size	:	40 mm (Maximum)
Temperature	:	Min. 25° C
Efficiency	:	more than 50%
Quantity	:	1 No. per Basin + 1 No. Store Standby

3.6 Automation and Control

- PLC based Automation System with application software based on Rockwell or equivalent to control SBR System including all Gates, Air Blowers, Pumps, Valves and Decanters as per Bidder's/Technology Provider's own design including I/Os with 20 % Spares and UPS.
- HMI Panel shall comprise latest Personal Computer with 22" LCD Monitor, Multi Media Kit, Printer, Internet Connection, RS-View, RS-Links (Gateway Version), Process and Operator Software with dynamic Flow Charts, Pictures, Screens, Alarms, Historical Trends, Reports etc.
- SCADA based Automation System to monitor the following parameters continuously in each SBR Basins:
  - Fill Volume
  - Discharge Volume
  - Temperature
  - DO Level
  - Oxygen Uptake Rate
  - Air Blower Speed
  - Decanter Speed

3.0 Disinfection (Chlorination) Units

Disinfection (Chlorination) Units including Chlorination Tank and Chlorinator cum Chlorine Tonner House shall be designed for Average Flow or Decant Flow whichever is higher.

3.1 Chlorination Tank and Chlorinator cum Chlorine Tonner House

Treated sewage from SBR unit shall be taken to Chlorination Tank by RCC Channel/RCC Pipe of Class NP3. Gas Chlorine shall be added for disinfection at suitable dosing rate. Baffle walls shall be provided in the Tank to facilitate hydraulic mixing of treated sewage. The entire construction shall be in M30 grade reinforced cement concrete and as per IS 3370.

Design Flow	:	Average Flow or Decant Flow whichever is more
Number of Units	:	1 No.
Hydraulic Retention Time	:	30 Minutes (excluding Outlet Channel after Weir)
Free Board	:	0.50 m min.

A Chlorinator cum Chlorine Tonner House shall be provided above/near Chlorination Tank to house Chlorination Systems. It shall be RCC (M30) Frame cum Brick Masonry Structure with Rolling Shutter, Windows & Ventilators, Electrical Hoist with Electrical Travelling Trolley of minimum 3 Ton capacity or 1.5 times the weight of the single Unit whichever is more to lift the Pumps/Chlorine Tonners and Safety Equipments including Sand Buckets, Fire Extinguishers and Fire Alarms etc. Also, it shall be provided with IPS Flooring, Internal & External Plaster and Internal & External Painting. Plinth Protection shall be provided along the periphery as per specifications.

All other accessories, whether specified or not, but required for completion of Contract shall form the part of Bidder's Scope.

3.2 Chlorination System

Gas Chlorination System comprising Vacuum Chlorinators (2 Nos.), Water Feed Pumps (2 Nos.), Interconnecting Piping and Appurtenances, Chlorine Gas Detector, Empty Chlorine Tonners (Suitable for 30 days' Storage) with Trunions, Lifting Device and Suspended Weighing Scale, Residual Chlorine Test Kit, Safety Equipment (e.g. Exhaust Fan, Canisters, Gasmasks etc.), Mandatory Spares, Chlorine Leak Detection and Chlorine Leak Absorption System including FRP Half Hoods, Caustic Solution Tank, Caustic Recirculation Pump, Centrifugal Fan, Interconnecting Piping and Ducts complete and other required ancillary shall be provided.

Design Flow	:	Average Flow or Decant Flow whichever is more
Type	:	Vacuum Type
Chlorine Dosing	:	5 ppm minimum
Quantity of Chlorinator	:	2 Nos. (1Working + 1Standby)

All other accessories, whether specified or not, but required for completion of Contract shall form the part of Bidder's Scope.3

4.0 Sludge Dewatering Units

Sludge Dewatering Units comprising Sludge Sump and Pump House, Centrifuge House and Dewatering Polymer Dosing System shall be designed for Average Flow.

4.1 Sludge Sump & Pump House

A Sludge Sump shall be provided to hold excess sludge from SBR Basins. It shall be equipped with a submersible mixer to facilitate mixing of its contents on continuous basis. It shall be constructed in M30 grade reinforced cement concrete and as per IS 3370.

Design Capacity	:	As required for 33.00 MLD Average Flow at STP
Number of Units	:	1 No.

Hydraulic Retention Time	:	6 hrs. min. of Average Daily Sludge Production
Free Board	:	0.50 m minimum

A Pump House shall be provided near Sludge Sump to house Sludge Transfer Pumps (Centrifuge Feed Pumps). It shall be RCC (M25) Frame cum Brick Masonry Structure with Rolling Shutter, Windows & Ventilators and Electrical Hoist with Electrical Travelling Trolley of minimum 1 Ton capacity or 1.5 times the weight of the single Unit whichever is more to lift the Pump and Safety Equipment including Sand Buckets, Fire Extinguishers etc. Also, it shall be provided with IPS Flooring, Internal& External Plaster and Internal & External Painting. Plinth Protection shall be provided along the periphery as per specifications.

All other accessories, whether specified or not, but required for completion of Contract shall form the part of Bidder's Scope for all the three STPs.

4.2 Sludge Sump Mixers& Sludge Transfer (Centrifuge Feed) Pumps

Submersible mixer (<500 rpm) shall be provided inside the sludge sump to keep the sludge in suspension. The material of construction of the mixer shall be SS304 along with lifting device with SS 304 square tube.

All other accessories, whether specified or not, but required for completion of Contract shall form the part of Bidder's Scope.

Sludge Transfer (Centrifuge Feed) Pumps shall be of positive displacement type Screw Pumps suitable for handling biological sludge of 0.8 – 1% solids consistency.

Capacity and Head	:	As required for 33.00 MLD Average Flow
Type	:	Positive Displacement Type Screw Pump
Liquid	:	Biological Sludge of 0.8 – 1% Solids Consistency
Specific gravity	:	1.05
Solid size	:	40 mm (Maximum)
Temperature	:	Min. 25° C
Efficiency	:	more than 30%
Quantity	:	As per requirement + 1 Standby Minimum

All other accessories, whether specified or not, but required for complete shall form part of contractor's scope.

4.3 Mechanical Sludge Dewatering Device (Centrifuge) and Centrifuge Platform

The Mechanical Sludge Dewatering Device shall be solid bowl type Centrifuges designed for 100% trouble free operation at all times and provided as per the following guidelines.

- The device shall be so located that the dewatered sludge can be loaded into Trucks/ Trolleys / Containers directly. Preferably the device shall be so located that the dewatered sludge falls into the Trucks/ Trolleys / Containers without requirement of another Material Handling Unit.
- The dewatered sludge shall have a minimum solids concentration of 20% or more (measured as dry solids w/w basis) so that it can disposed by open body Trucks/Trolleys.

The Centrifuge shall be solid bowl type of co-current/counter current design, as decided by the

Bidder. It shall have sufficient clarifying length so that separation of solids is effective. The Centrifuge and its accessories shall be mounted on a common Base Frame so that the entire assembly can be installed on an elevated structure. Suitable Drive with V-Belt arrangement and Turbo Coupling shall be provided along with Overload Protection Device.

Differential speed and Bowl speed shall be adjusted by changing the Pulleys. Differential speed may be adjustable by use of epicyclical gears. The Bowl shall be protected with flexible connections so that vibrations are not transmitted to other Equipments. The Base Frame shall be provided with anti-vibration Pads. The Drive Motor shall be of 1,450 RPM. The noise level shall be 85 dB (A) measured at 2.00 m distance under dry run. The vibration level shall be below 50 micron measured at Pillow Blocks under dry run condition.

Capacity	:	As required for 33.00 MLD Average Flow
Operating Hours	:	18 hrs per day maximum
Type	:	Solid Bowl Type
Liquid	:	Biological Sludge of 0.8 – 1% Solids Consistency
Specific gravity	:	1.05
Quantity	:	As per requirement + 1 Standby Minimum

All other accessories, whether specified or not, but required for complete shall form part of contractors' scope for the STP.

A Centrifuge Platform shall be provided near Centrifuge Feed Pump House to house Centrifuges. It shall be a G(Stilt) + 1 type RCC (M30) Frame Structure. Centrifuges shall be installed at First Floor whereas Trucks/Trolleys/Containers shall be parked at Ground Floor. An Electrical Hoist with Electrical Travelling Trolley of minimum 3 Ton capacity or 1.5 times the weight of the single Unit whichever is more and Safety Equipment including Sand Buckets, Fire Extinguishers etc. shall be provided. Also, it shall be provided with Anti-Skid Tile Flooring, Internal & External Plaster and Internal & External Painting. Plinth Protection shall be provided along the periphery as per specifications.

Bidders can opt for considering either centrifuge or Belt Filter press or screw technique for extracting the sludge.

4.3 Belt Filter Press

General

The Sludge Dewatering System includes, in addition to belt filter press, a polymer feed / dosing system, belt filter press feed pumps, Online mixer for mixing of polyelectrolyte with sludge, piping and valves to inlet of belt filter press, discharge hopper for collection and disposal of dried cake, filtrate collection piping and belt wash pumps along with piping and valve for washing of belt filter press. For the purpose of discharge of dewatered cake and for collection of filtrate, the Belt Filter Press is located on the first floor of building so that the trolley etc. can be placed directly below the chute.

The scope includes the belt filter press with connecting hydraulic piping etc. The belt wash pump required shall be of 20 M3/Hr. at 70 M TDH for one 2M wide BFP.

- Technical Specifications

The belt filter press shall dewater the sludge as gravity drainage and belt pressure system without the need for vacuum dewatering.

Sludge is usually required to be conditioned using a polymer prior to dewatering on the belt filter press. The optimum polymer dosage and type of for the specific sludge is determined by testing. Typical polymer dosing rate ranges from 0 – 6 lbs/T of dry solids.

Each belt press is designed and sufficiently automated to require minimal operator attention. The belt press shall incorporate the following components.

- Main Structural Frame

The structural frame shall be of all welded construction and shall be fabricated from channel designed to adequately support all components. The design permits roll removal without requirement of disassembly of frame.

- Extended Gravity Drainage Section

To maximize gravity water removal, adequate gravity drainage area shall be provided. A set of gravity dispersion device spaced on 6½" maximum centres shall be provided to disperse sludge for effective removal of water. The devices shall be designed so each one can be moved in either lateral direction and shall be a minimum of twelve (12) inches long to turn the sludge over in the gravity section for maximum water removal. Dispersion devices shall be constructed of ultra-high molecular weight polyethylene. Each set of devices shall have the capability of being rotated out of the flow by handles, for maintenance purposes or process flexibility. Sludge shall be contained within the drainage section by a barrier equipped with replaceable rubber seals on each side. The gravity drainage belt shall be supported by polyethylene grids over the complete length and width of the gravity drainage section that are also used for effective removal of gravity and capillary water.

- Adjustable Wedge

Following gravity dewatering, adjustable wedge section for process flexibility is incorporated into the press design. Gradual increased pressure shall be applied as belts pass through the adjustable wedge section

- Pressure Section

A minimum diameter roll shall be used as the initial roll in contact with gravity concentrated sludge. A S-shaped roll configuration shall be used to apply maximum pressure and shear.

To ensure optimum cake dryness, a minimum number of rolls shall be used in the pressure area.

- Filtration Belts

Each belt shall be a continuous design woven from monofilament polyester strands. Each belt shall incorporate a mechanical seam that does not interfere with press operation and also allows simple, periodic belt replacement.

- Doctor Blade

For removal of dewatered cake, the press shall incorporate doctor blade for each filtration belt. Blade pressure shall be field adjustable against the belt by means of spring tensioning mechanism and shall

be replaceable, reversible with two useable edges and fully accessible to the operator.

- Rolls

All rolls, including guide and tracking, shall be of low deflection design.

- Roller Bearings

All bearings shall be pillow block type with split, cast iron, two bolt housings. All bearings shall be capable of compensating for misalignment without seal distortion. Each bearing shall be grease lubricated.

- Filtrate Collection

Drainage pans shall be located under all gravity and pressure section of the press. Drain pans with standard NPT connections shall collect gravity filtrate and pressure filtrate to common drainage points.

- Belt Washing Device

Following cake discharge, each polyester belt shall be continuously washed using a 100 psi pressure, low volume steel shower assembly. A Y-strainer is provided in wash water line to remove any particles which may enter the shower assembly. Each shower assembly shall have replaceable brass or steel nozzles. The shower assembly shall be designed to completely contain the high velocity water spray and remove any solids trapped in the belt. Pumps required for belt washing are not included in our scope of supply.

- Belt Tracking

Belt positioning for each belt shall be continuously and automatically monitored by suitable arrangement which shall be installed with guide devices. The guide device shall ride the edge of the polyester cloth belt. The micro-torque unit shall sense belt misalignment and shall automatically walk the belt back to the normal operating position by means of a live hydraulic cylinder which shall be attached to tracking rolls. The opposite end of the tracking roll shall incorporate self-aligning pillow block bearings which allow the tracking rolls to pivot in a horizontal plane. Belt tracking shall be automatically operated by the hydraulic power pack. A limit switch shall be provided on each side of each belt to sense extreme belt travel and initiate a shut-down signal and sound an alarm. The limit switches for the pressure section shall be positioned to sense both belts simultaneously.

- Belt Tensioning

Each belt in the pressure section shall be equipped with a hydraulic cylinder belt tension system operated by the hydraulic power pack to automatically ensure proper preset belt tension while dewatering varying thickness of sludge. The belt tension system shall assure parallel movement of the tension rolls by use of rack and pinion system.

- Belt Press Drive & Component Operation

The belt press drive comprises of an electric geared motor unit coupled to the drive roll through a flexible coupling. A local electrical control panel complete with control logic, variable frequency drive etc. is also supplied along with the belt filter press.

- Painting

All MS parts (wherever applicable) shall be provided with one coat of epoxy primer and two coats of coal tar epoxy paint. The total DFT shall be minimum 225 microns.

Specification for Multi-Plate Screw Press Sludge Dewatering Machine

The rotation of the screw press shaft serves a dual purpose: firstly, it should propels the sludge

from the concentration section to the dewatering section, and secondly, it should constantly drives

the moving ring to clean the filtering gap, preventing any risk of clogging.

The core of the Screw Press Sludge Dewatering Machine consists of a filtration unit comprising fixed and moving rings, threaded through by the screw axis. The front section serves for concentration, while the rear section excels in dewatering. The filtration gap between the fixed ring and the moving ring of the dewatering screw press narrows gradually along the pitch of the screw axis, transitioning from a wider gap in the concentration section to a tighter gap in the dewatering section.

Following gravity concentration in the dedicated section, the sludge is conveyed to the dewatering section. As it progresses, the filtering gap and screw pitch gradually decrease, and the back pressure plate plays a vital role in generating substantial internal pressure.

This pressure causes a continuous reduction in volume, effectively achieving thorough dewatering.

Technical Specifications

Machine Configuration:

- Type: Multi-plate screw press
- Capacity: As per requirement
- Number of Screws: Single/Double/Triple screw as per capacity requirements

Material of Construction:

- Moving and Fixed Rings: SS304 with 3mm thickness
- Screw Shaft: SS304 with specialized alloy coating
- Flocculation Tank and Agitator: SS304
- 12.3 Auxiliary Components
- Automatic Spray Equipment: For cleaning
- Electrical Control Panel:
- Material of Construction (MOC): Carbon steel with powder coating

- Functions: Control the dewatering process with options for automatic and manual operation

Drive Motors:

- -Drive Motors for Screw with 3 – 5 rpm and Flocculator Agitator with 25 – 35 rpm: To be provided as per required capacity

Pipeline Connections:

- Material: SS304 or UPVC, as per application requirements.

4.4 Polyelectrolyte Dosing System

Polyelectrolyte shall be dosed online at the inlet of Centrifuge. Minimum dosage of polyelectrolyte shall be 1.50 – 2.50 Kg/Ton of dry solids in sludge at 0.1% solution strength. There shall one Solution Preparation Tank and one Solution Dosing Tank, each suitable for minimum 8 hrs. of operation and quipped with slow speed Mixer (100 RPM). The entire construction shall be in M30 grade reinforced cement concrete and as per IS 3370. RCC Platform/Walkway, minimum 1.00 m wide with Hand Railing as per specifications shall be provided. RCC Staircase, minimum 1.00 m wide with Hand Railing as per specifications shall be provided for access from Finished Ground Level to the top of the Unit & to the Operating Platform/Walkway.

Design Capacity	:	As required for 33.00 MLD Average Flow
Number of Units	:	2 Nos. Each
Hydraulic Retention Time	:	Suitable for min. 8 hours of Operation
Free Board	:	0.50 m minimum

The solution will be dosed using mechanically actuated diaphragm type Metering Pumps. Dedicated Dosing Pumps shall be provided and shall be interlocked with Centrifuge in such a way that they Start/Stop along with Centrifuge.

Capacity and Head	:	As required for 33.00 MLD Average Flow
Type	:	Mechanically Actuated Diaphragm Type Metering Pump
Liquid	:	Polyelectrolyte Solution of 0.1% Strength
Quantity	:	As per requirement + 1 Standby Minimum

red type with motor chain drive. The drive comprises Drive Motor, Reduction Gears, Chain and Sprocket. Power shall be transmitted by the SS 304 chain. The reduction gear shall be installed on the base for access for the tension adjustment. A protective cover made of SS304 shall be equipped for the drive motor, reduction gear and the chain. The rpm of the disc filter drive shall be adjustable by the inverter that is attached in the field control panel

Sr. No	Drive Data	Specifications

1.	Motor Specifications	Class F / IP 55
2.	Gear Box Specifications	Worm Gear, suitable
3.	Sprocket Drive Specifications	Worm geared motor Chain drive type
4.	Motor Protection	IP 55
5.	Material of Construction - Reduction Gear	Cast Iron FG 200
6.	Material of Construction - Chain & Sprocket	SS 304
7.	Rotation speed of filter disc &centre drum	<2 rpm

Backwash system

Cleaning device consists of Suction cleaning unit, which conducts the suction cleaning in each side of disc, the automatic valve and the suction cleaning pump. Cleaning device shall clean the contaminated filter cloth thoroughly by the suction unit on both side of disc with automatic valve and suction cleaning pump which shall be activated by the water level switch that contacts the water level raised with the increase of the loss of head. Disc filter should be operated for filtration without the stop during backwash and suction of sludge. Suction cleaning unit shall be made of or the even cleaning efficiency without dead zone for all area of filter cloth. Suction cleaning pumps shall be of submersible type and shall be directly mounted on the top of Filter unit. One pump shall cater to maximum two discs. Design should be such that suction cleaning pump discharge does not require any Auto motorised valves.

Sr. No	**Suction Cleaning Pump Details**	
1.	Pump Type	Submersible Vortex type
2.	Motor RPM	≤ 3000
3.	Type of Sealing	Mechanical Seal
4.	Class / Protection	Class F / IP 68
5.	Power Supply	415V x 3 ¢ × 50Hz
	Material of Construction Suction Cleaning Pump	
1.	Casing	Cast iron FG 200
2.	Impeller	CF8M
3.	Shaft	SS304
4.	Sleeve	SS304

Control panel & Instruments

Control panel shall be SS304, double door (Inner & outer door), IP55, self- standing, floor-mounted type in case if it is outdoor. Indoor control panels shall be CRCA, powder coated and self- standing, floor-mounted type. Control panel shall contain PLC, HMI (6", colour, touch screen), circuit breaker, relay, terminal blocks, push button switch, indication lamp, etc. on the door. Control panel shall accommodate an inverter/VFD to control the rotation velocity of the disc drive. Automatic/Manual switch and indication lamp shall be equipped in case of breakdown of the automatic interlocking device. Control panel shall have a nameplate displaying the name of the equipment; operation switch shall have a nameplate indicating its intended use.

1.	Control Panel Type	Self- standing type, Floor mounted Outdoor – Double door Indoor – Single door
2.	Control Panel MOC	Outdoor – SS304 Indoor – CRCA, powder coated
3.	Control Panel Protection	Outdoor – IP55
4.	Level Switch / Transmitter Quantity	Min 1 per stream
5.	Level Switch / Transmitter Type	Conductivity level switch / Hydrostatic level Transmitter
6.	Valve Quantity	1 Lot

Bidder shall provide disc filter based on above specification and in case of any minor changes in above specification based on OEM requirement then proper justification/documentation shall be provided for approval.

3.5 Plant Utilities

3.5.1 SBR Air Blower cum Administrative cum MCC & PLC/Control Building

The SBR Air Blower cum Administrative cum PLC/Control Building shall be G+1 type RCC (M30) Frame and Brick Masonry Structure. SBR Air Blower House, Workshop & Tool Room shall be constructed at ground floor whereas Administration Block (comprising Office, Conference Hall and Laboratory), PLC/Control Room shall be placed at first floor.

SBR Air Blower House shall house Air Blowers for SBR Basins. It shall be equipped with Rolling Shutters, UPVC Windows/Ventilators, Exhaust Fans and a Manual forklift of minimum 3 Ton capacity or 1.5 times the weight of Air Blower whichever is more. Similarly, PLC/Control Room shall be designed.

Laboratory shall be fully equipped with all necessary Equipments, Instruments, Chemicals, Reagents, Glassware and Furniture.

Adequate number of Toilets and Washbasins shall be provided separately for Men & Women at each floor. A covered Overhead Tank of capacity 5 m^3 shall be provided along with an Underground Water Tank of capacity 10 m^3 to cater to the water requirements of the Building.

In addition, the building shall be provided with Porch, Staircase, Passages, Wooden/Aluminium/Glass Doors / Windows / Ventilators and Safety Equipments including Sand Buckets, Fire Extinguishers, smoke detectors and Fire Alarms etc. Adequate Flooring shall be provided in various Rooms/Areas as per requirement or as per instructions of the Engineer-in-charge. Internal & External Plaster with Painting shall be done as per instructions of the Engineer-in-charge. Plinth Protection shall be provided along the periphery as per specifications.

The building shall be provided with the following:

Sr. No	Item of work	Work
1.	Personal Computer in PLC/Control Room	1no. of PC of latest configuration with 3nos. of 24" VDU along with 55 inches LCD display
2.	Printer in PLC/Control Room	1 No. of A3 Size Laser Printer of latest version & configuration complete.
3.	Telecommunication Facility	Min. 1 No Android Mobile with activated SIM any company where network is available /Telephone Line with a Broad Band facility with Wi-Fi router. The chargers will be borne by the Contractor up to the O & M Period.
4.	Plant Model	• 1 No. Wall Mounted Process Model (Electronic Plant Display Model) with Flow Diagram (Minimum size 3 m x 1.5 m) • 1 No. 3D Model with display of flow direction and lighting.
5.	Air Conditioner	Adequate nos. of Air conditioners shall be provided as directed by Executive Engineer.

3.5.2 Electrical HT Substation

The Electrical HT Substation shall be provided to house HT Components comprising Metering Kiosk, HT Panel, Outdoor Transformers and Power Control Centres. It shall be RCC (M30) Frame and Brick Masonry Structure equipped with Rolling Shutters, Windows/Ventilators, Exhaust Fans and Safety Equipments including Sand Buckets, Fire Extinguishers and Fire Alarms etc. complete.

Also, it shall be provided with IPS Flooring, Internal and External Plaster with Painting and Plinth Protection along the periphery as per specifications.

Separate HT panel and transformers shall be provided for STPs

3.5.3 DG House

The DG house shall be provided to house DG Set of adequate rating capable of running the entire STPs at Peak Flow including AMF Panel, Fuel Tank and other Accessories. It shall be RCC (M30) Frame and Brick Masonry Structure equipped with Rolling Shutters, Windows/Ventilators, Exhaust Fans and Safety Equipment including Sand Buckets, Fire Extinguishers and Fire Alarms etc. complete. Also, it shall be provided with IPS Flooring, Internal and External Plaster with Painting and Plinth Protection along the periphery as per specifications. Separate**DG shall be provided for STPs.**

3.5.4 Security Cabins

Security Cabin of size 3.00 m x 3.00 m shall be provided at each entry Gate of the Plant. It shall be RCC (M25) Frame and Brick Masonry Structure equipped with Doors, Windows/Ventilators, etc. complete. Also, it shall be provided with Flooring, Internal and External Plaster with Painting and Plinth Protection along the periphery as per specifications.

3.5.5 Schedule of Finishes

Sr. No.	Unit	Flooring	Doors	Windows/Ventilators
1.	Administrative Block, Laboratory, MCC Room, PLC & Control Room, Security Cabins	Marbonite flooring of approved make. The size of Marbonite tiles shall be min 800 mm x 800 mm & thickness min 10 – 12 mm	Solid Core Flush Door with heavy duty Brass Fittings of approved make	CPVCof approved make
2.	SBR Air Blower House, Workshop & Tool Room, Chlorinator cum Chlorine Tonner House, Sludge Pump Houses, Electrical HT Substation, DG House	IPS Flooring with Abrasion Resistant Additives of approved make	MS Rolling Shutter (See Through Type) of approved make	CPVC of approved make
3.	Centrifuge/ Filter press Platform	Anti-Skid Tile Flooring ofapproved make	---	---
4.	Vehicle Parking Area	Glossy Coloured Pre-cast Heavy Duty Paving Blocks with Lacquer Finish	---	---
5.	Toilet Blocks	Antiskid ceramic Tiles	UPVC of approved make	UPVC of approved make
6.	Staircase: Inside Building	Granite or approved stair case tiles.	---	---

3.5.6 Roads, Pathways & Vehicular Parking Area

All internal Roads shall be provided with Drainage and constructed to prevent standing water. All Roads shall be minimum 4.0 m wide CC. The first layer at the bottom in CC road shall be provided CC 1:2:4 as levelling course of depth 15 cm and top layer of the CC shall be provided M-20 Grade of 20cm thick.

Pathways shall be constructed interconnect the entire Plant with Roads. Minimum width of pathways shall be 2.00 m. Pathways shall be in coloured Pre-cast Heavy Duty Paving Blocks with Lacquer Finish. All the pathways to be provided with M 15 base course with side beams.

Vehicle Parking Area shall be provided to permit the parking of Vehicles in coloured Pre-cast Heavy Duty Paving Blocks with Lacquer Finish.

The entire system of Roads, Pathways and Vehicle Parking Area shall be designed such that Vehicles involved in the delivery of Materials, Chemicals, Consumables and Residual Disposal can continuously route through the Works and get out again.

Layout of road shall be in such a way that there shall not be any obstacles in operation of golf carts.

3.5.7 Storm Water Drainage

Adequate Storm Water Drainage shall be provided adjacent to the Internal Roads considering local rainfall intensity with 100% runoff. It shall be in RCC Class NP 3 pipe of min 600 mm dia. with necessary Chambers at appropriate locations. These Chambers shall be covered with CI Gratings. This Storm Water Drainage shall be connected to the nearby Storm Water Drain or Channel of City Network.

3.5.8 Boundary Wall with Gate

Boundary Wall shall be constructed all around the STPs plot. Boundary Wall having architectural and elegant view shall be provided along entire periphery of the Plot. Height of boundary wall should not be less than 2.0 m from finished ground level. And barbed wire in 7 rows shall be provided at the top of boundary wall and it shall be fixed on M.S. angle in Y-shape Also, size of angle shall be provided 50x50x6 mm, before execution of work the section of boundary wall with barbed wire fencing shall be guard approved from Engineer-in-charge. It should be able to bear wind pressure up to 80 Km/hr. At least two Entry Gates, 3.60 m wide each shall be provided. Each Entry Gate shall be provided with a Wicket Gate. Minimum length of boundary wall to be considered for STPs Area shall be 600 m.

3.5.9 Internal Water Supply and Water Supply for Gardening

Proper water facility shall be provided at STPs. Rate of water supply may be kept as 150 Liter per capita per day for a population of 20 people. Storage should not be less than 1000 litres. Water supply for gardening purpose may be from treated final sewage in sufficient quantity.

3.5.10 Disposal of Plant Residuals & Treated Sewage

Plant Residuals (Screenings, Grit and Dewatered Sludge) and treated sewage after chlorination shall be the property of the KMC. However, the Contractor shall be responsible for disposal of Plant Residuals within 10 Km from Site. The Contractor may sell off the Dewatered Sludge (As Manure) but at the discretion of the KMC.

3.5.11 Landscaping

Landscaping involves beautification of Sewage Treatment Plant site by cultivating lands, plants and trees of environmental value and suitably modifying the appearance of STPs site. It shall add scenic value to the STPs site to obtain maximum visual impact. Contractor has to develop proper landscaping in the STPs site from professional landscaper approved by KMC. Area for future expansion shall Also, be considered for landscaping. Plantation shall be done near compound wall for which space between compound and plantation shall be maintained about 1m.

3.5.12

3.5.13 Interconnecting Piping and Valves

All interconnecting Piping, Gates, Valves, Specials and other appurtenances, auxiliaries and accessories required as per Process Design and Scope of Work. In case of Rising Mains, thrust blocks shall be provided wherever required. In case of buried Pipes, warning tapes shall be provided of the appropriate colours. The material of construction for major interconnecting Piping shall be as follows

Piping: Guide Line for Velocity

Sr. No.	Service	Design Velocity m/s	Limitations
1.	Gravity Lines for Sewage & Water	0.6-1.2 Designed as pipe line flowing full.	Min. Velocity shall not be less than 0.6 m/sec. Max. Velocity up to 1.2 m/sec is allowable at Peak Flow.
2.	Pressure Lines for Sewage & Water	0.6 – 2.5	Min. Velocity shall not be less than 0.6 m/sec. Max. Velocity up to 2.5 m/sec is allowable at Peak Flow.
3.	Air (Pressurized Lines	18 – 22	Max. Velocity shall not be more than 25 m/sec in any section.
4.	Scum & Sludge Lines	0.6 – 1.5	Irrespective of flow, Diameter shall not be less than 150 mm for Gravity Lines.
5.	Chemical Feed Lines	0.6 – 1.5	Irrespective of flow, Diameter shall not less than 20 mm.

Notwithstanding the above, the Contractor shall submit a Pipe Line 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 guide lines. The Bidder can make suitable selection depending on Service, Type of Flow (i.e. Gravity or Pressurized) and Diameter of Pipe.

Piping: Guide Lines for MOC (Material of Construction)

	Service	Type of Flow	MOC
1.	Waste Water / Sludge	Gravity	RCC NP-3 Class
2.	Waste Water / Sludge	Pressurized	CI Class "LA" / DI K-9
3.	Service Water	Gravity / Pressurized	GI "C" Class
4.	Air Lines: Headers, Vertical Down-comers	Pressurized	**Above Water:** MS Sand/Shot Blasted, Epoxy Painted **Under Water:** SS 304
5.	Air Grid Piping: Aeration Zone	Pressurized	UPVC Schedule 40
6.	Air Grid Piping: Selector Zone	Pressurized	SS 304
7.	Chemicals	Gravity / Pressurized	SS 304 except Chlorine & FeCl3
8.	Chlorine & $FeCl_3$	Gravity / Pressurized	Schedule 40 UPVC

Valve: Guide Line

Sr. No.	Service	Type	MOC	End
	Sewage / Sludge			
1.	Gravity / Pressurized	Knife Gate	CI Body & SS 304 Gate & SS 410 Spindle	Flanged/Wafer
2.	Delivery of Pump	Swing Check	CS Body & SS 304 Internals	Wafer
3.	Suction & Delivery of Pump	Knife Gate	CI Body & SS 304 Gate & SS 410 Spindle	Flanged/Wafer
B	**Service Water**			
1.	Gravity / Pressurized	Ball	CS Body & SS 304 Internals	Flanged/ Screwed
2.	Delivery of Pump	Swing Check	CS Body & SS 304 Internals	Wafer
3.	Suction & Delivery of Pump	Butterfly	CI Body & SS 304 Internals	Wafer
C	**Air**			
1.	Pressurized	Ball	CS Body & SS 304 Internals	Flanged/ Screwed
2.	Delivery of Blower	Swing Check	CS Body & SS 304 Internals	Wafer
3.	Suction & Delivery of Blower	Butterfly	CI Body & SS 304 Internals	Flanged
D	**Chemicals**			
1.	Gravity / Pressurized	Ball	As per Chemical Compatibility Chart	Flanged
2.	Gravity / Pressurized	Diaphragm	As per Chemical Compatibility Chart	Flanged
3.	Gravity / Pressurized	Plug	As per Chemical Compatibility Chart	Flanged

Notwithstanding the above, the Contractor shall submit a Valve Schedule with Tag No., Flow, Size, Type, and Material of Construction, End Connection etc. with detailed P & ID for approval of the Engineer-in-charge prior to any further engineering or procurement/fabrication and installation.

3.6 Electrical & Instrumentation Works

It shall be the Contractor's responsibility to obtain adequate incoming HT power from State Electricity Authority based on the maximum demand load. The KMC will pay the charges for obtaining the above connection whereas necessary licencing for the same shall be done by the Contractor in consultation with Engineer-in-charge.

Two nos. of Transformers (1W + 1SB) for full load of the plant with 20% overload shall be provided**withAuxiliarytransformers**. **Separate transformers shall be provided for STPs.**These shall be step down Transformers suitable for outdoor installation manufactured in accordance with IS 2062/1962 and as modified from time to time. They shall be supplied with all accessories and mounting as per IS 2062 and shall Also, have Dial Thermometer, Bucholz Relay, Rollers and Explosion Vent. Each Transformer shall be provided with off load tap changer for ± 2.5%. The windings shall be of connections as per vector group DY II. The efficiency of the Transformer at 100%, 75% and 50% loading should Also, be indicated separately. The Transformer should be tested as per I.E. Rules & Regulations. Suitable cable boxes for H.T. and bus ducting for L.T. side be provided.

The entire Plant shall be operated on 415 V, 3-Phase, 50 Hz, 4-Wire system. The Contractor's Scope of Work shall include the following:

- Obtaining incoming HT Power from State Electricity Authority including necessary lesioning, documentation etc. complete.
- HT Cable with Termination Kit from "Source" to the Electrical HT Substation located at the Sewage Treatment Plant.
- HT Substation including 4-Pole Structure, Metering Kiosk, HT Panel, Transformers, Power Control Centre etc. complete.
- Motor Control Centres.
- Cabling including Power, Control and Instrumentation Cables.
- Earthling for Electrical equipments as well as Instruments.
- Internal Lighting in Buildings.
- External Lighting.
- Local Push Button Stations near respective Drives.
- Any other item / accessories required for successful completion of the Project.

The Contractor shall design/execute the System as per standard specifications, I.E. Rules and Regulations, requirements of State Electricity Board and other local Authorities and actual site conditions.

- Also, the Contractor shall provide adequate automation for fully automatic operation of the entire Sewage Treatment Plants including Primary Treatment Units, Biological Treatment Units based on SBR technology, Chlorination Tank, Sludge Dewatering Units, Power source through a one Programmable Logic Centre (PLC) and Supervisory Control and Data Acquisition (SCADA) with Man-Machine Interface (MMI). Provision shall Also, be made to operate each Unit of the Plant manually, if required.Remote monitoring shall also have to be provided on static IP on iOT using cloud tunnel.

3.6.1 PLC/PC/SCADA BASED AUTOMATION SYSTEM FOR ENTIRE PLANT

The complete Plant shall be designed for automatic operation through Programmable Logic Control (PLC) and Supervisory Control and Data Acquisition (SCADA). This shall be achieved by either individual equipment PLCs with SCADA/HMI or single PLC and SCADA for entire Sewage Treatment. These shall be located at control room of the STPs.
The plant shall have provision for operations in following modes –

1. Automatic – Auto operation through PLC/digital controller.
2. Manual – Operator intervention through SCADA/HMI.
3. Local – Local operation through local control panel located near equipment.

Audio Visual Alarms –

Audio visual alarms shall be initiated under emergency or equipment trip conditions, other than usual service alarms. Salient features of the proposed control system shall be as follows:

- Dynamic display of all Units, equipment and drives shall be available on SCADA screen.
- It shall Acquire, process and manage the processed data.
- It shall safeguard the process by means of interlocks and alarms.
- Auto/Manual operation of each drive shall be made by selecting a soft switch on SCADA/HMI screen.
- In Auto mode, each drive shall operate based on pre-set sequence and interlock. Also, automatic change over from working to standby drive shall happen after a drive reaches pre-set hours of operation.
- In Manual mode, each drive shall be operated in Local/Remote mode by selecting a soft switch

on SCADA/HMI screen. In Local mode, each drive shall be operated from the Local Push Button Station (LPBS) located nearby. In Remote mode, operation from LPBS shall be disabled and each drive shall be operated manually from PLC. Also, provision for working/standby selection of drives by selecting a soft switch on SCADA screen shall be provided.

- Run/Trip indication of all drives shall be displayed on SCADA/HMI screen.
- Open/Close indication of all Auto Sluice Gates and Auto Valves shall be displayed on SCADA/HMI screen.
- Annunciation & Alarm facility shall be available in PLC/HMI/SCADA. In the event of a Fault, the symbol representing the equipment/drive shall continue flashing on SCADA/HMI screen with equipment/drive description appearing at bottom of the SCADA/HMI screen and electric Hooter shall continue blowing until the Fault Alarm is acknowledged.
- Data logging of Running Hours of each drive, Alarms, Historical Trends of monitored Parameters, etc. shall be envisaged in SCADA.
- Report generation for plant performance.

The process system must have pre-configured software packages which can be adapted to the process by parameterization.

The monitor images must be designed to be user-friendly by hierarchical breakdown with the possibility of selective display and optimum selection possibilities.

Changing of parameters and other software units must be possible "online", i.e. with the system running.

Different alarms colors provide information on their priorities.

For the system engineering offered, the Contractor must take measures, e.g. by the installation of surge voltage arresters or surge voltage filters, to ensure that internal and external surge voltages do not impair the function of his parts of the system.

The programs and data entered must be backed up in a non-volatile read-only memory.

A limit value and plausibility check must be provided in the software of the process station for the measured values and messages. Exceeding of limit values or deviations detected by the above checks must trigger an event and cause a message to be sent.

Further demanded features of the process system:

- Integrated, detailed error message and fault detection concept with display on the HMI/SCADA for quick localization of faults. The system operator must be able to identify the fault from the error.
- Essentially maintenance-free
- Robust against external interferences of all kinds
- Proven design and solder-free connection technique
- Protection of the equipment against surge voltages
- Automatic fault detection and quick troubleshooting in the PLC system by integrated, hierarchically structured diagnostic devices
- Power supply in wide admissible voltage range
- Simple function-oriented operation

The process system (PLC, HMI/SCADA) shall be protected against power failure by an uninterruptible power supply (UPS). When the critical charge state of the UPS is reached, the process system is automatically shut down.

Mode selector switch

A mode selector switch is to be installed on the MCC or distribution board. It serves for pre-selection between Automatic mode and Manual/Local mode.

The following switching functions must be provided:

Automatic – Manual/Local

- Automatic: In this position, only automatic operation is possible; the local switches have no function (Except emergency stop).
- Local: Automatic mode cannot be started. The drives can be operated individually without interlock with the local switches.

Local switches (LPBS)

Each drive must be equipped with a local switch positioned in such a location that the corresponding machine or conveyor can be switched on in Manual/Local mode and can be monitored visually at all times.

The local switch must have the following switching functions:

START – STOP (for drives with one direction of rotation)or

FORWARD – STOP - REVERSE (for reversible drives)

- If a unit has several drives (e.g. conveyor belt drive and travel drive), the local switches should be installed if possible in one switch box or at least installed next to one another.
- Each local switch must be adequately labeled in plain text so that no operator errors can occur.

3.6.2 PLC

The automatic start-up of the whole system, sequential operations and the automatic shutdown, allowing for external control influences, e.g. EMERGENCY STOP, etc., is performed by programmable logic controller (PLC).

This performs not only the control of the system, but also, the display of the operating state in the HMI/SCADA.

The interlocks of the individual process groups and their signaling must be performed by the PLC. A system must be selected which is sufficiently protected against external interference in the supply, control and signaling lines. The aim is that the program can continue to run without fault signals in the event of transient earth faults in the supply grid. In the event of prolonged power failures, on the other hand, a controlled restart must be triggered (under-voltage trip of the non-automatic circuit breaker).

PLC Specifications: Technical

- The PLC shall be non-redundant.
- PLC of individual equipment shall be selected to carry out necessary operations without overloading the PLC memory.
- The PLC shall have adequate I/O per card.
- There shall be 20% spare I/O of each type.
- The CPU shall not be loaded more than 60% of its capacity.
- Retentively shall be 100% to save the recorded data and saving the programmed logic, other attributes connected with system for power & system failure.
- Change in programme / modifications to programme shall be possible by a portable laptop.
- It is preferred to have all PLC's in the plant from same manufacturer.

3.6.3 HMI/SCADA system

The HMI system shall be designed as a minimum 10", color, touch-screen on the panel. Whereas SCADA system must be computer based.
All displays must be designed by the Contractor with graphic sophistication and all texts in the visualization system must be displayed in English.
A sub-menu for each operating mode and further menus for editing the system parameters, fault archive, etc., must be developed. It must be as simple as possible to switch between the various menus and to edit the system parameters.

When designing the user interface or the assignment of the function keys, attention must be paid that the function key assignment remains the same in all sub-menus so that it is possible to jump to another menu without first having to jump back to the main menu.

It must be possible to edit the following parameters at the touch-panel and SCADA:

- Operating mode
- Changes in the speeds of frequency converter-controlled equipment
- Start-up times
- Shutdown times
- Duration of the operation of warning devices
- Limit values for sensors, etc.

Faults, level messages, pressed EMERGENCY STOP buttons, etc., must Also, be clearly displayed at the bottom of the screen, irrespective of the selected screen page or sub-menu.
It must be possible to output all important menu items to the printer. The corresponding interfaces must be provided.
The display of the function plans, images, etc. is affected in direct dialog with the system by means of the mouse and keyboard.
The central SCADA shall generate various reports to analyze plant performance. The process is documented via the laser printer.

3.6.4 Computer hardware and software

All programs required for operation of the system must be correspondingly compatible. The corresponding licenses must be supplied for the standard programs. The operating systems must be agreed upon with the Client. Minimum requirements shall meet:

CPU		
1.	CPU	
2.	Processor	Intel i7 or higher
3.	Processor speed	2 GHz or higher
4.	Configuration	Tower
5.	Architecture	32/64 bit
6.	System memory (RAM)	16 GB or higher
7.	Hard disk	1TB or higher

8.	Operating system	Microsoft Windows 10 professional
9.	Communication ports	USB – 4Nos., Ethernet – 3Nos.
10.	Graphic accelerator	4 GB
11.	Power supply	240V, 50Hz, 1Phase
12.	Keyboard	Internet Keyboard (with USB interface)
13.	Mouse	Optical, 3 buttons (Cordless)
Monitor		
14.	Type	Full HD LED colour monitor
15.	Screen size	72" or higher
16.	Resolution	1920 x 1080 4K
17.	Power supply	240V, 50Hz, 1Phase

Complete Project shall operate in auto mode. As a minimum, following controls must be considered in Bidder's Control Philosophy:

1. Wet well and Pumps

All the pumps shall be fitted with measuring equipments and automatic operation

2. Inlet chamber

A clamp on type Ultrasonic or Electromagnetic flow transmitter shall be provided on inlet pipe of inlet chamber for measurement of flow coming to Sewage Treatment Plant. PLC shall calculate instantaneous flow as well as cumulative flow, both shall be displayed on SCADA.

3. Fine screens

Each mechanical fine screen shall be installed with ultrasonic differential level transmitter /level switch, across it; the same shall be operated on the basis of set level in SCADA. Also, if level is not reached for certain time period, the screen shall be operated on the basis set time in SCADA.

The selection of Auto/Manual and Working/Stand-by shall be made available in SCADA. In manual mode the screen operation will be done from SCADA screen. Physical switch over of screens in plant will be done by operator using manual gates.

Necessary interlocks, controls, alarms, report generation, etc. shall be considered in PLC for auto operation of fine screen.

4. Grit Chambers

Each grit chamber will consist of Detroiter (1No.), Organic Return Pump (1No.) and Screw Conveyor for grit removal (1No.). As such Detroiter, Organic Return Pump and Screw Conveyor will not have auto operation; these will be started and stopped from SCADA screen as required.

Necessary interlocks, alarms, report generation, etc. shall be considered in PLC for operation of Grit chamber equipment.

5. SBR Basin

Complete operation and control of SBR plant will be done through a separate PLC and SCADA. However, it shall have necessary inputs and generate required outputs to operate in co-ordination upstream and downstream units of balance plant.

Alternatively, contractor may provide single PLC and SCADA for entire Sewage Treatment Plant.
Necessary interlocks, controls, alarms, report generation, etc. shall be considered in SBR PLC for auto operation SBR basin.

Each SBR basins shall be equipped with Level Transmitter, DO Transmitter for monitoring and recording of critical operation parameters through SCADA.

6. Sludge sump and pump

An ultrasonic type level transmitter shall be used for measurement of level in sludge sump. Screw pumps will be used to feed sludge to Centrifuge. These will operate as per level in sludge sump.

The selection of Auto/Manual and Working/Stand-by shall be made available in SCADA for sludge pumps. In manual mode the Start/Stop of pump will be done from SCADA screen.

Necessary interlocks, alarms, report generation, etc. shall be considered in PLC for operation of chlorination system.

7. Chlorination tank

The selection of Auto/Manual and Working/Stand-by shall be made available in SCADA for booster pumps. In manual mode the Start/Stop of pump will be done from SCADA screen. Though chlorinator will have standalone operation, feedback for the equipment shall be taken to PLC and displayed SCADA for monitoring purpose.
Necessary interlocks, alarms, report generation, etc. shall be considered in PLC for operation of chlorination system.

8. Centrifuge/ Filter Press

The drives and instruments of centrifuge/ filter press shall be connected to PLC for its auto operation. Starting of dewatering system will be a manual process.
Necessary interlocks, alarms, report generation, etc. shall be considered in PLC for auto operation of centrifuges.

9. **Power Sources**

The transformers and DG sets are to be hardwired to communicate with the PLC controller.The fuel consumption of the DG set is also to be communicated to the PLC controller

A. SPECIAL TECHNICAL SPECIFICATION FOR ELECTRO – MECHANICAL WORK(SEWAGE TREATMENT PLANT) (PART B)

1.0 General Requirements

1.1 Material

All materials incorporated in the Work shall be the most suitable for the service conditions and duty concerned. They shall be new and of reputed make / approved quality, free from imperfections and selected for long life and minimum maintenance. Non–destructive tests, if called for in the Specification, shall be carried out. All submerged moving parts of the Plant, or shafts and spindles or faces etc. in contact with them shall be of corrosion resistant materials. All parts in direct contact with various chemicals, shall be completely resistant to corrosion, or abrasion by these chemicals, and shall maintain their properties without aging due to the passages of time, exposure to light or any other cause. All materials shall conform to the material standards as per BIS or any equivalent standard.

1.2 Workmanship

Workmanship and general finish shall be of first class quality and in accordance with best workshop practice. All welds shall be as per IS, BS, ASME standards. All tolerances and clearances shall be as per good and sound engineering practices. Should the KMC's representative not consider any material acceptable, it shall be replaced.

1.3 Design Features

As far as practicable, all designs shall be as per latest concept and practices. The equipment shall be new, of robust design for a long reliable operating life. These shall be capable of 24 hours per day continuous operation for prolonged period in the climatic and working conditions prevailing at the site and with a minimum of maintenance. Particular attention shall be given to extra temperature and the rating of electrical and mechanical equipment, cooling systems and the choice of lubricants shall be for the temperatures as specified.

Paints used shall be the manufacturers' standard and shall be suitable for duty as described. The equipment shall be designed to provide easy access to and replacement of component parts which are subject to wear without the need to replace whole units. All parts in contact with water shall have a life from new to replacement for 5 years minimum and new to repair of not less than five years.

Design features shall include the protection of equipment against damage caused by vermin, dirt, dust and dampness and to reduce risk of fire. Equipment shall operate without undue vibration. Noise reduction measures shall be adopted such that levels of 75 dB (A) at 3 meters are not exceeded. Parts shall be designed to withstand the maximum stresses under the most severe conditions of normal service. Materials shall have a high resistance to change in their properties due to the passage of time, exposure to light, temperature and any other cause which may have a detrimental effect upon the performance or life of the Plant.

All rotating elements shall be dynamically and statically balanced.

All equipment shall have name plates specifying the makes, model, rating and other pertinent information.

1.4 Lubrication

The equipment shall be lubricated by long life lubricants such that working life is not less than 3000 operation hours or as recommended by equipment manufacturer.

A complete schedule of recommended oils and other lubricants shall be furnished by the Contractor. The number of different types of lubricants shall be kept to a minimum. The schedule and the name of the supplier of the lubricants shall be submitted to the KMC's representative for approval.

Lubricants shall be oil and grease. The Contractor shall indicate indigenously available equivalent lubricants, with complete specification.

Where the lubricant is grease, preference shall be given to a pressure system which does not require frequent adjustment or recharging. Preferably, life lubricated grease packed bearings shall be used.

Where more than one special grease is required, a grease gun for each special type shall be supplied and permanently labelled.

1.5 Name Plates

Each equipment of the Plant shall have permanently attached to it a nameplate and rating plate in a conspicuous position, Upon these shall be engraved or stamped, the manufacturers name, type and serial number of the equipment, details of the loading and duty at which the equipment has been designed to operate, and such diagrams as may be required by the KMC's representative. All indicating and operating devices shall have securely attached to them or marked upon them designations as to their functions and proper manner of use.

1.6 Painting

At Manufacturer's Works:

The Contractor shall be responsible for the cleaning, preparation for painting, and priming or otherwise protecting, as specified, all parts of the Plant/ Equipment at the place of manufacture prior to packing.

Parts may be cleaned but surface defects may not be filled in before testing at the manufacturer's works. Parts subject to hydraulic test shall be tested before any surface treatment. After testing, all surfaces shall be thoroughly cleaned and dried out, if necessary by washing with an approved de-watering fluid prior to surface treatment. Except where the specification provides to the contrary, all painting materials shall be applied in strict accordance with the paint manufacturer's instructions.

Steel and cast iron parts shall be sand blasted to near white cleaning before painting. Edges, sharp corners etc. shall be ground to a curve before sand blasting. A primer coat of a zinc rich epoxy resin based coating with at least 75 microns dry film thickness is to be provided. In addition, the parts for wet duty are to be provided with an adequate number of coats of coal tar epoxy polyamine coating to a dry film thickness of 175 microns excluding primer coating.

1.7 At Site:

Immediately on arrival at the site, all items of Plant shall be examined for damage to the paint coat applied at the manufacturer's works. Any damaged portions shall be cleaned down to the bare metal, all rust removed, and the paint coat made good with similar paint.

After erection, such equipment/ items which are not finish painted shall be done so. Items that

have been finish painted at the manufacturer's works shall be touched up for any damaged paint work. For finish painting, two coats of synthetic enamel conforming to IS: 2932 shall be applied. Dry film thickness of each coat shall be at least 25 microns.

The dry paint film thickness shall be measured by Elcometer or other instruments approved by the KMC's representative. In order to obtain the dry film thickness specified, the Contractor shall ensure that the coverage rate given by the paint manufacturer will enable this thickness to be obtained. Strength of adhesion shall be measured with an adhesion tester and this value shall not be less than 10 kg/cm2. Painted fabricated steel work which is to be stored prior to erection shall be kept clear of the ground and shall be laid out or stacked in an orderly manner that will ensure that no water or dirt can accumulate on the surface. Suitable packing shall be laid between the stacked materials. Where cover is provided, it shall be ventilated.
Acceptable Makes: - Berger/ Shalimar/Asian/ /Neroalc

1.8 Galvanising

Wherever galvanizing has been specified the hot dip process shall be used And electro-galvanized parts, equipment shall not be permitted. The galvanized coating shall be of uniform thickness. Weight of zinc coatings for various applications shall not be less than those indicated below:

a) Fabricated steel : 460 gms/sq. m
b) Fasteners :300 gms/ sq. m

Galvanising shall be carried out, after all drilling, punching, cutting, bending and welding operations have been carried out. Burrs shall be removed before galvanizing. Any site modification of galvanized parts should be covered well by zinc rich primer and aluminium paint.

1.9 Supports for Pipe Work & Valves

All necessary supports, saddles, slings, fixing bolts & foundation bolts shall be provided to support the pipe work. Valve and other equipment mounted in the pipe work shall be supported independently of the pipes to which they connect.

All valves to be installed in straight lines shall be installed between the flanges with a dismantling joint or SS expansion bellow at one side of the valve. The dismantling joint must allow a minimum clearance of 20 mm. The pressure rating of the dismantling joint / expansion below shall be same as that of the valve.

2.0 Mechanical & Manual Coarse Screens

2.1 Purpose & Scope:

a. Mechanized screens should be suitable for installation in Sewage pumping stations for removal of floating wastes coming along with sewage. These screens should be capable to screen out most of the medium and large floating material such as plastic bags, floating debris, weeds, paper wastes, clothes and rags etc. which are generally clogging the impellers of the pumps installed downstream of the screens.

b. The operation of the screen shall be automatic. An ultrasonic type differential level controller / level switch shall be provided to sense the head loss through the bar and give the signal to the traveling raking mechanism to start its operation. The sensor will signal the raking mechanism to operate continuously till the head loss is reduced to a preset level.

c. A complete electrical control system shall be supplied with each screen and shall be mounted independently near to the screen installation. The system shall provide for total automatic operation of the screen with the feedback from the level controller. Alternatively,multi-rake screens can also be provided.

2.2 General Material and Equipment Requirements:

a. Fabrication and design features:

(i) Use power grinder to dull and produce smooth edges.
(ii) Use bolted field connections. Field welding will not be allowed.
(iii) Design all components for continuous 24 hours per day service.

b. The screen shall be so constructed so as to mechanically remove the waste from the bottom most portion of the bar portion using a traveling type raking mechanism without shutting the water flow through the screen. The raking mechanism shall then travel up to the top of operating platform and automatically discharge the waste through a discharge chute.

c. The screen shall have protection against overload conditions, which might damage the equipment.

d. All screens shall be constructed and shipped as an integrated product comprising of frame structure and guides, rake and rake arm mechanism, dead plates, cog wheels, sprockets and chains, discharge chute, drive unit and cover apron.

e. The screen shall be supplied factory assembled and duly tested at manufacturer's works before dispatch. This integrated and factory assembled screen shall involve minimum dismantling and assembly at site for erection.

f. Upon receipt at site these shall be installed resting on the channel floor and mechanically or chemically anchored to the parallel sidewalls of the channel (without making grooves in concrete or breaking open the concrete side walls and thereby weakening the civil structure) in a way that there are minimum chances of misalignment.

g. All parts shall be designed to withstand the stresses that will be imposed upon them during handling, shipping, erection and operation.

h. All stainless steel fabricated materials will be pickled and passivated before dispatch to remove ferrous contamination, if any.

2.3 Specifications :

a. Material of construction:

All parts of screen including fixed bars, raking mechanism, screen frame and guide rails,

dead plate and discharge chute shall be constructed from stainless steel material SS304 for long life in aggressive sewage environment. Suitable measures should be taken to ensure long life of parts like bearing, chains, sprocket and cogwheels etc, which are not made from stainless steel material.

b. Drawings & Documents:

Drawings for the following shall be submitted for approval before taking up manufacturing of Screens:

General Arrangement drawing of screens.
Bill of Materials (BoM) & Wiring diagram of control panels.
Quality Assurance Plan.

All drawings shall be submitted in 3 copies of which one will be returned duly commented / approved.

Approval of manufacturer's drawings shall not relieve the manufacturer of his responsibility for supplying equipment confirming to the Technical Specification laid herein for any mistakes, errors or omissions in his drawings.

c. Screen Construction:

- The bars shall be designed to have a tear drop profile so that they are wider on the upstream side and narrower on the downstream side. This is required to ensure that choking of bars due to stones and other hard material does not take place. The tear drop profile shall be 12 mm wide in the front and 10mm wide at the back and the depth of bars should be at least 60 mm.
- The bar rack shall be firmly anchored to the channel floor and supported by a dead plate at the top.
- The face of bars towards the incoming water should be half round (Dia 12 mm) to ensure minimum resistance to the flow and avoid turbulence and Also, to offer guide and support to the rake during its travel.
- The rake shall be made of Ultra High Molecular Weight Poly Ethylene (UHMWPE) so as to avoid the Galling between rake and bars. Further to this the rake should be provided with rounded off cavity to match the bars with a view to avoid sharp corner contact between the rake and bars thereby minimizing wear and tear.
- The rake arm shall ride on a cogwheel / roller in a single guide channel (min. thickness 5 mm in stainless steel) on each side of the rake and will be lifted away from the dead plate on the downward travel direction. Upon reaching the bottom of its travel the rake would be rotated/ swung into the bar screen to remove the collected debris.
- To effectively remove the debris from the bottom most part of the bar screen, the rake should engage with the bars from the start of its inwards rotating motion. To achieve this, he fixed bars should be curved at the bottom and taken forward so as to enable the rake to engage from the start of its inwards rotating motion.
- The rake arrangement shall be spring loaded to ensure that the rake is always pushed on to the dead plate.
- The dead plate shall be minimum 3 mm thick in stainless steel shall be suitably braced to ensure rigidity and prevent caving / bending due to increased water flow in monsoon.
- The sprocket for screen chains shall have chilled tooth bearing surfaces and the chain and sprocket shall be of the same material.
- The cogwheel and chains should be so located that these generally remain out of the flow of water during normal plant operation. An exception to this would be allowed only in case when water depth is greater than 2 m.

- The screen should have integrated scraper for discharging the screenings to discharge chute. The scraper / wiper shall be cushioned during travel to the rest position by a shock absorber.
- The rake mechanism should be operated by an Electro brake motor and be suitable for automatic operation controlled by a level sensor and electric control cabinet. Torque switch should be provided to protect the screen from damages resulting from excessive torque.
- The screen shall be provided with non-corrosive apron and enclosure at the top above the platform.

After fabrication and assembly, the stainless steel parts and all welded joints are to be further cleaned by acid pickling and after that they should be passivated to remove any ferrous contamination that might have taken place during manufacturing / handling / movement of raw and fabricated material.

d. Level controller

The level controller shall be of ultrasonic differential type / level switch.

e. Electrical motor

The motor shall be of TEFC type with IP 55 protection and suitable for operation on 415V±10% and frequency of 50 Hz ± 5%.

f. Control Panel

The control panel shall have IP 65 protection, painted with epoxy paint and shall be comprising of

- Mushroom head emergency stop.
- Overload relays for motor protection.
- Circuitry to operate the screen with ultrasonic level sensor.
- Selector switch to operate the screen in Auto, off and JOG mode.
- Provision to run the screen on timer in case of failure of level sensor.

g. Shop Testing

The screen should be completely manufactured and offered for inspection at the plant of the manufacture confirming the above mentioned eligibility criteria. A screen assembled by a vendor and offered for inspection at the plant of a vendor / sub-contractor shall not be accepted. The screen shall be subjected to following tests at manufacturer's premises by third party inspection and / or Municipal Corporation representative(s):

- Dimensional Check: The overall dimension of the screen shall be conforming to the approved drawings.
- Operational Test: The complete screen including its carriage, rake, drive system and brake motor shall be mechanically operated and tested to verify interference free movement and satisfactory operation.

2.4 Miscellaneous:

Any type of work, either supply and or erection of material / equipment which have not been specifically mentioned in this specification, but are necessary to complete the works for trouble free and efficient operation and guaranteed performance of the entire plant system and equipment offered shall be deemed as included within the scope of this specification and shall be provided by tenderer without any extra price to purchaser.

The installation and commissioning of screens has to be done in the presence of manufacturer's

representative(s) so as to avoid any possibility of misalignment and faulty installation. Minimum two (2) working days of training has to be imparted to the concerned Municipal Corporation people by the manufacturer's representative(s). Packing of screens and allied accessories shall be transit worthy to avoid any possibility of damage during the transportation to the site(s).

2.5 Manual Bar screen

The manual bar screen will be of opening not more than 20 mm for coarse screen and 10 mm for Fine screen and inclination about 55^0 with respect to horizontal. Specifications for Manually raked screen shall be as under.

The trash screen shall be rectangular in shape. The screen shall be fabricated out of stainless steel SS 304 of not less than 10mm thick and 75 mm wide in section. The screen shall be rigidly fixed to the frame and provided with 2 sets of cleaning rakes.

2.6 Mechanical fine Screens

2.6.1 Step/Mat Type

General :

Mechanically operated step Screen completely made of Stainless Steel having 6 mm clear spacing between the bars shall be provided in inlet screen channel for screening out floating materials such as plastic pouches, bags, rags, floating debris, weeds, paper wastes and other floating materials from the raw sewage coming from the pumping station / gravity mains.

The screen shall include discharge chute as required to discharge the screenings in the bin without employing any external mechanism / rake mechanism.

The screen shall be factory assembled & movement tested at plant before dispatch to site & shall only be installed at the site in factory assembled condition thereby avoiding chances of misalignments.

Scope :

Design, Supply, Installation, Testing & Commissioning of screening equipment consisting of following:

Mechanized step screen having 6mm spacing between bars and suitable for installation at an inclination of 40 degrees in channel.

Level sensing instrument connected to control panel for automatic operation of screen mechanism and allied accessories.

Local control panel installed near screen.

To discharge the screened material of the screen to the waste bin.

Specification

Material of construction:

The fixed as well as movable bars, mechanism, support frame, fixings discharge chute shall be manufactured from stainless steel for long life in the aggressive sewage environment. No component of the screen assembly shall be made of carbon steel or any other material, which can get corroded in sewage environment.

Screen Construction

The step screen shall be a complete unit comprising of main frame with an integral mechanism containing movable bars located in between fixed bars without engagement of external mechanism / rake mechanism for pulling out the screened material ensuring minimum movement of the mechanism.

The mechanism comprising of movable bars located between fixed bars shall gradually move the screened material upward in the form of a mat and deliver on the up to the discharge chute.
The fixed as well as movable bars shall contain a series of steps to prevent the screenings from falling back into the main flow.
The mechanism shall be mechanically operated by Electro-motor or hydraulic system and shall be suitable for automatic operation controlled by a level sensor.

- The screen shall operate automatically when the upstream water level of the screen increases beyond a pre-set limit and it shall stop when the upstream level decreases to a preset low level due to upward travel of screened material.

The fine bar screen shall be capable of being tilted out of the sewage flow up to horizontal position for the purpose of cleaning & maintenance.
The base of the screen shall be fitted with a specially profiled stainless steel plate to direct any grit that may be present towards the screen and taken out along with other screened material thus reducing the possibility of building up of grit in front of the screen.

Level Controller

The level controller shall be differential type Ultrasonic level transmitter / level switch.

Electrical Motor

The motor shall be TEFC type with IP 55 protection and shall be suitable for operation on 415V + 10% and frequency of 50Hz + 5%.

Control Panel

The Control Panel shall have IP 55 protection, painted with Epoxy paint and shall be comprising of
Mushroom Head Emergency stop
Overload relays for motor protection
MCB's, HRC Fuses and Glass Fuses
Circuitry to operate the screen with level sensors.
Selector Switch to operate the screen on JOG mode

2.6.2 Perforated Plate Screen

- General
  The fine band (Escalator)/perforated plate screen shall consist of continuously moving perforated stainless steel belt.
  The machine shall be arranged to pivot out the channel.
  The aperture size shall be 6 mm.

- Construction
  Self-supporting stainless steel construction with attached screenings chamber for reception of the brush roller, including maintenance-free flange bearing

The screening elements are perforated plate filter baskets, partly equipped with rake bars.
Each end of the perforated plates is connected with a drive chain that is driven by chain wheels.
Each chain is driven by a sprocket on a common shaft and a flange mounted gear motor.

At their upper turning point the perforated plates are continuously cleaned by a fast counterrotating brush which increases the cleaning energy and thus significantly improves the cleaning efficiency.

- Cleansing is supported by an integrated spray bar.
  The sturdy perforated plate screen is able to reliably cope with even high amounts of gravel and grit.
  The two-dimensional screening elements prevent especially long fibres from passing through the screen and achieve thus the maximum separation efficiency.

  Formation of screenings rolls is prevented by rake bars extending over the full width of the screen in combination with the screen's installation angle. Even cans and bottles are lifted by these rakes.
  Counterrotating brush roller for removal of screenings from the trough edge so that no additional scraper roller is required for trough edge cleaning.
  Wear-resistant plastic elements ensure proper sealing between the travelling screening elements and the frame whilst the perforated plates are moving.
  The connection between the plastic and screening elements is designed to allow quick and easy replacement.
  Internal spray nozzle bar
  Wash water connection: Storz C coupling,
  Required washing pressure: 4-5 bar;
  Washing medium: service water (particle size < 200 µm)
  Activation via the solenoid valve of the customer's wash water supply unit.
  Bushed conveyor chains each deflected by two upper and lower chain wheels and guided in lateral profiles.
  Guiding tracks with required connecting profiles for reception of the jack-to-jack chains
- Chain wheel bearings:
  Re-greasable upper flange bearings
  Wear-resistant, maintenance free lower ceramic bearings
  Upper chain tensioning unit, easy to access from outside
  Completely odour-encased screen with easy to remove covers
  The machine should be suitable to be used in zone 1 hazardous areas.

- Screen Panels: Minimum 3 mm thick panels of SS 304L construction shall incorporate 6 mm diameter perforations. These panels shall be carried on the chains. The Panels shall be specially formed to give a very rigid construction and shall create steps to enable larger screenings to be removed.
- Seals: Polypropylene sealing brushes shall be incorporated at each side and across the bottom of the screen to prevent screenings from by-passing the screen panels.
- Screenings Discharge
  Screenings shall be discharged on the downstream side of the unit and shall be removed from the screen panels by a heavy duty rotating brush. The brush material shall be polypropylene.
  Screenings are delivered down an enclosed chute.
  Two nos. screening collection containers (wheeled) of suitable capacity shall be supplied with the screens.

- Enclosure
  The entire assembly shall be enclosed with SS304L housing. A hinged front cover shall be provided to give access to the rotating brush assembly and screen discharge area. A Sliding inspection hatch shall Also, be incorporated.
- Drive Unit
  The drive to the main shaft shall be TEFC weatherproof IP 65 motor shall be suitable for operation on 400 V and frequency of 50 Hz. The motor shall be coupled to a shaft mounted gear unit giving the final output speed. This shall produce a linear speed for screen panels.
- Drive shall be in accordance with explosion protection class II2GEExeIIT3
- The drive shall be protected from mechanical overload by an electrical current sensing device in the screen control panel.
- Differential pressure switches shall be provided to annunciate screen jamming.
- Suitable conveyor arrangement shall be provided to transfer the screening to the nearest container/trailer.
- A spry system shall be provided to backwash the screen panels and to help in cleaning the screenings. Water/treated sewage shall be used for the back wash purpose.
- Control Pane
- The control panel shall have IP 55 protection, painted with Epoxy paint and shall be comprising of
- Mushroom Headed Emergency stop
- Overload relays for motor protection
- MCB's, HRC fuses and Glass Fuses
- Circuitry to operate the screen with level sensor
- Selector Switch to operate the screen on JOG mode.

- Shop Testing
  The screen should be completely manufactured and offered for inspection at the plant of the manufacture confirming the above mentioned eligibility criteria. A screen assembled by a vendor and offered for inspection at the plant of a vendor / sub-contractor shall not be accepted. The screen shall be subjected to following tests at manufacturer's premises by third party inspection and / or client representative(s):

- Dimensional Check: The overall dimension of the screen shall be conforming to the approved drawings.

- Operational Test: The complete screen including its carriage, rake, drive system and brake motor shall be mechanically operated and tested to verify interference free movement and satisfactory operation.

3.0 Mechanical grit separator

The grit separator shall be square in size and twin unit construction. A Central drive mechanism of worm reduction type driven through helical gear and motor or by geared motor shall be mounted on the RCC platform spanning the tank. All exposed steel parts shall be sand blasted and painted with epoxy. All wetted parts shall be in stain steel 304. The drive shall be provided with electro-mechanical device, torque indicating arrangement and mechanical trip contacts with electrical overload relays. Flow regulating vanes shall be provided at the inlet side of the collection chamber and shall be of FRP. The vanes shall be adjusted as per the flow requirement. The weirs at the outlet

of grit chamber shall be SS 304 with minimum 3-mm thickness or FRP with minimum thickness of 6 mm. The spacing of anchor bolts of SS 304 for the fixing of the weir shall not be more than 450 mm.

The classifier mechanism shall comprise of a screw driven by a suitable motor. The material of construction of the mechanism shall be SS 304 of suitable dia. The length of screw shall be such that the grit can be elevated up to the discharge end. SS puddle pipe shall be provided in the concrete trough at the discharge point of wet grit. An organic return pump with wetted parts in SS304 shall be provided.

4.0 Air blowers for Oxygenation

The blowers shall be provided for providing adequate oxygen into the reactor tank for aeration. The air requirements shall be calculated for summer and winter as well as for mixing power the higher duty shall be installed.

The blowers shall be capable of developing the required total pressure at the rated capacity for continuous operation. The blowers shall be Tri lobe or Twin lobe type. The blowers shall be provided with suction air filter, reactive silencer, dead weight pressure relief valve and pressure gauge and the air delivered shall be clean, dry and oil free. The blower noise level and velocity of vibration shall be within 85 dB (A) at a distance of 2 m respectively. The blower must be V-belt driven by squirrel cage induction motor.

The speed of the blowers shall be below 1,500 rpm. The power rating of motor shall be at least 10% above the maximum power requirement by the blower. The kW of single blower shall not exceed 250 kW. The blowers shall be mounted at a level necessary to avoid back flow or siphoning of sewage into the blower.

Material of construction:

Casing	: C I conforming to IS: 210 Gr FG 260
Rotor	: Alloy steel
Shaft	: Carbon steel C40/EN 24/19
Timing gear	: Cast alloy steel
Pulley and gear side plates and cover	: CI conforming to IS 210 Gr FG 260

Tests

Sr. No.	Tests	Specs
1	Hydrostatic tests	Twice the maximum working pressure
2	Performance test	As per BS : 1571
3	Strip test	Clearances with

		tolerance limit
4	Mechanical balancing	ISO 1940 Gr. 6.3 or better
5	Visual Inspection	Before painting

5.0 Diffused Aeration System

This comprises piping to diffusers and the diffusers.

5.1 Type of diffuser system

A fine bubble diffused aeration system shall be applied to aeration tank for oxygenation. The number of diffuser elements can be varied by the bidder depending on the manufacturer selected, subject to the condition that sufficient design calculations are attached along with it and the manufacturer is a standard one having supplied the diffusers to various waste water treatment plants of similar nature.

5.2 Diffuser Elements

The diffuser elements shall be of PU tubular membrane type and resistant to such ingredients as hydrocarbons, oil and grease. This shall afford a high oxygen transfer rate coupled with a minimal pressure drop besides permitting simple erection onto the horizontal air manifold. They shall have self-cleaning properties while in action. The diffuser unit shall be of corrosion resistant material. The membrane diffusers shall permit connection to the air manifolds of circular or square cross section and the entire lot of diffusers shall be capable of discharging designed flow of air at an average flow (maximum of summer and winter requirement) when installed in the said SBR tanks.

The diffuser grid shall be of fixed type. The headers onto which the diffusers are fixed shall be of standard Imported PVC/UPVC pipe sections of suitable inner bore and shape with custom fixtures of the diffuser elements as directed by the membrane manufacturers. Alternative pipe materials shall be acceptable provided the same are a mandatory part of the diffuser supplier and have been in the supplier's line of supply as original equipment. The headers shall Also, be procured from the equipment manufacturers who are the suppliers of the membrane diffusers. These headers shall have enough counterweight or alternative arrangement to surmount any buoyancy lift from the floor during air charging.

5.3 Air Supply Piping

The air piping from the blower to the basin header (above water) shall be of MS epoxy painted material and pressure rated for the sewage depth plus frictional losses etc. Each air header shall travel downward from the air piping by aligning itself onto the sidewall of the aeration tank and thereafter travel horizontally onto the tank floor. These shall be fixed securely to the concrete surfaces in the horizontal plane and vertical plane so that they are not clamped horizontally onto vertical sides of the walls. The clamping shall be so designed as to permit "in-situ" screw driven fittings. Breaking open concrete surfaces shall not be permitted.

6.0 Specifications for Epoxy Painting

Zinc rich epoxy primer and epoxy paint of approved quality shall be used for external and internal painting. No primer shall be applied without prior approval from the KMC's Representative. The max of zinc rich epoxy primer shall be prepared at work site not earlier than 15 minutes before applying the same on pipes and special surfaces. One coat of zinc rich epoxy primer of DFT 75 micron shall be applied along with two coats of epoxy paint DFT 40 micron and DFT 30 micron

respectively. No thinner shall be added to ready mix paint without previous approval of the KMCs' representative and the finishing coats on top of the primer coat shall only be applied after allowing the film to cure for at-least 48hrs.

After application of zinc rich epoxy primer, the surface should be cleaned by duster and inspected. If during inspection any portion is found rusting the same shall be removed by emery paper and coated with zinc rich epoxy primer.

Mixed paint should be used within 3 to 4 hrs. of mixing and fresh mixing shall be done for every new application. Every successive coat of paint shall be given only after 48 hrs. of previous coat. Before applying the next coat, the surface should be properly cleaned by duster.

7.0 Specifications for Decanting Drive

7.1 Specifications for Decanting Drive

- The Decanting Device shall be Moving Weir Arm Device of SS 304 with top mounted Gear Box, Electric Drive, Scum Guard, Down comers, Collection Pipe, Bearings. The following type of decanter assemblies are not acceptable: Rope Driven Decanters, Floating Decanters, GRP Products, Valve Arrangement.
- The maximum design travel rate shall be 60 mm/min with proven hydraulic discharge capacity of the decanter proportional to the selected Basin area.
- The hydraulic design based on design flow rate as given above shall not exceed flow speed of 1.30 m/s.
- Flexible rubber hose kind of decanter Sealing is not acceptable.
- One or more decanters shall be provided in each basin which functions under a controlled lowering rate to withdraw treated water out of SBR Basins.
- The decanting mechanism shall be designed for a variable speed mode of operation. Decanter shall be capable to travel at varying speeds. The rate of travel of the decanter shall be adjustable during its travel in air and into the liquid surface, at which point the rate of travel of the decanter shall be automatically adjusted to a calculated rate of operation. The maximum design travel rate shall be restricted to 60 mm/min. Rope driven or Fixed subsurface arrangements will not be acceptable.
- The rate of operation shall be calculated for each cycle and shall be determined by the volume of treated effluent to be discharged per cycle. The calculation of decanter travel shall ensure that the volume of treated effluent shall be discharged throughout the designated decant phase of the process cycle. The travel of the decanter shall be limited and controlled by limit switches which shall communicate with the PLC. Upon reaching the designated BWL, the decanter shall return to its parked position.
- During non-decanting cycles, the decanter collection weir shall be parked above the top water level of the basin during aeration and settling phases, thereby eliminating any possibility of solids carryover during these phases. Therefore, weirs or entry ports of the Decanters shall not be submerged below the top water level of the basin during non-decant phase. Each decanter shall be fitted with a scum retention mechanism to prevent surface scums and floatable from exiting with the treated effluent.
- In addition, at park position, the decanter shall also provide fail safe overflow protection in the event of a power failure by allowing clear supernatant to flow via gravity, under the scum guard, over the weir, and into the decanters and out of the basins.
- If more than one decanter is provided per basin, operation of all decanters shall be synchronized precisely using synchronization panel to achieve even distribution of flow through each decanter.
- Weir loading for each decanter shall not exceed 140 m3/hr/m of the inlet weir. During Decanting Phase, decanter weir shall always be visible from the basin walkway to provide the operator with a visual check of the effluent quality. Maximum velocity down comer shall not exceed 1.3 m/sec. at the designed decant flow.

- All components of the decanter except seals and bearings shall be constructed of stainless steel 304. The decanter seals and bearings shall be constructed of maintenance free, synthetic materials for longest possible service life. All seals and bearings shall be shipped factory assembled, simplifying installation. All fasteners shall be constructed of 304 stainless. Site fabrication of decanters shall not be allowed.
- Drive mechanism or actuator shall be equipped with variable frequency drive connected to PLC to facilitate its operation at varying flow rates to ensure controlled and seamless operation at varying flow rates. Complete Drive Mechanism shall be mounted on the walkway to provide easy access for maintenance and service purposes.
- All critical decanter components that may require routine inspection or maintenance shall be easily accessible from an access platform at basin coping level without taking a basin out of service or draining or partially draining the basin. It shall be possible to carry out decanter maintenance activities without interrupting normal operation of the basin while the decanter is at its parked position during non-decant phases of the process cycle.
- The SBR blowers, Automatic Air supply Valves, RAS Pumps/Mixers, switching mechanism shall be interlocked with the decanter controls so that aeration/mixing is prevented in a basin which is settling or decanting.

8.0 Submersible Pumps for Return and Excess sludge

8.1 Raw sewage pumps shall pump sewage from wet well at sewage pumping station to inlet chamber of STPs. Return sludge pumps shall pump the return sludge from the sump to the aeration tank. Pumps shall be submersible type of non –clog design. They shall be suitable for pumping soft solids normally present in raw sewage. Raw sewage pumps with maximum 960 rpm shall be provided. In addition to this, the pumps shall be fitted with a special tearing system on the suction side for tearing soft solid material. The impeller shall be of a non-clog design with smooth passage and desired solid handling capability. Maintenance-free anti- friction bearing, deep grooved permanently greased filled ball bearings shall be provided to take care of all the axial and radial forces at any point of operation. The pump installation design shall be such as to facilitate automatic installation and removal of the pumps without having to enter into the sewage pit. The motor shall be squirrel cage type, suitable for three phase supply continuous duty with class 'F' insulation. Motor shall have integral cable parts and the cable entries shall be sealed. The cables must be leak tight with respect to liquids and firmly attached to the terminal block. The motor shall be designed for non-overloading characteristics. There shall be thermal protection against overheating of the motor winding. The pump design shall ensure that seal does not come directly in contact with the liquid being pumped as well as cooling / lubrication by oil is provided. The moisture sensor of the tripping unit shall be located inside the oil chamber.

The pump unit shall be supplied along with the special duck foot bend, flanged elbow, lifting chain with shackles, enough guide wire / pipe, sufficient tough rubber sheeted water proof cable, as well as stainless steel foundation bolts and nuts. Alternatively, pump unit can be with SS wire rope guiding system and pedestal cart integrated with the discharge head.

Reverse Rotation

The pump shall be designed to operate safely in the reverse direction of rotation, due to wastewater returning through the pump.

Pump Construction

Refer Section – 2.0 Scope of Work of the tender.

Pump Bearings

Pump bearings shall be of the antifriction type. The bearings shall be able to take normal axial thrust loads due to unbalanced hydraulic loads on the impellers plus the weight of all rotating parts of the pumps. Pump bearings shall be designed with a minimum life of 40,000 hours. The bearings shall be grease lubricated for life and shall be maintenance free

Mechanical Seals

A double mechanical seal of approved type shall be provided to prevent pumped liquid entering into the motor winding. The seals shall be running in oil bath. The oil bath shall have moisture sensors to sense water leakage. The sensors shall be used for tripping the pump and also, for alarm.

Pump Balance

All rotating parts shall be accurately machined and shall be in rotational balance. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided. In any case the amplitude of vibration as measured at any point on the pumping unit shall not exceed the limits set forth in the latest edition of Indian Standards. At the operating speed, the ratio of relative speed to the critical speed of the unit or its components shall be less than 0.8 or more than 1.3.

Lifting chain

Each pump shall be provided with galvanized steel lifting chain of suitable capacity. One end of the chain shall be attached to the pump and the other end fixed near the upper bracket for guide rail / wire rope assembly, by means of GI D shackle. The chain shall have GI rings fixed at an interval of about 1 meter for engaging the hook of the chain pulley block.

Submersible Cable

Each pump shall be provided with submersible cables of equal length for power and control so that the pump positions can be interchanged with each other. The cable shall be terminated in a common weatherproof junction box.

Moisture Sensor

The moisture sensor shall be provided in the oil chamber to detect the failure of the mechanical seal.

Motor

The motor shall be integral part of the pump. The enclosure for motor shall be IP-68. Each phase of the motors shall be provided with thermostat. The motor winding shall be suitable for star delta/soft starter. The motor shall be designed for minimum 10 starts/stops per hour, irrespective of whether it is DOL start or otherwise. For other requirements refer subsection VI. The motor shall operate satisfactorily at all operating levels in wet well.

Protective Coating: The pumps shall be epoxy painted.

8.2 Other **Sludge Pumps**

These pumps shall be of screw type used for pumping sludge to centrifuge. The pumps shall be designed to operate satisfactorily without detrimental surges, vibration, noise, or dynamic imbalance. Over the required head range, the head-capacity curve of the pump shall have a

continuously rising head characteristic with decreasing capacity over the whole range of total head. The pump shall have the maximum efficiency at the specified duty point. The unit shall be designed to operate safely at the maximum speed attainable in the reverse direction of rotation due to sewage returning through the pump at times when power supply of the motor is interrupted.

All rotating parts shall be statically and dynamically balanced as per ISO standards.

A stationary coupling guard shall be provided for the coupling conforming to all relevant safety codes and regulations. Guards shall be designed for easy installation and removal. They shall be complete with necessary support accessories and fastener.

The pumping unit shall be provided with a common base plate. The base plate shall be of sufficient size and rigidity to maintain the pump and motor in proper alignment and position.

The pump design shall be as per IS 6595 and pump performance shall be as per IS 9137. The power rating of the pump motor shall be the larger of following
(i) 115 % of power required by the pump at the duty point
(ii) 110 % of maximum power required by the pump from zero discharge to the runoff point total head

Material of Construction & Specifications

Type	Screw
MOC	Alloy Steel
Base plate	CI / MS Epoxy painted
Fastener	SS AISI 304
Pump speed	960 rpm (maximum)
Ball passing size	25 mm minimum
Applicable code	
Design	IS 6595
Performance	IS 9137

Testing

Material test certificate	Casing, Impeller, Shaft
Hydrostatic test	1.5 times shutoff head or twice the rated discharge head whichever is greater
Performance test	IS 5120 and IS 9137 at full speed
Mechanical balancing	As per ISO 1940, Gr. 6.3 or better
Visual inspection	Pump shall be offered for visual inspection before shipment. The pump components shall not be painted before inspection
Field Tests	Field performance tests required for satisfactory operation

9.0 Dosing Tank Agitators

The equipment shall include drive motor, coupling, turbine impeller assembly, intermediate bearings, basket, walkway with handrails and such other fittings, devices or appurtenances necessary for a complete operating installation.

Mounting Arrangement

The civil tank for the sludge storage will be provided with a minimum freeboard of 300 mm. The agitator drive unit shall be mounted on RCC platform spanning the tank. These shall be mounted above the freeboard elevation over a RCC bridge walkway with necessary cut out for agitator shaft. The walkway will be provided with hand railing in SS 304 and steel ladder with handrails. A portal shall be provided permanently in the platform required for the maintenance work of the agitator components.

Drive Motor

The drive motor shall not exceed an rpm of 1500 and shall be directly coupled with the gear reducer. It shall be wired for 415 volts, 50 cycles, and three-phase service. It shall be totally enclosed, fan cooled, and rated for severe chemical duty with a minimum service factor of 1: 1.15. .

Rotary Speed

The rotary speed of the impeller shall not exceed 100 rpm so that the solids are not sheared.

Direct Coupling & Torque

The drive motor output shaft and the impeller rotary shaft shall be connected by a direct coupling using such couplings as "Lovejoy" type to avoid cumbersome erections and de-erections. The coupling shall be able to withstand continuous duty with occasional upward thrusts. The drive assembly for each agitator shall consist of a suitable drive motor, directly coupled to a helical gearbox. The gear reducer shall be of heavy duty, high efficiency type with a rugged housing and shall have a minimum service factor of 2.0 and suitable for 24 hours continuous service. The gear reducer shall have oil bath lubrication and dry well construction on the vertical output shaft to prevent leakage of lubricant. The casing of the gear reducer shall be of CI and the gears shall be hardened and ground for precision.

Impeller Elements

The circulating element of each agitator will consist of a single, axial flow design, 4 inclined impeller having SS304 blades

Fasteners & Anchor bolts

All fasteners and anchor bolts shall be of such metallurgy that shall be compatible with the duty conditions shall be used.

10.0 Dosing Pumps

The dosing solution from the preparation tanks shall be pumped by the use of dosing pumps. The pipe and the pipe fittings shall be HDPE and valves shall be Polypropylene.

These pumps shall be capable of pumping the up to 0.5 % Polyelectrolyte solution. Dosing pumps shall be of the diaphragm type hydraulically operated. These shall permit flow control at both sides of the chosen median duty point for the duty already stated herein. The construction shall be totally enclosed and corrosion proof. The liquid end shall be in SS 304.

11.0 Centrifuge

The centrifuge shall be solid bowl centrifuge of co-current/counter current design, as decided by the bidder. The centrifuge shall have sufficient clarifying length so that separation of solids

is effective. The centrifuge and its accessories shall be mounted on a common base frame so that entire assembly can be installed on an elevated structure.

Suitable drive with V- belt arrangement and turbo-coupling shall be provided along with overload protection device. Centrifuge shall be with SS304 wetted parts.

Differential speed and bowl speed should be adjusted by changing the pulleys; differential speed may be adjustable by use of epicyclical-gear. The bowl shall be protected with flexible connections so that vibrations are not transmitted to other equipment. The base frame shall be in epoxy painted steel construction and provided with anti-vibration pads. All steps necessary to prevent transmission of structure borne noise shall be taken. The drive motor shall be of 1450 rpm. The noise level shall be 85 dB (A) measured at 2 m distance under dry run. The vibration level shall be below 50 microns measured at pillow blocks under dry run condition. Adequate sound proof shall be carried out for the housing the centrifuges to ensure that the noise level at 5 m distance from the enclosure is less than 75 dB (A).

Centrifuge shall be capable of handling sludge consisting of minimum 0.8% solids by weight. The dewatered cake shall be based on minimum consistency of 20% by weight dry solids.

Filter Press Specs

12.0 Disinfection System

12.1 Chlorination System

Chlorinators

Vacuum type chlorinators shall be supplied with one duty and one stand by unit.
Chlorinators shall be free-standing, floor-mounted, and shall have a turn down ratio of 10:1 over the full range of works operation.
The dosing rate shall be manually set and each chlorinator shall be equipped with a 0 to 10mg/l scale and a manual dose setter over the complete range.
Mal-operation of the duty chlorination system shall be indicated in the chlorination room and the central MMI. The change to the standby system shall be carried out automatically in the event of duty chlorinator failure.

Dosing Pumps

Dosing pumps (1 working + 1 standby) shall be installed.
The dosing pumps shall draw their supply from treated sewage line.
The pumps shall be placed inside the chlorination room and shall be made from material resistant to corrosion by chlorine.

Injectors

Two injectors shall be provided, each serving a duty /standby pair of chlorinators. The injectors shall be located in the chlorination room.

Chlorine

Chlorine shall be supplied as liquid from nominal 1 tonne chlorine toner.

The Toner Room

(a) Storage shall be provided for chlorine tonners, sufficient for at least 15 day's usage at normal rate of withdrawal.

(b) The system shall be designed to prevent freezing of the liquid chlorine at the maximum rate of withdrawal.

(c) Tonners on line, tonners on standby and full and empty tonners shall be stored separately in the tonner room. Three sets of tonner rollers shall be provided. Tonners not in use shall be stored on concrete cradles.

(d) The container lifting beam shall be specifically designed for handling chlorine containers and equipped with necessary shackles and hooks.

(e) Operation of crane system shall be from the floor level using independent push button pendent controls operating at a 230 volt 50Hz AC supply.

(f) Two lifting beams shall be provided (a duty and a spare) and a one tonner weighed to be suspended from the crane hoist.

(g) When the pressure in the duty chlorine tonner falls to less than 1.00 Kg/cm2, the automatic change over device shall operate to isolate the empty tonner and to bring the full standby tonner on line.

(h) A chlorine leak absorption system shall be provided to contain and neutralize chlorine in the event of leak. The system shall comprise FRP Half Hoods, NaOH Storage Tank, NaOH Re-circulation Pump, Centrifugal Pumps and interconnecting ducting/piping.

(i) Special consideration shall be given to any floor drainage system in the tonner building; adequate shall be provided to ensure that chlorine gas cannot escape. All leader tubes carrying cables or pipes out of the building shall be sealed at either end to prevent any chlorine gas leaking out.

Chlorination Room

The chlorination room shall be constructed adjacent to the tonner room but with no interconnecting door or other form of access.

Gas lines from the tonner room into the chlorination room shall run in ducts to be sealed after installation and prior to commissioning.

Chlorine Leak Detectors

Chlorine gas leak detectors shall be provided each, with a single detector cell. At least two sensors shall be located in the chlorine tonner storage room and at least one sensor in the chlorination room.

The chlorine leak detectors in the tonner room shall be mounted at each end of the tonner room.

The chlorine leak detectors shall initiate a local audible and visual alarm. Statutory warning notices relating to the storage and handling of chlorine shall be provided. The signs shall be pictorial and provided in Hindi and English.

Ventilation System

Each area where chlorine is stored or used as gas or liquid shall be provided with a forced ventilation system.

Air intakes shall be sized to allow uniform ventilation and positioned to prevent possible recirculation.

An air change rate of four per hour under normal condition and a minimum of twenty changes of air per hour under shall be used in the event that a chlorine leak is detected.
Exhaust fans shall be heavy duty industrial pattern manufactured from chlorine resistant materials.

Safety Equipments

Materials and equipment necessary to ensure the safety of personnel operating the chlorination plant and others shall be provided.
The equipment shall include:

(i) two sets of approved self-contained breathing apparatus, each comprising an air set, carrying harness, face mask and valves and ancillary equipment . Each set shall be provided with three 1200 Liter capacity, 140mm diameter, air tonners.
(ii) Two 'instant action' resuscitators;
Four sets of safety clothing in various sizes, each comprising PVC overalls, Wellington boots with steel toe caps, goggles, gloves and safety helmets.

Each set of safety equipment shall be mounted in a glass-fronted, non-locking PVC coated steel cabinet in approved locations on the outside of the building.
Two emergency showers shall be provided and shall be installed outside on either side of the tonner room.
Each shower shall be operated automatically by a quick acting hand or foot valve.
Four eyebaths shall be supplied. Two eyebaths shall be adjacent to each of the showers.
Water for showers, etc. shall be drawn from the service water supply.
A telephone will be provided close by outside the building for emergencies.

13.0 Valves

General

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.

13.1 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	IS 14846

13.2 1.8.21.3 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 centre 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 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	: AISI:304 Gr. ASTM A240
Retainer ring: SS	:304 ASTM A351 Gr. CF:8
Inlet Seal	: EPDM
Spindle	: AISI:410 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

13.3 Reflux Valves

Reflux 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

13.4 ValveActuators

All actuators shall be motorized type and local controls shall be protected by a lockable cover.

Each actuator shall be adequately sized to suit the application and be continuously rated to suit the modulating control required. The gearbox shall be oil or grease filled, and capable of installation in any position. All operating spindles, gears and head stocks shall be provided with adequate points for lubrication.

The valve actuator shall be capable of producing not less than 1½ times the required valve torque considering valve spindle jamming and shall be suitable for at least 5 continuous operations.

The actuator starters shall be integrally housed with the actuator in robustly constructed and totally enclosed weatherproof housing. The motor starter shall be capable of starting the motor under the most severe conditions.

The starter housing shall be fitted with contacts and terminals for power supply, remote control and remote positional indication, and shall Also, be fitted with internal heaters so as to provide protection against damage due to condensation. Heaters shall be suitable for single phase operation. The heaters shall be switched "ON" when the starters are "OFF" and shall be switched "OFF" when the starters are "ON".

Each actuator shall be equipped as follows:

(a) AC electric motor with engage/disengage clutch mechanism of the dry type.
(b) Reduction gear unit (with thrust bearing if required)
(c) Torque switch mechanism
(d) Limit switch mechanism
(e) Geared hand wheel for manual operation of valve.
(f) Valve position indicator – open/closed
(g) Auto-Manual lever with suitable locking arrangement
(h) Reversing contactor starter complete with overload relays of suitable range and adequately rated control fuses
(i) Actuator shall have selection between local/remote operation
(j) Local control switch/push buttons
(k) 415 V/110 V AC control transformer
(l) A white lamp for supervision of main supply to be provided locally.
(m) A potential free contact shall be provided to annunciate over-load trip/main supply failure on remote panel
(n) Provision for local as well as remote operation

14.0 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 the KMC'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 fiber glass one more coat of enamel and the final wrap of enamel impregnated fiber 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.

14.1 C I Pipes

The C I pipes 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 the KMC'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:
(i) Mechanical Tests
as specified in I.S. 1536 during manufacture of the pipes.

(ii) Hydrostatic tests 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.

(iii) 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.
(d) Markings:

The following markings on the pipe shall be cast, stamped or indelibly painted-
1. Manufacturer's name or identification mark
2. The nominal diameter
3. Class reference
4. Mass of pipe
5. The I.S. Code reference
6. 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.

14.2 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.

14.3 LDPE Pipes: (Low Density Poly Ethylene Pipe)

The International standard specifies the required properties of pipes made from poly ethylene (PE) confirming to ISO 4427:1996.

Dimensions
The dimensions of pipes shall be measured in accordance with ISO 3126.

The tolerances on the outside diameters shall be in accordance with ISO 11922-1 as
Grade A for normal tolerance (NT pipes)
Grade B for close tolerance (CT pipes)

Length of pipe.
The length of straight pipes & coils shall be not less than that agreed between supplier and user.

Finishes
All internal surfaces of the pipes should be regular and smooth. The shape of the finished ends should be fixed by the manufacturer to suit the type of joint used.

Specials
The specials should be manufactured from LDPE/Hard plastic, polyacetal split rings for positive grip and should sustain maximum working pressure 16 bar at 20° C. should be available in sizes 20mm (1/2"), 25 mm (3/4").

The fittings should Also, be supplied by the manufacturer of the pipes. They should preferably be manufacturer by the manufacturer of the pipes. In case they are not, it will be the responsibility of the manufacturer of the pipes to have them manufactured from a suitable manufacturer under its own supervision and have it tested at his / sub contractor's premises as per the contract. The pipe manufacturer will However, be responsible for the compatibility and quality of the products.

14.4 Ductile Iron 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:
(i) Visual and dimensional check as per clause 13 and 15 of IS 8329.
(ii) Mechanical tests as per clause 10 of IS 8329.
(iii) Hydrostatic test as per clause 11 of IS 8329.
(iv) 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:
(i) Manufacturer name / stamp

(ii) Nominal diameter
(iii) Class reference
(iv) 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.

14.5 Sluice Gates

The construction of sluice gates shall be in accordance with the specification and generally as per AWWA C 501 or IS 13349. The sluice gates shall be capable of performing the duties set in the specification without undue wear or deterioration. They shall be constructed so that maintenance is kept to a minimum. All parts of sluice gate, including mechanism components shall be designed for the heads specified with a minimum safety factor of five. All sluice gates shall be of the raising spindle type.

All sluice gates shall be manually operated. Motorised gates, if provided by the Contractor, the actuator specs be got approved from the KMC's representative.

Constructional features
The sluice gates shall be standard design of manufacturer's and of robust construction. The special features shall be as follows

Frame:
The frames shall be of ample section and cast in one piece. All surface forming joints and bearings shall be machined. The frame shall be of the flange back type and shall be machined on the rear face to bolt directly to the machined face of the wall thimble.

Guide:
The guide shall be bolted to the frame or cast integrally with it and shall be machined on all bearing and contact faces. The length of the guide shall be such that it should support the gate upon the horizontal line of stem nut pocket. Arrangements shall be such that it should support the gate upon the horizontal line of stem nut pocket. Arrangements shall be made to prevent lateral movement of bolted on guides. They shall be capable of taking the entire thrust produced by water pressure and wedging action. Wedges or wedge facings shall be attached to the guides at point where, in the closed position, they will make full contact with the wedging surface on the slides.

Seating Faces

The seating faces shall be of full width, solid section. They shall be secured firmly by means of counter sunk fixings in finished grooves in the frame and slide faces in such a way as to ensure that they will remain permanently in place as well as free from distortion and loosening during the life of the sluice gates.

Wedging devices

Sluice gates shall be equipped with adjustable side, top and bottom wedging devices required providing contact between the slide and frame facing when the gate is closed position. All faces shall be machined accurately to give maximum contact and wedging action. Wedges shall be fully adjustable with suitable adjusting screws and lock nuts and so designed that they will remain in the fixed position after adjustment.

Gate slides

The slide shall be with strengthening ribs where required and reinforced section to receive the seating faces. The slide shall have tongues on each side extending its full length and tongues shall be machined accurately on contact surfaces. Surfaces of the slide that in come in contact with the seat facing and wedges shall be machined accurately. The maximum allowable clearances between the slide and slide gate shall be 1.6 mm. An integrally cast stem nut pocket with reinforced ribs shall be provided above the central line of the slide.

Stem nut and Lift nut

A gate shall be provided with lower fixed stem nuts for connecting the stem to the slide and revolving lift nut located in the lifting mechanism in the head stock. They shall be of ample design to endure the thrust developed during gate operating under maximum gate operating condition loads in opening and closing direction. The stem nut and slide shall be constructed to prevent turning of the stem nut in the pocket in the slide. The stem nut shall be threaded and keyed or threaded and pinned to the stem.

Stem

The operating stem shall be designed for a tensile strength to withstand 90 kg effort on the crank and for a critical buckling compressive load assuming a 36 kg effort on the crank. The threads of the stem be machine cut or rolled and of the square or acme type. The number of threads per inch shall be such as to work most effectively with the lift mechanism used. The top of the stem be provided with a stop collar. Stem shall be provided with polycarbonate cover fixed to the headstock.

Stem coupling

The coupling shall be threaded and keyed or threaded and bolted and shall be of greater strength than the stem

Stem guide

Stem guides shall be cast, with bushings and mounted on cast brackets. Guides shall be adjustable in two directions and shall be so constructed that when properly spaced they shall hold the stem in alignment. The number of stem guides shall be such that the unsupported length of stem shall not exceed one hundred times its diameter.

Lifting Mechanism

Sluice gates shall be operated through a suitable lifting mechanism, which shall incorporate gearing if required. The lifting mechanism shall be suitable for operation by one man under all conditions. The lifting mechanism shall incorporate a strong locking device suitable for use with a padlock or padlock and chain. The manual operation shall be of the hand wheel crank operated type and shall have a lift nut threaded to fit the operating stem. The crank shall be removable. Ball or roller thrust bearings shall be provided above and below flange on the lift nut to take the load developed in opening and closing the gate with torque of 14 kg-m on the crank. Fittings shall be provided to lubricate gears and bearing. The design of the lift mechanism of the hand operated gates shall be such that the slide can be operated with torque is not more than 7 kg-m on the operator after the slide is unseated from wedges based on the operating head. The maximum crank radius shall be 380 mm.

14.6 Gears and bearings

All gears and bearings shall be enclosed in cast iron housing with labyrinth seals. The lifting mechanism shall be of cast iron pedestal, machined and drilled to receive the gear housing and suitable for bolting to the operating floor. The gates shall close with clockwise rotation of the crank. The direction of rotation to close the gates shall be indicated on the lift mechanism. A suitable means shall be provided for lubricating the stem threads directly adjacent to the lift nut. An inspection cover shall be provided to access the lift nut and gearing.

14.7 Fasteners

All anchor bolts, assembly bolts, screw, nuts etc., shall be of ample section to safely withstand the forces created by the operation of the gate.

14.8 Wallthimbles

The wall thimbles shall be made of cast iron and shall be supplied along with the gate. The wall thimbles shall provide a rigid mounting and designed to prevent warping of the gate frame during installation. The cross section of the thimble shall have the shape of the letter ‘F’. The front, or mounting flange, shall be machined and shall be attached to the thimble with bolts and studs. The depth of the wall thimbles shall not be less than 300mm. To permit entrapped air to escape as the thimbles are being encased in the concrete, holes not less than 35 mm diameter at not more than 600 mm span, shall be cast or drilled in each entrapment zone formed by the reinforcing ribs or flange and water stop.

Material of Construction	
Frame, Guide, Thimble, Stem	C I conforming to IS 210 Gr 260
Guide Bracket, Wedges,	
Door Sealing faces	Bronze conforming to IS 318 Gr LTB 2
Spindle	SS AISI 431
Flush bottom resilient seal	Natural or synthetic rubber conforming to IS: 1855
Anchor bolts	SS conforming to IS 6603
Hand wheel	Cast iron
Stem cover	Polycarbonate transparent tube.

Parameters	
Type	Rectangular rising spindle
Size	As per requirement
Applicable code	IS 13349
Class	1
Maximum seating head	As per contractor's design
Unseating head	As per contractor's design
Maximum distances between gates centre line and operating platform	As per contractor's design.

Tests Seat clearance check, moving tests, leakage tests and Hydrostatic tests as per IS 13349/ AWWA C 501 shall be conducted at Manufacturer's works in accordance with the Inspection category.

15.0 Open channel Gates

The manufacture of open channel gates shall be in accordance with the manufacturer's standard. All open channel gates shall be of the rising spindle type. All open channel gates shall be manually operated or motorised as per process requirements. Open channel gates shall be tested as per manufacturer's standard. The open channel gates for pumping stations shall be CI sluice gates. The material of construction shall be as follows.

Components	Material	Specification	Grades
Gate frame, shutter, Headstock, Flush bottom seal support bar, Stop nut.	Cast Iron	IS: 210 – 1993	FG: 260
Sealing faces/ Seat facings	Stainless Steel	ASTM A276	AISI: 304, 316
Resilient rubber seal	Natural Rubber EPDM Rubber Neoprene Rubber		
Seal retainer bar	Stainless Steel	ASTM A276	AISI: 304, 316
Stem / Spindle	Stainless Steel	ASTM A276	AISI: 304, 316
Operating Nut/ Stem Nut	Leaded Tin Bronze	IS: 318 – 1981	LTB 1, LTB 2
Fasteners	Stainless Steel	ASTM A276	AISI: 304, 316
Anchor Bolts	Stainless Steel	ASTM A276	AISI: 304,

			316
Yoke	Mild Steel	IS: 2062 – 1992	Grade A

16.0 Chain Pulley Blocks

Geared Chain Pulley Blocks shall be adopted. The monorail and trolley and the chain pulley block shall be provided for lifting the blowers and submersible pumps. The trolley and chain pulley block shall be hand driven. The capacity of the trolley and the chain pulley block shall be for the maximum weight to be lifted during erection and maintenance of the equipment but should not be less than 1 tonne. The travelling trolley shall run on the lower flange of the rolled steel joist. The trolley shall have two wheels on both sides of the joist web. The trolley wheels shall be single flanged with treads machined to match the flange of the beam. The wheels shall be of carbon steel casting conforming to IS 1030. The trolley shall have an arrangement for the fixing chain pulley block and sling. Pushing the load shall move the trolley. Suitable arrangement shall be provided on the joist to prevent over travelling. The chain pulley block shall have frame housing gears load sheave, brake unit, hand chain wheel and load chain wheel shall have hooks on both sides, one fixed with traveling and other for the load. The frame shall be of welded construction.

The gears shall be of spur type incorporating high grade hardened carbon steel pinion and heat treated carbon steel wheels. The width of the gear shall be adequately sized for long life. The driving pinion shall be integrated with the driving shaft. The load hook (bottom hook) shall rotate on the ball bearing. The chain shall be electrically welded, accurately calibrated, pitched and polished. The length of the load chain shall be sufficient for taking out the blower/pumps from their location. The hand chain wheel shall be provided with roller type guarding to prevent slipping the chain. The hand chain wheel shall hang to cleat of the hook. The braking shall be automatic, the screw and friction disc type and shall offer no resistance. The load shall be sustained in any position of lift when effort for hoisting or lowering is removed. Each chain pulley block shall be supplied with one set of 1 tonne sling with galvanized D- shackles and clamps. The slings shall be about 3 m long. The monorail shall be 'I' section. The exposed mild steel surfaces shall be enamel painted. The fasteners shall be GI or Cadmium plated. The chain pulley block shall be tested for 150% overload through a length of lift which will be ensure that every part of the block mechanism and every teeth of gears come under load.

17.0 Laboratory Equipment

Laboratory equipments shall be provided as mentioned below (each location):

Sr. No	Item Description	Unit	Qty
A	Laboratory Instruments		
1	Digital Spectrophotometer	No.	1
2	Cuvette 50mm	No.	1
3	Cuvette 10mm	No.	2
4	Digital Nephelometer	No.	1
5	T D S meter	No.	1
6	Magnetic Stirrer	No.	1

7	Hot Plate with regulator	No.	1
8	Autoclave portable	No.	1
9	Digital pH meter	No.	1
10	Distilled water plant	No.	1
11	Vacuum Desiccator	No.	1
12	Vacuum Pump	No.	1
13	Centrifuge	No.	1
14	Microscope	No.	1
15	Digital Colony Counter	No.	1
17	Water Bath Thermostatic	No.	1
18	Digital Muffle Furnace	No.	1
19	Lab. Oven	No.	1
20	Bacteriological Incubator	No.	2
21	B.O.D. Incubator, made by Refrigerator	No.	2
22	Single Pan Balance	No.	1
23	Inoculation Chamber	No.	1
24	Gas stripping Apparatus	No.	1
25	Membrane filter Assembly	No.	1
26	Membrane filter Disc	No.	1
27	Heating Mantle	No.	1
28	Fume Hood	No.	1
29	Thermometer with calibration	No.	1
30	Kjeldahl Distillation Assembly	No.	1
31	Flow Meter	No.	1
32	Reduction Column	No.	1
33	Activated Carbon Column	No.	1
34	ERTL Approved calibration Certificate	No.	10
B	Laboratory Glassware		
1	Amber coloured bottle, 1000ml	No.	4
2	Amber coloured bottle, 500ml	No.	10
3	Amber coloured bottle, 250ml	No.	12
4	Amber coloured bottle, 125ml	No.	6
5	Plain wide mouth bottle, 1000ml	No.	1
6	Plain bottle, 1000ml	No.	4
7	Plain bottle, 500ml	No.	10
8	Plain bottle, 250ml	No.	52
9	Plain bottle, 125ml	No.	6
10	Beaker, 1000ml	No.	2
11	Beaker, 500ml	No.	4
12	Beaker, 250ml	No.	4
13	Beaker, 100ml	No.	4
14	Beaker, 50ml	No.	2
15	Plastic Beaker, 500ml	No.	3
16	Plastic Beaker, 250ml	No.	3
17	Measuring Cylinder, 500ml	No.	3
18	Measuring Cylinder, 250ml	No.	2

19	Measuring Cylinder, 100ml	No.	1
20	Volumetric flask, 500ml	No.	4
21	Volumetric flask, 250ml	No.	4
22	Volumetric flask, 100ml	No.	8
23	Grouch crucible G-4	No.	1
24	Grouch crucible G-3	No.	1
25	Silica dish	No.	1
26	Filter funnel	No.	4
27	Screw capped tube, 50ml	No.	12
28	Screw capped tube, 30ml	No.	12
29	Nesslers Cylinder, 100ml	No.	8
30	Durham's tube	No.	3
31	Test tube, 20ml	No.	60
32	Test tube, 10ml	No.	15
33	Round bottom flask, 500ml	No.	1
34	Round bottom flask, 100ml	No.	3
35	Flat bottom flask, 500ml	No.	1
36	Flat bottom flask, 250ml	No.	3
38	Separating funnel, 500ml	No.	2
39	Separating funnel, 125ml	No.	4
40	Separating funnel, 1000ml with Teflon	No.	1
41	Dropper	No.	4
42	Glass rod	No.	10
43	Graduated pipette, 25ml	No.	3
44	Graduated pipette, 2ml	No.	2
45	Petri plate 4"	No.	60
46	Conical flask, 500ml	No.	3
47	Conical flask, 250ml	No.	3
48	Iodine flask, 250ml	No.	2
49	Condenser	No.	2
50	Burette, 50ml	No.	3
51	Boiling Beads	Kg	0.5
52	Watch Glass	No.	2
53	Cover Slip	No.	2
54	PP Measuring Cylinder, 100ml	No.	2
55	PP Conical flask, 250ml	No.	2
56	PP bottle 250 ml	No.	6
57	Tripod Stand	No.	2
58	Wire gauge	No.	10
59	Watman filter paper No. 1/2	No.	1
60	Watman filter paper No. 40/42	No.	1
61	Test tube stand	No.	1
62	Pipette stand round	No.	1
63	Burette Stand	No.	1
64	Non-absorbent cotton	No.	2
65	SS Spatula	No.	2

66	SS Tong	No.	2
67	Test tine	No.	2
68	Tissue role	No.	2
69	Gas burner	No.	2
C	Laboratory Chemicals		
1	Ammonia buffer soln.	ml	500ml
2	Activated charcoal	gm	500gm
3	Ammonium Dichromate	gm	500gm
4	Ammonium acetate	gm	500gm
5	Ammonium chloride	gm	500gm
6	Ammonium hydroxide	gm	500ml
7	Antimony metal powder	gm	500gm
8	Azomethane H	gm	2gm
9	Acetic acid Glacial	ml	500ml
10	Ammonium oxalate	gm	500gm
11	Aluminium potassium sulphate	gm	500gm
12	Ammonium carbonate	gm	500gm
13	4 - Aminino antipyrine	gm	25gm
14	Acetone	ml	500ml
15	Ascorbic acid L	gm	100gm
16	Buffer tbt 4.0	tbt	10tbt
17	Buffer tbt 7.0	tbt	10tbt
18	Benzene	ml	500ml
19	Boric acid	gm	500gm
20	Barium chloride	gm	500gm
21	Barium hydroxide	gm	500gm
22	Calcium chloride	gm	500gm
23	Cobaltous chloride	gm	100gm
24	Chlorotex Reagent	ml	100ml
25	Citric acid	gm	500gm
26	Cyclohexanone	ml	500ml
27	Calcium hydroxide	gm	500gm
28	Copper metal powder	gm	500gm
29	Chloroform	ml	500ml
30	Cupric sulphate	gm	500gm
31	Chromotropic acid	gm	25gm
32	Dodecyl benzene sulphonic acid	gm	500gm
33	Di ammonium hydrogen orthophosphate	gm	500gm
34	Ethyl acetate	ml	500ml
35	Ethanol	ml	500ml
36	E D T A	gm	100gm
37	Erichrome Cyanine R	gm	5gm
38	Ferric chloride	gm	500gm
39	Ferric citrate	gm	500gm
40	Ferrous ammo sulphate	gm	500gm
41	Formaldehyde	ml	500ml

42	Gelatine powder	gm	500gm
43	Glycerine	ml	500ml
44	Hydrazine sulphate	gm	100gm
45	Hexamethylene tetramine	gm	500gm
46	Hydrochloric acid	ml	500ml
47	Hydrogen peroxide	ltr	1ltr.
48	Hydroxylamine Hydrochloride	gm	100gm
49	Iodine resublimed	gm	100gm
50	Iso Propyl alcohol	ml	500ml
51	Methanol	ml	500ml
52	Mercuric chloride	gm	250gm
53	Neocuprone (2, 9 dimethyl 1, 10 (N1-napthyl) ethylene dihydrochloride	gm	1gm
54	NED dihydrochloride		5gm
55	Nitric acid	ml	500ml
56	N,N dimethyl - P - Phenylene diamine oxalate	gm	5gm
57	Orthophosphoric acid	ml	500ml
58	Potassium chloroplatinate	gm	1gm
59	Potassium iodine	gm	250gm
60	Perchloric acid	ml	500ml
61	Potassium dichromate	gm	500gm
62	Potassium chromate	gm	500gm
63	Potassium nitrate	gm	500gm
64	Potassium permangate	gm	500gm
65	Patton &Readers indicator	gm	5gm
66	Potassium cyanide	gm	5gm
67	Phenol crystal	gm	500gm
68	Potassium bromate	gm	500gm
69	Potassium bromide	gm	500gm
70	Potassium dihydrogen phosphate	gm	500gm
71	Potassium ferricyanide	gm	100gm
72	Potassium chloride	gm	500gm
73	Potassium metaperiodate	gm	100gm
74	1, 10 Phenanthroline	gm	5gm
75	Potassium hydroxide	gm	500gm
76	Rhodamine B	gm	25gm
77	Sodium acetate	gm	500gm
78	Sodium hydroxide	gm	500gm
79	Sodium chloride	gm	500gm
80	Sodium thiosulphate	gm	500gm
81	Sulphuric acid	gm	500ml
82	Sodium hydrogen carbonate	gm	500gm
83	Sodium carbonate	gm	500gm
84	Sodium sulphate	gm	500gm
85	Starch soluble	gm	500gm
86	Silver nitrate	gm	25gm

87	Sodium sulphite anhydrous	gm	500gm
88	Sodium ascorbate	gm	100gm
89	Sulphur dioxide solution	gm	500ml
90	Sodium fluoride	gm	500gm
91	Sodium mete bisulphate	gm	500gm
92	Sodium nitrite	gm	500gm
93	Sodium oxalate	gm	500gm
94	Sucrose	gm	500gm
95	Sulpha nil amide	gm	500gm
96	Tri sodium citrate	gm	500gm
97	Tri ethanol amine	gm	500ml
98	1, 1, 2 trichloro trifluoro ethane	gm	250ml
99	Urea	gm	500gm
100	Zinc dust	gm	500gm
101	Zincon	gm	1gm
102	Zinc sulphate hepata hydrate	gm	500gm
103	Zinc acetate	gm	500gm
D	List Of Media		
1	Aspergine praline broth	gm	100gm
2	Andrede peptone water	gm	100gm
3	Brilliant green bile broth 2%	gm	100gm
4	Chloramphenicol yeast glucose agar	gm	100gm
5	Differential reinforced clostridial medium	gm	100gm
6	EMB Agar	gm	100gm
7	Lactose broth	gm	100gm
8	MacConkey's broth	gm	100gm
9	MacConkey's agar	gm	100gm
10	Milk agar with cetrimide (Twin)	gm	100gm
11	MR-VP Medium	gm	100gm
12	Nutrient broth	gm	100gm
13	Nutrient agar No. 2	gm	100gm
14	Peptone water	gm	100gm
15	Plate count agar	gm	100gm
16	Simmon's Citrate agar	gm	100gm
17	Tergitol - 7 agar base	gm	100gm
18	Violet red bile agar	gm	100gm
E	list of Indicators		
1	Brilliant green	gm	25gm
2	Bromocresol purple indicator	ml	125ml
3	Bromocresol green	ml	125ml
4	Crystal violet	ml	125ml
5	Eosin	ml	125ml
6	Methyl orange	ml	125ml
7	Methyl red	ml	125ml
8	Methylene blue	ml	125ml
9	Muraxide (Ammo Purpurte)	gm	5gm

10	Neutral red indicator	ml	125ml
11	Phenol phthalein indicator	ml	125ml
12	Eriochromes black T	gm	25gm
13	Universal indicator	ml	125ml
14	Phenol red	ml	125ml
15	Gram iodine stain	ml	125ml
16	Bromothymol blue	ml	125ml
F	Providing Furniture for The Laboratory		Qty.
1	Providing, manufacturing &supplying Working table of approx. size 1200mm X 600mm & 750mm height with 4 Drawers of 300 mm width, in marine plywood finish with inside the drawers including all hardware etc. complete		3 Nos.
2	Providing, manufacturing and supplying Side table of specifications same as working table but along wall.		4 Nos.
3	Providing, manufacturing and supplying Running table of specifications same as side table but along wall and 450 mm deep.		2 Nos.
4	Providing, manufacturing, supplying and fixing Storage unit above the running table in marine plywood of approx. 450mm deep and 600mm height with shelves, shutters including all hardware, 1.5mm thick laminate on External face & wax polish internally.		2 Nos.
5	Office Chairs		16 Nos.
6	Steel Almirah		2 Nos.

18.0 E & M WORKS (Equipment & Machineries work)

18.1 GENERAL

All the E&M works shall be carried out as per latest CPWD Electrical Specifications Part – I (Internal) – 1994, Part – II (External)-1995, Part-IV (Sub-Station) – 1982, Part – VI (Fire Alarm System) – 1988 & Air Conditioning - 1997 with up to date corrections slips issued up to the date of submission of bid. In case the CPWD specifications are not found applicable and adequate than the relevant BIS specifications shall be used. Further in case, any of these are not applicable to particular tools, Equipments and machinery, then the manufacturer's specifications or their relevant instructions shall be followed.

18.2 Lighting System - Drawings and Data

a) The contractor shall furnish relevant descriptive and illustrative literature on lighting fixtures and accessories dimensioned drawings/ data for the respective lighting fixtures with manufacturer's catalogue numbers.

b) It shall be the responsibility of the contractor to work out a detailed layouts in order to provide the level of installations as indicated under Design Criteria and shall be furnished for the approval of the Engineer In-charge before commencement of installation

18.3 General Requirements

The Lighting system includes the following items:

Lighting fixtures complete with Lamps and accessories

Lighting system equipment

Light control switches, receptacle units with control switch units, lighting wires, conduits and other

similar items necessary to complete lighting system

Lighting fixture supports and street lighting poles

Lighting main distribution board, lighting panels.

c) Multi core cables for street, boundary and flood lighting

d) Provision of automatic on-off road switches through solar system

18.4 Design Requirements

It shall be responsibility of the contractor to work out a detailed layout for different units/areas in order to provide the levels of illumination as indicated in the design requirement above. The contractor shall be responsible for measuring the levels of illumination after installation and establish compliance with the specification.

The design, manufacture and performance of equipment shall conform to the latest amended Indian standard and following design and general criterion is given in Volume – I, Section – 2.0 Scope of Work above.

Mechanical Equipments:

Ambient Air Temp	:	Max.	45°C	Min.	2°C
Relative humidity	:	Max.	85%	Min.	15%

Electrical Equipments:

Ambient Air Temp	:	Max.	45°C	Min.	2°C
Relative humidity	:	Max.	85%	Min.	15%

Nominal system supply

1.	Incoming power	:	11KV, 3Ø, 3W, 50Hz
2.	Power distribution	:	11KV/ 415V, 3Ø, 4W,50Hz, AC
3.	Lighting & space heating	:	240V, 1Ø, 2W, 50HzAC
4.	D.C. Controlling	:	30V and 24V D.C
5.	A.C. Control	:	240V A.C
6.	P T Secondary	:	110V, 3 Phase, 50 Hz A.C
7.	Variation Voltage	:	± 10%,
	Frequency	:	± 5%
	Combined Voltage and Frequency	:	± 10%,
8.	System Earthing:		
a)	11KV System	:	Wherever generation is taking place at 11 KV, this will be earth through resistance.
b)	415V system	:	Neutral solidly earthed
c)	240V Single Phase	:	Neutral solidly earthed
d)	30V D,C, System	:	Unearthed

18.5 Inspection, Pre-Dispatch Inspections and Testing by the KMC

i) Bidder shall note that, all equipment manufactured within India shall be inspected from reputed third party inspection agency such as SGS / Bureau VERITAS / . All costs towards inspection of this material shall be borne by the bidder. In case, the equipment are manufactured outside India then inspection shall be carried out by third party inspection agency such as SGS / Bureau VERITAS / .

Sl. No	Name of the Equipment	Stages of inspection		
1.	Pumps	1	Review of material test certificate for pump casing, bowls, shaft, impeller bearings, columns pipe etc.	
		2	Review of heat treatment certificate if any	
		3	Dynamic balancing or rotating parts / impeller	
		4	Examination of the shaft	
		5	Hydro test of casing.	
		6	Performance test at 49Hz and 50Hz frequency including vibration measurement covering following tests	
			i)	Capacity in LPM / LPS
			ii)	Delivery Head in mtrs.
			iii)	Efficiency at the specified duty.
			iv)	Power absorbed by the pump at the specified duty.
			v)	N.P.S.H required.
			vi)	Maximum power required by the pump.
			vii)	Shut off Head of the pump.
			viii)	Discharge of the pump when only on pump is operated in the system.
			ix)	Delivery pressure when only on pump is operated in the system.
			x)	Power absorbed by the pump when only one pump is operated in the system.
			xi)	Efficiency of the pump when only one pump is operated in the system
			xii)	Visual and dimensional check.
			xiii)	Strip test.
			xiv)	Speed test at 49 Hz and 50 Hz frequency
2.	Motors	1.	Dynamic balancing of rotor and visual examination of rotor assembly.	
		2.	Visual inspection and testing of stator assembly	
		3.	Review of Test Certificate for conductor, Stator Coils, shaft Bearings etc.	
		4.	Routine test no load x load test vibration measurement as per IS	
		5.	Verification of type test report.	
		6.	Visual and dimensional check.	
3.	Switch Gear and Electrical Panels	1. 2.	Visual and dimensional check. Verification of bill of materials.	
		3.	Functional Test.	
		4.	H.V / I.R. Test.	
		5.	Verification of type test reports.	
		6.	Voltage ratio, burden class, induced high voltage, applied high voltage test for potential transformers	

Sl. No	Name of the Equipment	Stages of inspection	
		7.	Current ratio, burden, class of accuracy, test for current transformers.
		8.	Rate symmetrical breaking capacity, rated making capacity, rated short time current, auxiliary voltage for release coils, Impulse with Standard voltage test for Switch Gear panels.
		9.	Test results of Relay provided.
4.	Transformer	Visual inspection, dimensional check and verification of bill of materials. Iron losses and Copper losses test at 90% of the rated voltage, 100% rated voltage and 110% of the rated voltage. Resistance voltage test at HV side and L.V side. Routine tests as per IS:2026. Verification of type results, temperature rise test, Impulse test, Insulting oil test etc.	
5.	Capacitor	All routine and type test as per IS:2834 such as sealing test, test for output / capacitance, Insulation resistance test between terminals. Containers and loss angle measurements, test for efficiency of discharge divide, test for dielectric loss angle, thermal stability test, self-healing test, voltage test between terminals.	
6.	Cables	Visual Inspection and dimensional check. Routine test as per IS: 1554. Insulation test, resistance test, current rating test, star reactance test, star capacitance test, short circuit current test, voltage drop test.	
7.	Valves	Visual and dimensional check. Review of material test certificate for Valve body and internal parts. Operational smoothness. Hydrostatic test / leakage test as per applicable code.	
8.	Pipes & Specials	1. Visual and dimensional check. 2. Review of chemical and physical test certificates as per the relevant Indian Standard specifications. 3. Hydrostatic pressure test as per the relevant Indian Standard specifications. 4. Ultrasonic testing of welded joints for MS pipes 5. Checking the integrity of epoxy lining for MS pipes at joints after laying and jointing pipes.	
9.	Penstock Gate	1. Visual and dimensional check. 2. Review of chemical and physical test certificates as per the relevant Indian Standard specifications. 3. Hydrostatic pressure test as per the relevant Indian Standard specifications. 4. Checking the integrity of epoxy lining	
10.	Screening Equipment	1. Visual and dimensional check-up. 2. All the manufactures test certificates shall be submitted. If the KMC desires any test, contractor shall arrange to perform the same at no	

Sl. No	Name of the Equipment	Stages of inspection
		extra cost.
11	Aeration Equipment/Diffuser	1. Visual check-up. 2. Oxygen transfer capacity.
12	Thickening/ Dewatering Equipment	1. Visual and dimensional check-up. 2. All the manufactures test certificates shall be submitted. If the KMC desires any test, contractor shall arrange to perform the same at no extra cost.
13.	Sedimentation Units	1. Visual and dimensional check-up. 2. All the manufactures test certificates shall be submitted. If the KMCdesires any test, contractor shall arrange to perform the same at no extra cost.
14.	EOT Crane	1. Visual and dimensional check. Load test at 25% in excess of rated load. Test for Deflection Test for lifting speed.
15.	Actuators	1. Visual and dimensional check. 2. Speed for actuation 3. All the manufactures test certificates shall be submitted. If the KMC desires any test, contractor shall arrange to perform the same at no extra cost.
16.	Motors and Reduction Gears	Visual and dimensional check-up. Test for speed All the manufactures test certificates shall be submitted. If the KMC desires any test, contractor shall arrange to perform the same at no extra cost.
17.	PLC, Automation, Field equipments	Visual and dimensional check-up. Checking for suitability in terms of connecting, fitting, auxiliary voltage, necessary change over contracts. Test certificate of all equipment and performance of equipment after connecting all controllers at local level and at remote level through controller. Display in terms of appropriate units and satisfactory calibration. Any error shall be removed. Coding and addresses of all inputs and outputs. Graphical representation alarm generation.

In addition to these the contractor shall carry out test of the other equipment in the presence of the KMC engineers and shall submit test certificates for approval.

18.6 Guarantee

i) The Contractor shall guarantee all plant and machinery and their equipments supplied under the Contract, including erection and commissioning works, to be suitable for the application for which it is designed, and against defects due to manufacture or poor workmanship for a period of 12 months from the date of satisfactory completion of the stipulated trial run period. The Contractor shall be responsible to

replace, free of cost, the whole equipment or parts thereof which may be found defective during this period, and to ensure the proper working of the equipment during the guarantee period. In case the Contractor fails to repair or replace any defective Equipment & machinery and equipment or part(s) thereof within 30 days from the date of intimation of any defects by the Engineer In-charge , the same will be done by the KMC/Engineer In-charge at the Contractor's cost.

ii) If it becomes necessary for the Contractor to replace or renew any defective portion of the plant or equipment under this Sub-Clause, the plant and equipment, so replaced and the work so renewed shall be guaranteed for a further period of 6 months from the date of replacement or renewal. Only genuine spare parts are to be used under the supervision and with approval of Engineer-in-Charge.

18.7 Certificates and Drawings for Electrical Installations

The Contractor shall furnish all the necessary data, drawings, layouts and test certificates, etc., as may be required by the power distribution agency and the Electrical Inspectorate Authorities in respect of all electrical installations, and shall obtain any required approvals or clearances. Necessary assistance will be given by the KMC in this respect. It would be obligatory on the part of the Contractor to obtain such sanctions and approval of the electrical load from the concerned authorities

18.8 Suitability of Equipment for Indian Tropical Conditions

All plant and equipment supplied under the Contract shall be suitable for operation under the climatic and operating conditions prevailing at the Site. All parts, surfaces and sealants which are subject to corrosion shall be made of such materials, and shall be provided with such protective finishes, as are appropriate to protect the installed equipment from deterioration or injury due to the climatic conditions or operating environment. All electrical and auxiliary equipment shall be specially treated for Indian tropical conditions especially in city of Kota.

18.9 Display Panels

The Contractor shall provide such charts and drawings as are appropriate to clearly illustrate the process, operation and maintenance requirements of the plant and facilities provided under the Contract. Such charts and drawings shall be mounted on a panel, protected with a glass cover, and affixed on to the wall(s) of the plant/pump house/control room, as the case may be, and shall include, as appropriate, the following:

General arrangement drawings.

Wiring diagrams and detailed drawings of all electrical and mechanical installations.

Assembly drawings for electrical and mechanical equipment.

Charts indicating operations and maintenance details and schedules for electrical and mechanicalequipment.Lists of commonly used spare parts and tools

18.10 Installation of Plants & Machineries

In case of all Electrical & Mechanical Equipment, plant & Machinery and fittings etc., the tendered rate shall include the costs of supplying, installation/erection, fixing in position, testing and commissioning etc. at the site of work. No extra charges shall be payable on this account by the KMC. 6 sets of completion drawings, complete set of equipment brochures, dimensional details, approved drawings, installation manuals, pre commissioning tests, commissioning tests required to be carried out, shall be kept & made available at site for inspection of the KMC's officers. These sets will be given to Engineer-in-charge before commencement of supple/erection of equipment.

(C) GENERAL SPECIFICATIONS –

1. Civil Works for STP

1.1 Survey Work

The Contractor shall carry out detailed survey work and submit both soft and hard copies of contour drawings with spot levels with 10 m x 10 m grid to the KMC. Necessary information such as reference to the location as proposed for the treatment plant by him with respect to site boundary. The investigations necessary to obtain HFL, nalla section and river section shall be done. The entire structure shall be proposed in such a way that the outlet of the STPs shall be above the HFL.The detailed survey shall be carried out with GTS bench mark andTBM shall be established in STPs area for construction purpose.

1.2 Geotechnical Investigation

The Contractor shall carry our Geotechnical Investigation work at the proposed location of treatment plant. The no. of bore holes to be taken, depth of boring etc. shall be decided in consultation with the Engineer In-charge. The Contractor has to provide the hard and soft copies of the test reports. If the bearing capacity of the soil found lower than that is mentioned in the soil report provided with the Tender document, the lower of the two values shall be considered for design.

1.3 Process / Hydraulics Design

- The Contractor shall provide his own design system and equipments based on Sequential Batch Reaction process to treat the raw sewage up to the sewage quality as said in Clause 2.2 or even better.
- Bidder shall design the plant in such a way that in case of non-availability of sufficient sewage at the time of commissioning, plant can be commissioned with a minimum quantity of sewage equal to 30% of the average capacity.

1.4 Treatment Objective

Considering the raw sewage quality and the required treated sewage quality, the Contractor shall furnish a process train to achieve the following objectives –

- To achieve guaranteed treated sewage quality or even better.
- To ensure that the offered treatment process is the most appropriate and state of the art in terms of both efficacy of treatment and cost (the Contractor shall have to produce the performance records with the same treatment systems applied elsewhere.)
- To ensure that the process is cost effective from both capital and running costs consideration.
- To ensure that the sludge produced is dewatered to a “spreadable” or “open body transportable” consistency – so that it can be easily disposed off.
- The process preferably should be free from utilization of chemical/any organic chemicals except for sludge removal process. No toxic chemical shall be used by the Contractor. He will submit the toxicity test report from any govt. recognized laboratory at his own cost before using such chemical.
- Oils/lubes/fuels/media/chemicals etc. to be used will be defined by Bidder.
- The final treated sewage is to be disinfected through chlorination & filtration before its disposal.

1.5 Structural Design

The Contractor shall have to do the structural design considering the survey details and geotechnical investigation details like safe bearing capacity, seismic forces, depth of water table and hydraulic flow diagram. The contractor has to carry out additional investigations required if any for carrying out the structural design. Rock anchoring shall be carried if required wherever uplift is considered. The design of plant units and Buildings – if any, shall be submitted by the Contractor in soft and hard copies, with General Arrangements and detail RCC drawings. The design of units shall be finalized in consultation with the Engineer – in – Charge. The design of units shall be as per relevant BIS or other Indian/international standards in absence of BIS or sound engineering practice. The contractor has to comply the queries raised during the scrutiny and if required has to redesign the structure till the structural designs are finally approved. The requirements to be fulfilled by the Contractor are described in detail in the general civil specifications and particular specifications for civil work for sewage treatment plant. Pressure releasing valve to release sub soil water pressure shall be allowed at appropriate locations.

1.6 Construction Works

The Contractor shall construct the civil units of the plant to accommodate the mechanical units to fulfil the requirement of process design. There shall be adequate working space, accessibility considerations like RCC staircase or ladders, walkway with proper width, hand railing, etc wherever needed. For Buildings, there shall be additional items like ventilation and lighting requirements, flooring and finishing (hard flooring like granite for machine bearing floors) etc. The civil units shall be constructed such that there is proper accessibility for repair or replacement of mechanical equipments. Any concreting shall be done only after approval of Engineer – in – charge. All construction work shall be carried out as per the provision of CPWD specifications unless otherwise mentioned in the document.

The finished GL of the STPs premises shall be above HFL

1.7 Equivalency of Standards and Codes

Wherever reference is made in the Contract to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise stated in the Contract. Where such standards and codes are national or related to a particular country or region, other authoritative standards which ensure an equal or higher quality than the standards and codes specified will be acceptable subject to the Engineer's prior review and written approval. Differences between standards specified and the proposed alternative standards must be fully described in writing by the Contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor desires the Engineer's approval. In fee event the Engineer determines that such proposed deviations do not ensure equal or higher quality, the Contractor shall comply with the standards specified in the Bid Documents.

1.8 Sign Board

The Contractor at his own cost, shall provide sign boards at approved locations, in English and Hindi at the site of the Works of approved size and design which provides

(i) The name of the Project,
(ii) The name and addresses of the KMC, the Contractor and the Consultant;

(iii) The name and short description of the Project and
(iv) The starting and completion dates. Contractor shall take care of signboard and re-do it in case of loss, damage, theft etc., as desired by the Engineer In-charge.

1.9 Assurance Programme/Sample Tests

Contractor shall be responsible to develop a quality control program and to all necessary materials, apparatus, instruments, equipment, facilities and qualified staff for sampling, testing and quality control of the materials and the under the Contractor. Without limiting the generality of the foregoing, the actor shall either (i) establish a testing laboratory at the site of Works which be adequately equipped and staffed to carry out all sampling and testing in accordance with the requirement set out in the Tender document specifications provide all field equipment and apparatus as necessary to conduct all in-situ tests and/or any Tests on Completion, or (ii) arrange for routine sampling, testing and reporting, as required, through a certified independent laboratory acceptable to the Engineer In-charge. The Contractor shall obtain the approval of the Engineer In-charge for the quality control programme developed by him and incorporate any modifications suggested by the Engineer In-charge at no extra cost.

All costs of such sampling, testing and reporting of test results will be borne the Contractor, and the Contractor shall include sufficient provisions in his; tendered rates to allow for independent sampling and laboratory testing under the direction of the Engineer In-charge. The Contractor shall furnish certified copies of all test reports to the Engineer In-charge within 3 days of completion of the specified tests.

The Contractor shall, within 14 days after the date of the issue of Letter of Acceptance, submit to the Engineer In-charge for his consent a detailed description of the arrangements for conducting the quality control programme during execution of the Work, including details of his testing laboratory, equipment, staff and general procedures. If following submission, or at any time during the progress of Works, it appears to the Engineer In-charge that the Contractor's quality control programme is not adequate to ensure the quality of the Works, the Contractor shall produce a revised programme, as desired by the! Engineer In-charge, which will be adequate to ensure satisfactory quality control, in case of the Contractor will fail to ensure quality control program the action deem fit will be taken against the Contractor. The KMC shall carry out supervision and quality control and monitoring the progress of works.

1.10 Protection of Utilities

The Contractor is required to carefully examine the location of the Works and their alignments and to make special enquiries with all authorities concerning utility lines such as water supply, sewers, gas pipe, telephone (underground and/or overhead) lines, electric cable (underground and/or overhead) etc., and determine and verify to his own satisfaction the character, sizes, position and lengths of such utilities from authentic records. The Contractor shall be wholly responsible for the protection and/or facilitating relocation of such utilities as may be required and shall not make any claim for extra work or extra time that may be required to protect or facilitate relocating such utilities. If any major shifting realignment of water supply, sewers, gas pipes, electric and telephone lines is necessary due to their interference with the proposed Works, the same may done by the Contractor. The cost of such relocations will be borne by the Contractor.

1.11 Erection

Bidders have to note that various major items shall be procured / executed under this Contract subject to inspection by the KMC or their authorized representatives at manufacturer's premises. Cost of inspection shall be borne by Contractor

1.12 Testing of Concrete

Testing of Concrete shall be carried out as per IS4926: 1976. The contractors shall send three flexural beams to the laboratory for every ten slabs, or part thereof, for testing flexural strength. The admixture used shall conform to IS 9103-1979 reaffirmed on 1990 or AS1 C-494 of 92.

All taxes/duties etc. will be borne by the contractors and not by the KMC. No extra payment will be made for the use of admixtures.

2. Mechanical Equipments for STPs

The Contractor shall have to design, supply, erect and commission the mechanical equipments as proposed by him in the treatment train to achieve the required parameters. The design, material of construction and type of various mechanical equipments shall confirm to the standards laid in various sections of Tender document.

3. Electrical and Instrumentation / Automation System

The Contractor shall design, shop test, supply, transport, storing at site, erecting, testing and commissioning all electrical equipments and instruments required for the plant as per general specifications, specific specifications for electrical works, typical power distribution scheme and typical control system architecture

4. Disposal of Sludge/Screenings/Debris

The screenings/debris/dried sludge from the Sludge Handling Unit shall be disposed off by the Contractor to a suitable location, which is away from the residential area. The place of sludge disposal shall be as per the decision of the Engineer In-charge, within a radius of 10 kms from the plant. The responsibility of sludge withdrawal and disposing off lies with the Contractor within the operation and maintenance period. The Contractor should explore the possibility promoting it as manure.

5. Disposal of Excavated Stuff

It will be the responsibility of Contractor to dispose all the excavated stuff within the KMC limits or as directed by Engineer In-charge.

6. General Utilities

For the proper functioning of the proposed works of sewage treatment plant, connection for rising mains, sewage channel, the other general utilities necessary for the proper functioning of the proposed works which shall be included under this Contract are :

- Internal & outdoor lighting, plant water supply and sanitation, waste disposal, etc.
- Electric substations and distribution of power supply to all necessary points
- Street and yard lighting and fire hydrant system for the STPs.

7. Safety Equipment:

Safety Equipments should be provided at STPs as per the recommendation of Inspector of Industries. Contractor shall Also, take care of safety compliance as applicable from time to time as per safety rules/Factory act/Indian Electricity regulations/manuals/manufacturer's special instructions.

8. Model of the Project:

A 3D working Model of the Plant shall Also, be submitted by the Contractor. The size of the Model shall not be less than 1.5 m x 2.5 m. The Model shall be within a wooden Box having glass on its top and kept over a Table for display.

9. Scope of Work for Operation & Maintenance

The Bidder shall operate and maintain the entire scheme with Sewage Treatment Plant and all other allied works under this Contract for a period of 180 months, including defect liability period of 12 months. For this period, the scope of work shall include, but not be limited to the Operation and Maintenance of the following:

- Diversion weir, all inlet screen and grit chambers, wet well. including operation and maintenance of pumping machinery, all electrical equipments, transformer substation, operation and maintenance of DG set, all electrical and mechanical equipment in wet well
- All interception diversion works including Raw Sewage Pumping Station, Sewage Treatment Plant, including all the Civil Units and Electro-Mechanical Equipments as per the Bidder's Proposal to ensure that all the output guarantees are met.
- General Facilities and Utility Services.
- PLC/SCADA based Automation system.
- All other in-plant facilities listed in the detailed Scope of Work

The Bidder shall Also, dispose-off the sludge, screenings, grit and any other material, as per specifications and to the satisfaction of the Engineer In-charge. It is to be noted that all costs during the O&M period excluding cost of power and diesel for DG is to be borne by the Contractor. Within his quoted cost, the Bidder is to ensure that the following guarantees are maintained:

- Guarantee for Quality of Treated Sewage.
- Guarantee for Power Consumption.
- Guarantee for Automation System.

The Bidder shall provide on job training to the KMC staff as per specifications.

The Bidder shall, at no extra cost to the KMC, repair and re-condition all the required mechanical equipments in the concluding year of the O & M period and Hand over the facility to the KMC in proper & fully working condition.

10. Operation and Maintenance Cost

All the cost for Operation and Maintenance of the Plant such as Chemicals and Consumables, Disposal of Screenings, Grit and Dewatered Sludge, Manpower, Spares, Repair and Maintenance of Civil, Mechanical, Electrical, Instrumentation Items including all other major/minor repairs, breakdowns, replacements etc. **excluding Cost of Electricity and Diesel for DG** shall be in the scope of the Bidder. **No extra payment other than whatever has been quoted in Price Schedule**

will be entertained by the KMC.

The Bidders are to quote O&M Cost and provide Functional Guarantee based on the following data which shall be used for technical evaluation of qualifying Bids:

BOD	:	250 mg/l
TSS	:	375 mg/l

11. Contract Period

The total Contract Period shall be as follows:

Construction Period	:	2 Months (including Monsoon)
Stabilization & Trial & Run Period	:	3 Months
O&M Period	:	15 Years including 12 months defect liability period

12. General Requirements

All the building and structure works shall generally comply with the following Requirements:

1) All building works shall be reinforced concrete framework with concrete floors and roofs.
2) All internal partition walls except for toilet shall be in 230 mm thick brick masonry built in cement mortar 1:5 with transomes and mullions as in (2) above. Toilet partition walls shall be in 115 mm thick brick masonry built in cement mortar 1:4 and shall have transomes and mullions similar to (2) above and shall form panels not exceeding 1200 mm x 1200 mm in size.
3) Toilet floor slab shall be filled with brick bat cobs (broken bricks in lime) and provided with waterproofing as per the specifications of an approved specialist waterproofing company.
4) The finished floor level in toilet areas shall be 25 mm below general finished floor level elsewhere in the building.
5) The toilet facilities shall be provided in Administration-cum-Laboratory building separately for men and women which include at least:
6) 2 Nos. Toilet (1 no. for men and 1 no. for women) with white porcelain Orissa pan minimum 580 mm long with flushing cistern of 10 litres capacity.
7) ii) 2 Nos. wash basins (1 no. for men and 1 no. for women) of size 510 mm x 400 mm in white porcelain with inlet, outlet and overflow arrangements,
8) iii) 2 Nos. mirrors (1 no. for men and 1 no. for women) of size 400 mm x 600 mm wall mounted type fitted over wash basins.
9) iv) 2 Nos. plastic liquid soap bottles (1 no. for men and 1 no. for women)
10) Nos. chromium plated brass towel rails (1 no. for mean and 1 no. for women) minimum 750 mm long,
11) All stopcocks, valves and pillar cocks shall be heavy-duty chromium plated brass.
12) All fittings such as "P" or "S" traps, floor traps, pipes, down take pipes etc.
13) The sewage from toilet blocks shall be led to the nearest wet well.
14) All staircases shall have 25 mm thick chequered mosaic tiles for treads and 25 mm thick plain mosaic tiles of approved shade for risers set in cement mortar or lime mortar to give an overall thickness of 50 mm.
15) All floor cut-outs and cable ducts, etc. shall be covered with pre-cast concrete covers in outdoors areas and mild steel chequered plates of adequate thickness in indoor areas. All uncovered openings shall be protected with galvanized MS hand railing.
16) All staircases shall be provided with MS galvanized and MS hand railing for protection.
17) For the entire finished roof surface shall have adequate slope to drain quickly the rainwater to rainwater down take inlet points.
18) For roofing drainage, CI rainwater down takes with CI bell mouth and MS grating at top shall be provided. For roof areas up to 40 sq.m. minimum two nos. 100 mm diameter down take pipes shall be provided. For every additional area of 40 sq.m. or part thereof, at least one no. 100 mm diameter down take pipe shall be provided.
19) Top surfaces of chajjas and canopies shall be made waterproof by providing a screed layer of adequate slope or application of an approved roof membrane and sloped to dram the rainwater.
20) All doors, windows, rolling shutters shall have lintels above. Chaija protection to lintels on external walls shall be such as to prevent the rainwater splashing into the building. The minimum width of chajja for doors, windows, and rolling shutter shall be 750 mm, 600 mm, and 900 mm respectively.
21) All windows and ventilators shall have 25 mm thick Tandoor/Kota stone still bedded in cement mortar (1:3)

22) All concrete channels and ducts use for conveying liquid shall have inside width ; be less than 500 mm. All open channels shall be provided with hand railings. Al all such channels, which are more than 1000 mm above finished plot level, shall provide with walkways for access.
23) Kerbs to be provided below the hand railing on the catwalks/pathways should be; per relevant sections of Factor Act.
24) Wherever equipment and machinery are to be moved for inspection, service replacement etc., and suitable movable gantry of minimum capacity of 2 tons or more; required shall be provided with monorail and operating equipment.
25) The design of buildings shall reflect the climatic conditions existing on site. Process buildings shall be as far as is possible permit the entry of natural light.
26) The Laboratory, Chlorine House and office building shall be provided with two drinking water taps of 20 mm size with adequate inlet and out connections.
27) The sidewalls of buildings shall, except those used for storage and handling Chlorine gas comprise at least 15% ventilation areas. Ventilated brickwork louvers shall not be used where the ingress of driven rain could affect plant or stored materials.
28) All walkways, staircase, platforms etc., shall be minimum 1200 mm wide and will be provided with hand railing on one or both sides as required.
29) The floor shall generally be made of 150 mm thick concrete slab on grade with mm thick rubble soling and polyethylene sheet. The grade slab shall be provided with TOR 8 mm reinforcement Bars at 200 mm c/c both ways.
30) All hardware fittings and fixtures for doors, windows and louvers (e.g. Hinges, locks, latches, stay doorstops, door closers, floor springs) shall be heavy matching to the size and weight of the door window/ventilator shutters. These operate easily without hindrance secure properly without jamming; require nominal maintenance durable under prevailing site/weather conditions.
31) Suitable steps and/or ramp with overhead RCC Canopy shall be provided as requirement, at the entrances of the buildings.
32) 1,000 mm wide Plinth Protection (Apron) shall be provided all around Building/Sheds.

ANNEXURE " E – X"

SPECIFICATIONS FOR CONSTRUCTION OF G TYPE, H TYPE QUARTERS AND GUARD ROOM

S. N.	SOR ref.	Particulars of Item	G Type	H type	Guard Room with toilet
1		Carpet Area of each Quarter	Not less than 60 Sqm	Not less than 40	15
2		Number of Quarters/units	two	six	1
3		Built up area of each building	Not less than 150 Sqm	Not less than 330	20
4		Number of Floors	1	Three	1
5		Plinth filled with hard compacted murum with watering and consolidation not less than	750 mm minimum	750 mm minimum	600 mm minimum
6		Floor to floor height not less than	3.30 m	3.30 m	3.3 M
SPECIFICATIONS					
7	3.1	All PCC work	Grade M15		
8	3.4.2 & 3.12.1	RCC framed structure as per approved design and drawing	Grade M 20 and with Fe 415 TMT		
		RCC designs has to be carried out as per relevant BIS codal provisions. The designs has to be got vetted from NIT/IIT and got approved from competent authority of KMC.			
9	7.5	External Walls and internal Brickwork in flyash brick 1:6 cement mortar	230 mm thick		
10	3.13 &3.15	Damp proof course minimum 50 mm thick	Grade M 15 + Hot Bitumen 30/40 grade 1.70 kg/sqm		

11	7.14	Internal Walls for WC Block 115 mm thick in 1:4 cement mortar flyash brick.	115 mm thick
12	9.18.5	Door Frame double rebate MS sheet frame 1.6 mm thick	115 mm x 50 mm
13	8.12.3	Flush Door veneer on both face single leaf	30 mm thick
14	8.148.2	UPVC Door frame for toilet doors with wall thickness 2 mm	42 x 50 mm
15	8.15	PVC flush door shutter	25 mm thick
16	9.47,9.47.2&9.48	Aluminium powder coated Windows with neoprene gaskets	1.5 mm thick
17	9.51.2	Glazing for widows with tinted glass	5 mm thick
18	17.24	Galvanised wire gauge for door and windows	0.45 mm thick
19	8.120.1	Aluminium sliding door bolts	300 x 16 mm rod
20	8.121.2	Aluminium door latch	250 x 12 mm rod
21	8.122.2	Aluminium tower bolt for doors	200 x 10 mm
22	8.122.3	Aluminium tower bolt for window and ventilator	150 x 10 mm
23	8.123.1	Aluminium door Handle 2.5 mm thick for doors and windows	125 mm
24	8.124.2	Aluminium door stopper	Double
25	8.125.2	Aluminium door stopper	75 mm long
26	9.12	Steel door MS sheet 1mm thick for Veranda and court yard	not less than 40 kg/sqm
27	9.15	Providing MS Grill for windows ventilator and Varanda	not less than 25 kg/sqm
28	11.1	Plaster to ceiling Neeru finish in 1:4 cement quarter	6mm thick
29	11.2.3	Internal Plaster Neeru Finish in 1:6 cement	12mm thick

		mortar	
30	11.3.3	External Plaster in 1:6 cement mortar	15 mm thick
31	12.3.2	Plinth protection with 50 mm thick M 15 cement concrete	1.0 m wide
32	12.7.2	ceramic glazed wall tiles on wall and dados over 12mm thick bed of cement mortar 1:3 for bath, W.C and kitchen	not less than 200x300mmsize Dado up to 2.10 m
33	12.9	Ceramic glazed floor tiles laid on 20 mm thick cement mortar 1:4.	size not less than 300 x 300 mm with 100 mm wide skirting.
34	13.3.5	Udaipur green marble laid over 20 mm thick cement mortar 1:4 over RCC Kitchen Platform	15 mm thick
35	14.10.1	Internal painting with acrylic premium emulsion paint	Two coats over primer
36	14.9.1	External painting acrylic washable distemper	Two coats over primer
37	14.22.1	Satin synthetic enamel painting to MS grill/door	Two coats over primer
38	19.42	Polythelin water storage tank on terrace	1000 lit two numbers for each building and 500 lit for Guard room
39	19.8	Down take water pipe on wall surface	25 mm GI
40	19.7.3	Internal piping in WC Block concealed up to branch	25 mm GI
41	19.7.1	Piping for individual tap point concealed	15 mm GI
42	18.1.3	WC pan white Orissa pattern with required P/ S trap10 lit PVC flushing cistern	580 x 440 mm
43	18.17.2	Vitrouschina white wash hand basin with 32 mm brass waste coupling	550 x 400 mm

		brackets	
44	18.22.2	Stainless steel ISI 304 (18/8)Sink in kitchen without drain board with 40 mm stainless steel plug	560 x 410 x 215 mm
45	18.76.2	UV stabilised Unplasticised PVC (single socket) having 3.2mm wall thick Rain water down take pipe, soil pipe, vent pipes with vent covel with necessary bend Tee P trap	110 mm
46	19.14.15	Fittings for WC and Bath, bib cock, shower 150 mm , towel rail	CP Brass
47		Providing Nahanni trap	100 mm Size cast iron
48	19.15	Drain Jali over Nahani Trap	Stainless steel
49	19.16.1	Brass/gun metal gate valve with C.I wheel on water supply lines	25mm
50	20.1.2 &20.2	Providing & jointing glazed stoneware pipe for drainage line embedded in 1:5:10 cement concrete	150mm
51	20.3.1	SW P type Gully trap	100 x 100 mm
52	20.28.1	Brick masonry chamber with C.I cover frame	455 x 610 x 450
53	9.38	Broken Glass over parapet	50 mm thick
54	20.31	soak pit with brickbat including S.W drain pipe, Dia 1.20m long	Not less 1.20x1.20x1.20 m

55		Septic tank of minimum 5.0 x2.4 x2.0 m excluding 0.4 m free board. Brickwalls shall be 300 mm thick with 15 mm thick plaster in 1:4 cement mortar on both sides. brick masonry inlet chamber of inner dimension 455 x 610 x 450mm with sewer trap, 110 mm PVC vent pipe with cowl	Not less than 5.0 x2.40 x 2.4 m inside dimensions
56		**Boring / Drilling tube well of 150 mm Dia in all type of strata up to 170 m including unplasticised PVC pipe of required length with necessary MS clamp etc complete. Providing 32 mm Dia GI pipe of 180-meter length including necessary bend couplings union, brass/gun metal gate valve.**	150 mm Dia 180 m deep
57		Providing installing and commissioning ISI mark 50 Hz 415 V submersible pump with 55 m head and 60-150 LPM discharge	Minimum 3 HP 6 stage pump or higher as required

Electrical Specifications

The details of point in each room are as under

Sr. No.	Room type	Light point		Fan point	Exhaust fan point	15 Amp Power point	5 Amp In pendent plug point	5 Amp Plug point on board
		Tube	Bulb					
1	Hall	1	1	1		1	2	1
2	Bed room	1	1	1		1	1	1
3	Kitchen	1	1	1		2	1	1
4	W/C+ Bathroom		1		1	1	1	1
5	Passage	1					1	
6	Gallery		1					

1. Under this item agency has to carry out the work of Supplying and erecting rigid steel conduit 16 SWG 20 mm dia. with necessary accessories in wall/floor with chiseling suitable laying the mains . Specifications for fixtures, switches, cables have been enclosed in specification for STP

2. The switch provided should be modular type.
3. The tube light fitting should be LED anodized aluminum corridor / passage light LED fitting (4 feet) Max. 22W
4. The fan provided should BE Energy Saving BLDC Ceiling fan 230 V A.C. 50 cycles 1200 mm, max. energy consumption of 28W.
5. The exhaust fan should be medium duty 230 V A.C. 50 cycles 225 mm. 1400 RPM
6. There should be separate circuits for lighting and power. Two-way circuit shall have to be provided in stair case lighting.
7. MCB/Isolator of adequate capacity should be provided in D.B. of required size.
8. Proper earthing has to be provided with required size copper plate GI earth pipe and required material in earthing pit.
9. Work also includes external electrification comprising of street lights as per approved layout, cabling, feeder pillar etc. complete

ANNEXURE "E-XI"

SPECIFICATIONS FOR LAND DEVELOPMENT WORK AT WET WELL COMPOUND WALL INTERNAL ROAD STROM WATER DRAIN

(Item wise Specification as per Chapter 1 to 14)

ANNEXURE "E-XII"

SPECIFICATIONS FOR OPERATION AND MAINTENANCE OF 33.00 MLD STP FOR THE PERIOD OF 15 YEARS

The successful bidder shall enter into a separate agreement for O & M of 15 Years after the issue of certificate of completion of trial run period of 3 Three months. The security deposit of the capital works shall only be released as stated in the conditions of contract, after successful completion of 15 years of O & M period. The Performance Bank Guarantee of 5% of the amount of the bidder's price for B (O&M offer for 15 years B in financial offer) has to be submitted by the bidder within 15 days of the written notice by the KMC.

Scope of work

A. Scope of work

1.1 Operations

The Operator shall carry out all Facility operation and sewage treatment operation indicated below, in accordance with Good Operating Practices, as set out in this Contract. The Facility operation and sewage treatment operation shall include, but not be limited to the following.

a) Wet wells at Kosabadi locations.

b) All 11 Nos, inlet chambers, intercepting sewer, diversion weir with all debris cleaning , making easy sewage flow, periodical cleaning of manhole chambers and debris facilitating easy flow entry to Wet well.

i. The contractor shall operate all the components of the work which has been executed by him and maintain the nalla streams, and keep them out of debris at all the time to allow smooth flow of waste water in the screens, inlet chambers, wet wells and pump houses, to ensure non-clogging of the inlet screens shall be the responsibility of the contractor.
ii. Pumping main Kosabadi SPS to STP at Pragati Nagar
iii. Operation of pump at Kosabadi SPS
iv. Interceptor from Gevra nalla to Kosabasi SPS
v. Cleaned Debris should be disposed as directed by engineer incharge within 10 Km radius

c) Interceptor lines and chambers cleaning Contractor has to clean and maintain interceptor line and chamber for the free flow of sewage. Chambers has to be periodically cleaned and the debris shall be dump safely to the landfill site provided by KMC

d) The contractor shall have to clean the choke up lines as and when required.

v.

e) Sewage Treatment plant :

i. Operator shall maintain the operation and maintenance as given in DETAILED SCOPE OF WORK attached in tender.

ii. Operating Sewage Treatment Plant to maintain the quality of treated sewage within the standards prescribed mention in tender.

iii. Carrying out cleaning of grit channels and screens removal and disposal of floating matter and removal of dried sludge and transfer to disposal point.

iv. Carrying out continuous flow measurement of treated sewage and recording the same online.

v. Collecting samples of influent and effluent and analysing them daily to determine the quality of sewage and performance of the treatment using existing laboratory.

vi. Carrying out preventive, routine & breakdown maintenance operations as indicated in Appendix 1.

vii. Replacement of mechanical & electrical equipments which becomes beyond repairs.

viii. Providing security for facilities and system at all times.

ix. Operation and Maintaining diesel generator including fuel and operator for round a clock duty in all seasons at Sewage treatment plant at Korba of following capacity.

x. Thirt Party testing of parameters BOD,COD,TSS,PH,TDS and coliforms from inlet and outlet of sewage treatment plant shall be carried out from NABL Lab once in every onth during the entire O&M period.

As per specification given

1. Pragati Nagar STP (Pump House) 1500 KVA
2. Kosawadi Nalla Wet well (Pump House) - 1500 KVA

Capacity diesel generator with necessary acoustic hood arrangement with less noise level. (Salient power with necessary cable and change over switch to HT panel)

1.2 Contingency plan : Development and implementing contingency plan in respect of responses to natural disasters, period of power failure, storm water inflow into sewers, pump house during monsoon, de-silting of wet well, basins, fails to operate electromechanical equipments such as pumps, motors, blowers starters etc. or it is in non-working condition which leads to overflow or blockage of sewerage distribution system and other units of treatment plants constraint operation's or other similar emergencies to maintain the quality of treated sewage

1.3 Service 1-Energy Audit

1.3.1 The Operator shall take all necessary measures to minimize the power consumption in carrying out its Operations. The energy audit Operations shall include, but not be limited to the following:

(a) Reducing electricity consumption by regulating pumping, through suitable modifications to the operating schedules;

Periodically perform pump efficiency tests to identify maintenance requirements.

Avoid periodic motor testing during peak hours.

Install high efficiency lighting systems.

(b) Maintaining power factor and demand to avoid penalty; Install capacitors to reduce power factor charges.

(c) Repairing / Replacing old and worn out pipes; and Blowers & compressors-
Minimizing energy use may be accomplished by:
Closing the valve on the inlet side if a centrifugal blower must be throttled.
• Monitoring pressure and cleaning filters regularly.
• Operating centrifugal blowers at more than 50% of their rated capacity.
• Monitoring daily loads with watt-hour meters.
• Maintaining blower operation within manufacturer's recommended speeds.

1.4 Service 2-Repairs and Maintenance

1.4.1 The Operator shall carry out preventive, routine maintenance and break down maintenance Operations as indicated in Appendix 1, and in accordance Operating Practices. The following items shall be included in such maintenance;

a. Wet well & Pumping Station
- De-silting of wet well at least once a year and disposing silt;
- Replacing damaged pipes, fittings and valves.
- Replacing damaged bearing, mechanical seal, o ring, gaskets.
- Repairing and replacing pump impellers, body, shafts, column pipes;
- Repair or replacing of guide pipe, coupling, duck foot bend.
- Repairing or replacing of soft starters, ATS starters, circuit breakers capacitors;
- Replacing damaged lightning conductor, push buttons , switchgears, MCCB, ACBs,
- Replacing ladders
- Repair &replacing of damaged railing.
- Waterproofing of leaking roof and painting of structure with two coats of paint (plastic coat).
- Repairing of overhead crane.
- Repairing and replacing of level sensors & flow meters,
- Repairing and replacing of coarse screens, hydraulic arrangements, power pack, motors bearing, jaw mechanism for screens,
- Repairing and replacing of screw/Belt conveyors, motor, etc.
- Repairing of manual & motor operated (actuator type) inlet gates for wet well and for bypass arrangement.
- Repairing and replacing of non-return valve, sluice valves, manual or motor operated pumping bypass valves.

b. Primary Unit &Detritor Mechanism
- Repairing of mechanical screens, rack arrangement, hydraulic arrangement.
- Repairing of manual gates.
- Repairing or replacing of detritor mechanism, gear box, rack arrangement, motors etc.
- Desilting of grit in grit mechanism unit at least once in a month.
- Repairing or replacing of screw conveyors motor, etc.
- Repairing and replacing of Hydrostatic level sensors.
- Repairing and replacing of grit wash pumps motors etc.
- Repairing of structure for Detritor and water proofing the same.
- SBR Basin & Blower Room

- Repairing and replacing damaged pipes, blower pipe line, RAS & SAS pipe lines, fittings and valves for above pipe line;
- Repairing and replacing pump impellers, body, bearing, shafts, column pipes for RAS & SAS pumps
- Repairing and replacing of cable trays, damaged cables, push buttons etc
- Repairing or replacing of SBR basin gates.
- Repairing or replacing of level transmitters, sensors, ultrasonic flowers meters float switch, DO sensors and other instruments used for automation system.
- Repairing or replacing of SS or GI railing, roof sheets for SBR walkway.
- Repairing & replacing of blowers and motors.
- Repairing or replacing of soft starters, VFDs, circuit breakers capacitors for pumps & blowers.
- Repairing or replacing of blower's accessories such as filters, inlet and exhaust silencers, acoustic hoods, pressures gauges, damage pipes and fitting NRVs.
- Servicing of raw sewage pumps, RAS/SAS pumps at least once in a year.
- Sludge sump & Sludge House
- Repairing or replacing of centrifuge decanters, feed pumps, poly dosing pumps, agitators, its motors starters valves, fittings, shafts, starters etc.
- Replacing damaged lightning conductor, push buttons, switchgears, MCCB, ACBs etc. for control panel of above unit.
- De-silting and entire cleaning of sludge sump every 3 months intervals and disposing silt;
- Repairing or replacing of level sensors for sludge sump.
- Chlorination Unit & Chlorine Contact Tank
- Repairing or replacing of chlorination unit.
- Repairing or replacing of safety equipment's, breather apparatus for chlorination system.
- Repairing or replacing of chlorine toners.
- Repairing or replacing of booster pumps
- Repairing or replacing of air blower for caustic solution

c. Repairing or replacing of motors, shafts, pipes, bearing for above pumps
   - Weekly Cleaning of chlorine contact tank.
   - Monthly Cleaning of Caustic solution tank.
   - Transformers & HT Substation
   - Repairing of transformer, oil filtration/oil replacement, breathers, silica gels etc.
   - Repairing or replacing of breakers, capacitors, indicating lamps, push buttons, ACBs, MCCBs,
   - Repairing or replacing of RMU, CT/PT and metering unit, Main Lighting Panel, Street lighting Panels, LDB's for diff areas, Earthing Grid, Street Lighting, Plant Lighting, Office Lighting.
   - Servicing of main breakers, bus couplers etc. at least once in a year.
   - Servicing of all earthing arrangement, earth pit, lightening system at least once in a year.

d. PLC SCADA / Automation System
   a) Repairing or replacing of PLC SCADA system, computers, printers etc

b) Up gradation of license used for SCADA system, computers system, its antivirus etc for smooth running of system.
c) License fees and periodical recharge of the network operator till the completion of 15 years O & M period shall be in the scope of contractor.Incase of default the KMC Shall deduct the payments from RA Bill.

1.5 Service 3-Advice

1.5.1 Early Warning: The Operator is to warn the Competent Authority at the earliest opportunity or specific likely future events or circumstances that may adversely affect the operations or the condition of the Facilities and\or System. The Operator shall cooperate with the Competent Authority in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced and in carrying out any resulting instruction to the Competent Authority.

1.5.2 The Operator shall Also, advice the Corporation, from time to time, on improving the quality of Operations, reduction in water\ energy losses.

2.0 Extra Work:

2.1 The Operator shall carry out all extra work indicated below, in accordance with Good Operating Practices, as set out in this contract. Notwithstanding extra work resulting in increased Operations resulting out of Force Majure events or other than those listed in CC Section 15.4 shall include, but not be limited to the following.

(a)Extension\modifications to the sewerage network ;
(b)Improvement to civil structures; and
(c) Any other work not covered under the Service, enumerated above

2.2 The Corporation shall reimburse the aforesaid extra work based on the prevailing schedule of rates (the lowest rate for an item featuring the PHED/ PWD SOR) or the actual cost of procurement by the Operator, whichever is lower. The Corporation reserves the right to either procure those items of stores or fix a rate contract against which the Operator can procure such stores. However, if the extra work does not feature in the schedule of rates, the value item and work shall be mutually agreed between the Corporation and Operator.

3.0 Reporting

3.1 The Operator shall utilize the office space, provided by the Corporation to establish kit's monitoring and reporting office along with computer and peripherals. It shall Also, obtain a telephone connection and maintain the same through the Contract Period. All data transfers and updates made to the Corporation shall be affected through the said telecommunication medium.

3.2 The Operator shall carry out all reporting (Appendix 2-Reporting) indicated below and as set out in the Appendices to this Corporation shall be affected through the shall include but not be limited to, the following;

a) Attachment 1: Daily summary of Operation at all the pumping Stations – A daily report providing information at all the pumping stations on the hours of pumping, quantity of sewage pumped and energy consumed during the day.

b) Attachment 2: Daily summary of Operator at Sewage Treatment Plant - A daily report of operation of Major equipment at the sewage treatment plant providing information on the quantity of sewage

treated, hours of equipments, energy consumed and use of chemicals.

c) Attachment 3: Sewage Quality Monitoring – A daily report monitoring the quality of raw and treated sewage through the analysis of samples.

d) Attachment 4 : Sewage Quality Monitoring at Sewage Treatment Plant

e) Attachment 5: Desilting Operating Schedules.

F. Responsibilities

4.0 Corporation's Responsibilities

4.1 The Corporation shall be responsible for procuring, obtaining and maintaining Corporation Clearances. Provided However, that the Operator shall be responsible for maintaining the conditionality of any such clearance, if such maintenance falls within the purview of the Operator.

4.2 The Competent Authority shall supervise the Operator's Operations at all times and notify the Operator of any defects that are found. Such checking shall not affect the Operator's responsibilities. The Competent Authority may instruct the Operator to search for a defect If the Operator has not corrected a defect within the time specified in the Competent Authority's notice, it shall proceed as per CC Section 33. However, any such tests not specified in the operations shall be carried out as indicated in CC Section 16.

4.3 The Corporation shall be responsible for.

a) Energy charges.

b) Maintaining administrative control over the personnel Facilities and System.

5.0 Operator's Responsibilities

5.1 The Operator shall maintain properly and keep intact all assets/works/Facilities/Systems of the Corporation throughout the Contract period and shall hand over the same in good working condition at the end of the Contract. The Operator shall not modify or alter any operations regarding the Facilities and / or System without prior written permission of the Competent Authority or it's Representative.

5.2 The Operator shall procure all spare parts required for the maintenance of equipment, excluding those to be supplied by the Corporation. The Operator shall warrant to the effect that all the spares shall be procured from the authorized sources and be of the best quality and fit for purpose for which it is being used.

5.3 The Operator is expected to carry out the work in such a manner as not be cause any damage to public property on account of negligence or otherwise. The Operator shall be fully responsible for making good the damages so caused by him entirely at his own cost.

5.4 The assets/works/Facilities/Systems of the Corporation shall be at the risk and in the sole charge of the Operator and it shall be responsible for making good any loss or damage there to arising from any cause whatever including that due to theft or robbery.

5.5 The Operator shall provide adequate engineering equipment, maintenance staff, inventories, plant and machinery and all other things, whether of a temporary or permanent nature required for carrying out Operations under the Contract.

5.6 The Operator shall carry out its Operations, so far as compliance with the requirement of the Contract permits, so as not interfere unnecessarily or improperly with.

a) The convenience of the public or

b) The access to, use and occupation of Public or private roads and footpaths to or of properties.

5.7 Permissions: The Operator shall obtain all required permissions, sanctions, clearances and permits for carrying out its Operations, including Operator Clearance, and shall be fully responsible for carrying out the operations in a safe and secure manner, consistent with the law

of the land, laws and regulations regarding such Facilities and/ or System, and directives of any Authority and planning permissions.

5.8 Safety:- The Operator shall be responsible for the safety of all activities on the Site and shall be absolutely for any and all kinds of injuries or damages to person and property of any description whatever may be caused by or result from the operations carried out, whether may have been carried out skillfully and carefully and strictly in conformity with the provisions of the specifications or not.

5.9 Discoveries: all fossils, coins, articles of value or antiquity and structures and other remains for things of geological or archaeological interest discovered on the Site shall, as between the Corporation and the Operator, be deemed to the absolute property of the Corporation. The Operator shall take reasonable precautions to prevent its workmen or any other persons from removing or damaging any such article or thing and shall, immediately upon discovery thereof and before removal, acquaint the Competent Authority of such discovery and carry out the Competent Authority`s instructions for dealing with the Same.

5.10 The Operator shall be responsible for payment of reinstatement charges for roads, footpaths, and land as per Corporation`s rates.

5.11 The Operator shall be taken full responsibility for the adequacy, stability and safety of all site operations. Provided that the operator shall not be responsible (except as stated hereunder or as may be otherwise agreed) for

a) Electrical power failure; and

b) Occurrence of breakdown in the network.

5.12 Staff &Labour

6.0 Engagement of Staff &Labour

6.1 The Operator shall employ skilled. Semi-skilled and unskilled labour in sufficient numbers to carry out its operations at the required rates of progress and of quality to ensure workmanship of the degree specified in the Contract for timely fulfilling of the Operator`s obligations under the Contract and to the satisfaction of the Competent Authority. A tentative requirement of such staff is indicated in Appendix 3 – Operator staff Requirement.

6.2 The Operator shall not employ in connection with the operations any child who has not completed his/her fifteen years of age. It shall Also, not employ an adolescent who has not completed his/her is eighteenth year unless he/she is certified fit for carrying out Operations as an adult as prescribed under clause (b) of sub-section (2) of Section 69 of the Factories Act. 1948.

6.3 The Operator shall provide its staff, a minimum of two sets of uniforms with the titles KMC inscribed on the back and subject to approval of the Corporation. Each worker on duty shall wear a clean uniform whenever on duty.

6.4 The Operator shall, if required by the Competent Authority, deliver to it, in such form and at such intervals as the Competent Authority may prescribe, a return showing the numbers of the several classes of staff employed by the operation on the site and such other information as the Competent Authority may require.

6.5 If the Competent Authority asks the Operator to remove a person who is a member of the Operator's staff stating the reasons, the Operator shall ensure that the person leaves the site within seven (7) days and has no further connection with Operations under this contract.

6.6 At all times during continuance of the contract, the Operator and its Subcontractors shall abide by all existing and future labour enactment and rules made there under, regulations, notifications and bye-laws of the Central, States or Local Government. The Operator shall keep the Corporation indemnified in case any is taken against the Corporation by any Authority on

account of contravention of any of the provisions of any Act or rules made there under, regulations or notifications including amendments.

6.7 If the Corporation is caused to pay or reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/byelaws/acts/rules/regulation including amendments if any, on the part of the Operator and in connection with labour enactment, the Competent Authority shall have the right to deduct any money due to the Operator including its amount of Security Deposit. The Competent Authority shall also, have the right to recover, from the Operator, any sum required or estimated to be required for making good the loss or damage suffered by the Corporation.

7.0 Operator's Superintendence

7.1 The Operator shall provide all necessary superintendence while carrying out its Operations and as long thereafter as the Competent Authority may consider necessary for the proper fulfilling of the Operator's obligation under the Contract. The Operator shall nominate a competent and authorized representative ("Operator's Representative) approved of by the Competent Authority, which approval may at any time be withdrawn. The Operators Representative shall give its whole time to the superintendence of the operations. The Operator's Representative shall receive, on behalf of the Operator, instructions from the Competent Authority, which shall be deemed received by the Operator.

7.2 If the Competent Authority withdraws approval of the representative the Operator shall remove the representative from the Operations within Twenty Eight (28) days, and replace him by another representative approved by the Competent Authority.

7.3 Contract Performance

8.0 Review and Progress

8.1 Management Meetings: - Either the Competent Authority or the Operator may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining Operations and to deal with matters raised in accordance with any advice. The Competent Authority shall record the business of management meetings and is to provide copies of its record to those attending the meeting and to the Corporation. The responsibility of the Parties for actions to be taken is to be decided by the Competent Authority either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

8.2 The Competent Authority may instruct the Operator to rectify defects and deficiency in its operations. Alternatively, the Corporation shall carry out the operations on its own and deduct the amount incurred in attending to such defaults from the next payment due to the Operator. The deduction of such damages shall not relieve the Operator from its obligation to carry out the operations, or form any other of its obligation and liabilities under the Contract.

8.3 Notwithstanding anything stated above, if the Corporation is of the Opinion that the actions of the Operator is deemed as an event of default of Service and the event persists beyond One (1) day, the Corporation shall be entitled to invoke the Security Deposit and carry out the Operations through a Successor Operator or departmentally. The Corporation shall then proceed as per CC Section 33.

9.0 Liquidated Damages and Penalties

9.1 The basis for applying penalties is to restrict Operator from deviating from disposing all raw/treated waste water efficiently from the service area – as per fixed schedule and with CGSPCB treated waste water norms for discharge in surface water bodies.

9.2 The Operator is Also, expected to carry out the instructions of the Competent Authority or its representative, from any time to time maintain the System in accordance with Good Operating Practices, attend to Customer complaints promptly provide new connections to Customers. Refrain from offering Operations without due authorization where so required, and follow other requirements under this Contract.

9.3 The Operator shall be subject to the following liquidated damages and penalties for its failure to carry out its Operations as indicated in Conditions of the Contract

s.n.	Basis of Penalty	Penalty Benchmark	Penalty Value
1	Failure to maintain parameters of treated sewage as mentioned in the tender	Up to 2 Occurrences/month	Rs. Nil
		2 to 5 Occurrences/month	Rs. 5000/- per occurrence
		5 to 10 Occurrences/month	Rs. 20000/- per occurrence
		Above 10 Occurrences/month	Rs. 100000/- per occurrence
2	Inadequate maintenance of Facilities, Pumping machinery ,Mechanical& Electric Equipments etc	For each case detected	Rs. 1500/- per occurrence
3	Inappropriate desilting of sewers and clearing of silt within plant premises	Per Occurrence	Rs. 1500/- per occurrence
4	Inappropriate clearance of blockage or nonattendance to complaints of blockage in sewers within plant premises.	Per Occurrence	Rs. 1500/- per occurrence
5	Non-replacement of damaged and missing manhole covers or frames.	Per Occurrence	Rs. 1500/- per occurrence
6	Inadequate contingency plan within plant premises.	For each case submitted.	Rs. 1500/- per occurrence
7	Delay in recording wet well levels; energy meter reading, power failure time or diesel consumption.	Per Occurrence/Day	Rs. 1500/- per occurrence
8	Duty staff not wearing uniform or it being dirty.	Per Occurrence/Day	Rs. 1500/- per occurrence
9	Non – attendance of Customer complaints in time or adequately	Per Occurrence/Day	Rs, 1,500/- per occurrence/Day
10	Security Personnel not provided	Per Occurrence	Rs, 1,500/- per occurrence/Day
11	Non repairing of Electric Motors, Pumps blowers, or other electro-mechanical equipments within 30 days of down time (asequipments are send to Manufacturer/ Manufacturer's or authorized representative for repairing) then after 30 days of down	Per Occurrence/Day	Rs. 2000/- per occurrence/Day

	time then for each day		
12	Non availability of MPCB records	Per Occurrence	Rs. 2000/- per occurrence/Day
13	Non availability of adequate staff.	Per person/Day	Rs. 1000/- per Day
14	Non-operating of PLC SCADA system	Per Occurrence/Day	Rs. 2000/- per Day
15	Delay in recording of chlorine doses or not using of chlorination unit	Per Occurrence/Day	Rs. 3000/- per Day
16	Day Non operation of sludge sump & sludge unit non-availability of disposal vehicles, centrifuge being not operated and not removing of sludge or bypass of sludge.	Per Occurrence	Rs. 2000/- per Day
17	Non availability of safety equipments	Per Occurrence/Day	Rs. 2000/- per Day
18	Development and implementing contingency plant in respect of responses to natural disasters, period of power failure, storm water inflow into sewers during monsoon, de-silting of wet well, fails to operate electromechanical equipments such as pumps, motors, blowers starters etc or it is in non-working condition which leads to overflow or blockage of sewerage distribution system and other units of treatment plants constraint operations or other similar emergencies to maintain the quality of treated sewage.	Per Occurrence/Day	Rs. 5000/- per Day
19	Power Factor Penalty /Excess demand charges	If P.F. penalty or excess demand charges are applied in energy charges or in CSEB bill then same will be deducted from contractor bill.	Contractor has to pay P.F. penalty or excess demand charges applied in energy charges or in CSEB bill
20	Clogging of interceptor sewer, inlet chamber, screens	Per occurrence/ day	Rs. 2000/- Per day
21	Deficient Solar Power Generation	Less than 10% of the guaranteed generation in the year	As per the actual bill difference of the CSPDCL
22	Biometric attendance of the O&M staff	Submission of monthly records in every month	Rs. 5000/- Per Month
23	Third party testing from NABL Accredited lab (both inlet and outlet parameters)	Submission of Test report in a month	Rs. 5000/- Per Month

10.0 Method of Affecting Penalties.

10.1 Items warranting penalties will be checked every two months this shall coincide with the billing cycle for Customers. The penalties shall be netted before any payments/deductions are made. The penalties shall be calculated on a cumulative basis during an Operating year.

10.2 In so far as the penalties are concerned the Competent Authority shall notify the Operator when in its opinion such defaults have occurred. The notification shall instruct the operator to present its case indicating the reasons for not attracting such penalties. If the Competent Authority is of the opinion that the cause of default is not by way of Operator`s action it shall drop such defaults and proceed with the final determination of incentives and penalties payable/recoverable from the Operator.

10.3 In the event that the net accrued penalty at any time of the Operating Year is greater than Ten percent of the Contract Price for the concerned Operating Year, the Corporation shall review whether the Contract needs to be continued with the Operator and may consider to proceed as per Conditions of the Contract.

10.4 Contract Price and Payment

11.0 Contract Price

11.1 The Operator shall be paid the Contract Price every month (The rate quoted by the contractor for the year in 12 instalments after deducting the security deposit and taxes) . The contract price shall cover all expenditure on staff, establishment, maintenance and repairs, spares and consumables, and any other expenses excluding expenses incurred on power and diesel for generator.

11.2 The Contract price shall include all customs duties import duties, excise duties, business taxes, income and other taxes that may be levied in accordance to the laws and regulation in-force on the Operator's equipment, materials supplies (Permanent, temporary and consumables) to be used on or furnished under the Contract and on the operations to be performed under the Contract. Nothing in the Contract shall relieve the Operator from its responsibility to pay any tax that may be levied on its Operations or on profits made by it in respect of the Contract.

11.3 The Operator shall pay Indian income Tax on all payment made to it under the Contract, other than reimbursements made to it by the Corporation to cover payment by Operator of minor custom duties, etc., or any other payment, which the Operator may make on the Corporation's behalf. Under the provisions of Section 194-C of the Indian Income Tax Act the Corporation is required to deduct Tax with surcharge at source at prevailing rates from the gross amount of each bill submitted. The Operator shall perform such duties in regard to such deductions thereof as may be imposed on it by such law and regulations.

11.4 The Operator shall pay all the Taxes directly to respective organizations and to the Government of India. The Corporation shall not take any responsibility for any kind of Tax payment to the Government or quasi-Government bodied at any point of time, other than those specified under CC Section27.4.

11.5 All charges pm account of octroi, cases, terminal or sales tax and other duties on material obtained for the operations from any source including the tax applicable as per GST/ CGST on the transfer of property in the goods involved in the execution of the operations, etc. shall be borne by the Operator.

11.6 The Operator shall submit form-3B or such other forms as are prescribed milder the said Act, , which is required to be produced by the principal employer in the events of any notice by the GST Department within one month of issue of Acceptance Letter.

11.7 The Operator is required to produce its registration for GST/ CGST to the Corporation before receiving the first payment for the operations executed by it, failing, which, no payment shall be made.

12.0 Procedures for Payment

12.1 The Operator shall submit a bill for payment at the end of every month. The bill shall be in accordance with the operations carried out during the contract Period form the last date of the previous bill and shall Also, account for any outstanding amounts, which are due from the Corporation.

12.2 The bill, in addition to payments due for the month shall contain supporting documents, which shall include without limitation; statements of:

(a) Calculations on any amounts due arising from any extraordinary adjustment penalties, extra work, variations, compensation events or incentive payment; and

(b) Calculation of interest due on late payments to or from the Corporation if any, and payable at an interest rate or 1% per month after completion of sixty (60) days from the date when such monies become due, and payable to the Party concerned.

12.3 The Competent Authority shall check the Operator's bill and certify the amount to be paid to the Operator after taking it to account any incentive or penalties the period in question. Where the incentives and are incentive or penalties are still to be determined the Corporation shall proceed to make payment to an extent of ninety (90) per cent of the amount due subject to the condition that no major deficiency in the operations has been noticed.

12.4 The Corporation shall pay the Operator the amounts certified by the Competent Authority within sixty (60) days of the date of each certificate. All payments shall be made in Indian Rupees.

12.5 The Competent Authority shall compute and verify the incentive\penalty applicable in the bill submitted by the Operator, If the Competent Authority is of the opinion that the incentive\penalty was warranted, it shall make necessary adjustments to approve the same and certify complete payments due to the Operator in the next month. However, if the Competent Authority is of the opinion that such incentives\penalty is not warranted, the excess amounts shall be adjusted from the payment due to the Operator for the following month.

12.6 Intellectual property& Confidential Information

13.0 Proprietary Material

13.1 The Parties agree that all details, plans, manuals documentations specifications, schedules, programs, reports, calculations and other work relating to the Facilities and\or Systems and the provision of Operations pursuant to this Contact (hereafter referred to as "Proprietary Material"), which have been or are hereafter written, originated or made by any of them or any of their respective employees, Subcontractors or agents and by the persons related to the Operator in connection with this Contract shall be owned by the persons related to the corporations. The determination of information as proprietary Material shall be made at the sole discretion of the Corporation.

13.2 The Operator shall have an irrevocable, royalty-free, non-exclusive license to use the Proprietary Material during the terms of this Contract for all purposes connected with fulfilling its obligations hereunder. However, this license shall not be transferable to any party other than to a permitted assignee under this Contract. Such license shall not continue after the suspension or termination of this Contract or the discharge by the Operator of its duties hereunder.

14.0 Confidentiality

14.1 The Operator shall cause the persons related to the Operator not to, without the prior written consent of the Corporation, at any time divulge or disclose to any person or use for any purpose

unconnected with the Operations Proprietary Material under this Contract. This condition shall not apply to information.

(a) Already in the public domain, otherwise than by breach of this Contract:

(b) Already in the possession of the receiving party before it was receiving from the other Party in connection with this Contract and which was not obtained under any obligation of confidentiality: or

(e) Obtained from a third Person who is free to divulge the same and which was not obtained under any obligation of confidentiality.

14.2 The Operator shall, whenever required, take necessary steps to ensure that all persons employed by it, under this Contract, comply with the India Official Secrets Act 1923 (XIX of 1923) and agree that it applies to them and shall continue to apple even after completion of this Contract.

14.3 No photographs of the Fanciless or system or any part thereof or equipment employed thereon shall be taken or permitted by the Operator to be taken by any of its employees or any employees of its Subcontractor without the prior approval of the Competent Authority in writing and no such photographs shall be published or otherwise circulated without the approval of the Competent Authority in writing

14.4 The Corporation shall use its best efforts to ensure that the confidential proprietary information relating to the Operator is not made public. However, the Corporation shall not be liable in any manner whatsoever in case such photographs shall be published or otherwise circulated without the approval of the Competent Authority in writing.

15.0 Assignment

15.1 The Operator shall not subcontract the whole of the operations or a substantial part thereof. Except where otherwise provided by the Contract, the Operator shall not subcontract any part of the operations without the prior consent of the Competent Authority. Any such consent shall not relieve the Operator from any liability or obligation under the Contract and it shall be responsible for the acts defaults and neglects of any Subcontractor, its agents, servants or workmen as fully as if they were the acts, defaults or neglects of the Operator, its agents, servants or workmen.

15.2 The Operator shall not be required to obtain such consent for:

(a) The provision of labour, or

(b) The provision of materials specified in the contract

15.3 In the event of a Subcontractor having undertaken towards the Operator in respect of the work executed, or the goods, materials, plant or Operations supplied by such Subcontractor, any continuing obligation extending for a period exceeding that the of the Contract period under the Contract, the Operator shall at any time, the expiration of such perio0d, assign to the Corporation, at the Corporations request and cost, the benefit of such obligations for the unexpired duration thereof.

15.4 Default of Operator

16.0 Events of Default

16.1 At any time after the Commencement Date, the Competent Authority may investigate each case where the Operator has fields to properly perform the operations in accordance with this Contract. The Competent Authority shall issue a notice to the Operator, instructing him to rectify the failure within a reasonable time.

16.2 An event of default on the part of the Operator, which results from the Operator being unable to fulfil its Service obligations under the Contract, shall be deemed as a serious default, and is said to have occurred due to any of the following caused:

(a) The Competent Authority certifies to the Corporation, with a copy to the Operator, that in its

opinion, the Operator:

1. Has repudiated the Contract, or

2. Without reasonable excuse has failed to commence Operations in accordance with this Contract, and pursuant to the Commencement Date; or failed to complete the Operations within the time stipulated for completion;

(b) Gross misconduct of the Operator;

(c) Despite previous warning from the Competent Authority, in writing, is otherwise persistently or flagrantly neglecting to comply with any of its obligations under the Contract;

(d) Operator persistently fills to follow Good Operations in execution of the Contract;

(e) If the Operator changes the use to which any part or whole of the Site is put, or initiates a variation without the required approval of the Competent Authority;

(f) The Operator stops providing the Operations for (1)one and the stoppage has not been authorized by the Competent Authority;

(g) The Competent Authority gives notice that failure to correct a particular defect is a fundamental breach of Contract and the Operator fails to correct it within a reasonable period of time determined by the Competent Authority;

(h) If the Operator is in breach of any law or statute governing the Operations;

(i) The Operator does not maintain a security, which is required; and

(j) The Operator, in judgment of the Corporation has engaged in Corporation has engaged in Corrupt Practices Fraudulent Practices in competing for or in carrying out the Operations under the contract;

(k) If the Operator fails to obtain or keep in force the insurance requirement under this Contract;

(l) The Operator (in case of a consortium) has composition of the consortium and\or the responsibility of each member of the consortium without period approval of the Corporation;

(m) The Operator is unable to maintain the composition and structure of its organization due to any of the following causes;

1. The Operator enters into voluntary or involuntary bankruptcy, or liquidation;
2. The Operator becomes insolvent;
3. A receiver , administrator trustee or is appointed over any substantial part of its assets; and
4. Any act is done or event occurs with respect to the Operator or its assets, which, under any applicable law has substantially similar effect to any of the foregoing acts or events.

17.0 Consequences of Default

17.1 If a default by the Operator is said to have occurred pursuant to Conditions of Contract, the Corporation may, after giving three (3) days' notice to the Operator, enter upon the Site, the Facilities and\or System, and terminate Contract without thereby releasing the Operator from any of its obligations under the Contract, or affecting the rights and authorities conferred on the Corporation by the Contract. The Corporation may use so much of the Operator's equipment, temporary works and materials as it may think proper.

17.2 If the Contract is terminated because of an Operator's event of default, the corporation shall be entitled to invoke the Security Deposit and carry out the Operations through a Successor Operator or departmentally and at the risk and cost of the Operator, If the total amount due to the Corporation exceed any payment due to the Operator the difference shall be debt payable to the Corporation.

17.3 If the Contract is terminated because of an Operator's event of defaults, all materials on Site, plant, equipment and temporary works shall be deemed to be the property of the Corporation.

17.4 Unless prohibited by law, the Operator shall if so instructed by Competent Authority within three (3) days of such entry and termination referred to in CC Section 33.1 assign to the Corporation the benefit of any Contract for the supply of any goods or materials or operations, which the Operator may have entered into for the purposes of the Contract.

Default of Corporation

18.0 Events of Default

18.1 An event of default on the part of the Corporation, affecting the performance of the Operator's Operations, shall be deemed to have occurred due to any of the following causes

(a) The Corporation does not give access to part the site by the Commencement Date;

(b) The Corporation does not make a payment citified by the Competent Authority's within ninety (90) days from the day of receipt of the Competent Authority's certificate:

(c) The Competent Authority instructs the Operator to stop providing the Operations and the instruction is not withdrawn within three (3) day and

(d) The Corporation is in breach of any law or statute governing this Contract.

(e) The Corporation fails to carry out the responsibilities as per clause 19 mentioned above.

19.0 Consequences of Default

19.1 Pursuant to Conditions of Contract the Operator may terminate its employment under the Contract by giving notice to the Competent Authority, with a copy to the Municipal Commissioner. Such termination shall take effect fourteen (14) days after giving the said notice.

19.2 If the Corporation, before the expiry of the above notice period, or immediately thereafter remover the cause of its default, the Operator's entitlement under the Conditions of the Contract shall lapse in respect of such defaults, and the Operator's shall continue with\resume normal working as soon as is reasonably possible.

Risks, Indemnification & Insurance.

20.0 Risks

20.1 The Corporation is not responsible for expected risks, arising solely due to the design of the Facility and System as all the designs has been prepared by the agency itself.

20.2 All risk of loss of or damage to physical property and of property and of personal injury and death, which arise during and in consequence of the performance of the Contract other than the risks stated in Conditions of the Contract, is the responsibility of the Operator.

21.0 Indemnification

21.1 The Operator shall indemnify and keep indemnified the Corporation against all losses and claims for injuries or damage to any person or any property whatsoever which may arise out of or in consequence of the operations and against all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect of or in relation thereto.

21.2 The Operator shall at all times indemnify the Corporation against all claims, damages or compensation under the provisions of, i) Payment of Wages Act. 1936 ii) Minimum Wages Act. 1948 iii) Employers Liability Act. 1938 iv) The Workmen`s Compensation Act. 1923 v) Industrial Dispute Act. 1947. vi) India Factories Act. 1948; and vii) Maternity Benefit Act. 1961 Or any modifications thereof and rules made there under from time to time or as a consequence or may accident or injury to any workman or other persons in or about the Operations, whether

in the employment of the Operator or not, save and except where such accident or injury have resulted from any act of the Corporation, their agents or servants, and Also, against all cost, charges and expenses of any suit, action of proceedings arising out of such accident or injury and against all sum or sums which may with the consent of the Operator be paid to compromise or compound any such claim without limiting its obligations and liabilities as above provided. The operator shall insure against all claim's damages or compensation payable under the various acts mentioned above or any modifications thereof or any other law relating thereto.

22.0 Insurance

22.1 The Operator shall provide in the joint names of the Corporation and the Operator, insurance cover from the Commencement Date to one year beyond the end of the Contract period, for the Operator's risks covering. a) Loss of or damage of property (except the Facilities System and Equipment) in connection with the contract; b) Personal injury or death; and c) The Contractor's All Risk (CAR) Insurance Policy.

22.2 The Operator may, at its own discretion, provide for the following insurance covers a) Loss of or damage to the Facilities and\or System; and b) Loss of or damage to equipment, such cover may be taken cither from cither from the Directorate of Insurance Chhattisgarh State, or from any other insurance company with the approval of the Corporation.

22.3 The Operator shall deliver policies and certificates to the Competent Authority for its approval before the Commencement Date. All such insurance shall provide for Compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred.

22.4 If the Operator or any of its Subcontractors does not provide any of the policies and certificates required, the Corporation may effect the insurance, which the Operator should have provided and recover the premiums the operator has paid from payments otherwise due to the Operator or if no payment is due, the Payment of the premiums shall be a debt due to the Corporation.

22.5 Alterations to the terms of insurance shall not be made without the approval of the Competent Authority and both Parties shall at all times comply with any conditions of the insurance policies.

Force Majeure

23.0 Force Majeure Events

23.1 A Force Majeure event, as defined in conditions of the contract, is said to have occurred if any such event arise after the issue of the Letter of Award of Contract and extends lifers a period greater than thirty (30) days, outside the control of both Parties, thereby rendering it impossible or unlawful for either Party to fulfil its Contract obligations under the law governing the Contract.

23.2 The Force Majeure Events are: a) War, invasion, mobilization, requisition or embargo; b) Rebellion, revolution, insurrection, or military or usurped power, or civil war; c) Contamination by radio-activity from any nuclear fuel, or from any nuclear waste form the combustion of nuclear fuel, radio-active toxic explosive, or other hazardous propertied of any explosive nuclear assembly or nuclear component of such assemble; d) Riot, commotion or disorder, unless solely restricted to employees of the Operator or of its Subcontractors; e) Floods and any other calamity resulting from climatic imbalances; and Provided always that such events are beyond the control of the Parties and have a Materially Adverse Effect to the Operations.

23.3 The Operator shall be under no liability whatsoever in consequence of any of the force Majeure events referred to in this clause, whether by way of indemnity or otherwise.

23.4 Both Parties shall be released from further performance pursuant to any Force Majeure event stated in CC Section 39.2 occurring outside the control of both parties and extending for a period greater that one hundred and eighty (180) days.

23.5 If the Contract is frustrated by a Force Majeure event, the Competent Authority shall certify that the Contract has been frustrated. The Operator shall make the site safe and stop Operations as quickly as possible after receiving this certificate.

24.0 Consultation and Duty to Mitigate.

24.1 For so long as the period of Force Majeure is continuing the affected Party shall consult with the other Party, on the period and effect of the Force Majeure event and the affected party shall use all reasonable endeavours to alleviate its effects of the performance of its obligations under this contract. The other party shall afford reasonable assistance to the affected party to alleviate the effect of the Force Majeure event on the performance by the affected party of its obligations under this Contract. The affected party shall use its best efforts to continue to perform its obligations hereunder and to correct or cure the same during the subsistence of such Force Majeure Event.

25.0 Consequences of Majeure

25.1 If and to the extent that any of the Force Majure events listed in CC Section 39.2 above results in loss or damage to the Facility and /or System the Operator shall promptly give notice to the Corporation. The Corporation may direct the operator to rectify this loss or damage to the extent required by the Corporation, at costs to mutually agreed between the parties. The operator shall expeditiously rectify the loss or damage and shall be entitled to payment of such costs. In the event that the parties are not able to reach an agreement on the cost of rectification, the Corporation may carry out the rectification works by itself or through any agency nominated by it. The Operator shall provide all corporation required to complete such rectification expeditiously.

26.0 Resumption of Performance

26.1 When the affected party is able to resume performance of its obligations under this Contract, it shall give to the other party a written notice to that effect and shall promptly, and in any event within three (3) days, resume performance of its obligation hereunder.

26.2 The obligations and liabilities of the parties under this Contract would continue as long as Force Majeure Event does not impede the performance.

26.3 There shall be no incentive or penalty/liquidated damages applicable in the period of subsistence of a Force Majeure.

Taking Over

27.0 Taking over process

27.1 At the end of the Contract Period and subject to the provisions of CC Section 11.4 or its earlier termination except on account of default of the Operator the Operator shall request the Competent Authority to rake over the Facilities and /or System. The Corporation shall take over the Facilities and / or System within Seven (7) days of such a request being made.

27.2 The Operator shall a) Cease all further Operation, except for such Operations as may be necessary and instructed by the Corporation's Representative for the purpose of making safe or protecting those parts of the Facilities and /or System and any Operations required to leave the site in a clean and safe condition. b) Hand over all documents and supplies for which the Operator has received payments and c) Remove Operator's equipment which is on the site and

repatriate its entire staff and labour from the site. d) Hand over STPs in good operating condition except normal wear & tear. all equipments related to STPs are in good operating condition.

27.3 The Operator shall supply to the Competent Authority a detailed account of the total amount that the Operator considers payable under the Contract before the end of the Contract period. The competent Authority within twenty eight (28) days of receiving the Operator's account shall certify any final payment that is due to the Operator, or indicate to the operator the corrections or additions that the necessary. If the final account is still unsatisfactory, after the operator resubmits it, the Competent Authority shall decide on the amount payable to the Operator and issue a payment certificate.

27.4 The Corporation shall any time, within a period of ninety (90) days from the Completion Date or Termination Date as applicable, carry out an independent assessment of the Facilities and/or System departmentally or through a successor operator. Any deficiencies in the Facilities and/or System shall be made good by or at the cost of the Operator so as to bring the Facilities and / or System into Good repairs and proper working condition as handed over at the Commencement Date and subsequent works done pursuant to CC Sections 14 and 16 normal wear and tear excepting.

28.0 Security Deposit

28.1 The Operator shallpay a Security Deposit equal to the amount indicated in 'Schedule ; as security for due fulfilment of the Contract, within Seven (7) days after receipt of intimation in writing of acceptance of Tender.

28.2 The mode of making this deposit is as under. a) Initial Security Deposit : It is optional to the operator to make the Initial Security Deposit in bank guarantees/fixed deposit from Nationalised/Scheduled Banks in the enclosed format; (Annexure 1 of Detailed Tender Notice)

b) Retention Money : The remaining amount of the Security Deposit (if applicable as per Schedule A) shall be recovered from the Operator`s running bills at the rate of five (5) percent and such retention with the Initial Security Deposit made as aforesaid shall not exceed in the Security Deposit as above after which such retention will cease.

c) In case, the Operator carries out any Improvement work, Additional Improvement work, Extra work, he will have to deposit a Bank Guarantee equal to 10% of contract amount as security towards Improvement work, Additional Improvement work, Extra work to be executed by Operator.

28.3 All compensation or other sums of money payable by the Tenderer under the terms of this Contract or any other account whatsoever, may be deducted from or paid by the sale of a sufficient part of this Security Deposit or from any sums which may be due or may become due to the Operator by the Corporation on any account whatsoever, and in the event of its Security Deposit being reduced by reason of any such deduction, the Operator shall within fifteen (15) days of receipt of notice of demand from the Corporation make good the deficit.

28.4 In the event of the said Deposit having been made by the Operator by delivery to the Corporation by the guarantee of the bankers of the Operator, and of the Operator under any of the provisions of this Contract becoming subject to or liable for any penalty for damages liquidated or unliquidated or of the said deposit becoming forfeited or any breach or failure or determination of Contract, then and in such case the amount of any such penalty or damages and the deposit so forfeited is not previously paid to the Corporation, shall immediately on demand be paid by the said bankers to Corporation and may be forfeited by the Corporation under and in terms of the said guarantee.

28.5 There shall be no liability on the Corporation to pay any interest on the Security Deposit deposited by or recovered from the Operator.

29.0 Forfeiture of Security Deposit

29.1 If during the term of this contract the Operator is in Default of the due and faithful performance of its obligations under this Contract the Corporation shall, without prejudice to its other rights and remedies hereunder or at the Applicable Law, be entitled to call in, retain and appropriate the Security Deposit.

30.0 Return of Security Deposit.

30.1 Subject to CC Section 46.1 excepting the Security Deposit of the last Operating year each Security Deposit shall be returned to the Operator by the Corporation within thirty (30) days following the expiration of its validity, provided that there are no outstaying claims of the Corporation on the Operator. The Security Deposit of the last Operating year shall be returned to the Operator at the end of twelve (12) months after the Completion Date or Termination Date of this Contract.

Procedure for Disputes & Arbitration

31.0 Competent Authority's Decision.

31.1 If dispute(s) of any kind whatsoever arises between the Operator and the Competent Authority's Representative the same shall be referred to the Competent Authority for its decision with detailed justification. Such reference shall be stated that it is in pursuance to this clause and is for reviewing and giving decisions by the Competent Authority. The Competent Authority shall give its decision within fourteen (14) days of receipt of notice. If either party is not satisfied with the decision of the Competent Authority or the Competent Authority fails to give decision within the period of fourteen (14) days from the date of receipt of notice under this clause, such a dispute may be referred to arbitration as per CC Section 48.

32.0 Sole Arbitration

32.1 Except where, otherwise provided for in this Contract, all questions and disputes relating to the meaning of instruction hear in before mentioned or as to any question, claim, right matter of handing whatsoever, if any arising out of relating to this contract, specification, estimates, instructions, orders or these Conditions or otherwise concerning the Operations, or the execution or failure to execute the same where arising during the progress of the operations or after completion or abandonment thereof of any matter directly or indirectly connected with this contract shall be referred to the sole arbitration of the Municipal Commissioner, and if the Municipal Commissioner is unable or unwilling to act as such then the matter in dispute shall be referred to sole arbitration or such other person appointed by the Municipal Commissioner who is willing to act as such Arbitrator. In case the Arbitrator so appoint is unable to act for any reasons, the Municipal Commissioner in the event of such inability, shall appoint another person to act as Arbitrator in accordance with the terms of the Contract. Such person shall be entitled to proceed with the reference from the point at which its predecessors left it. It is Also, a term of this Contract that no person other than a person appointed by the Municipal Commissioner as aforesaid should act as an Arbitrator.

33.0 Governing Provisions

33.1 As aforesaid the provisions of the Arbitration and Conciliation Act 1996 or any statutory modification or re-enactment thereof and the rules made there under and for the time being in force shall apply to the arbitration proceedings under this clause.

DETAILED SCOPE OF WORK – OPERATION & MAINTENANCE OF STPs

General Requirements for Operation and Maintenance

i. The Contractor shall operate and maintain the entire plant within its Contract price for a total operation and

maintenance period of 15years from the date of taking over of the plant by the KMC and issuance of "Taking Over Certificate" or the issuance of "Conditional Taking-Over
Certificate".'

ii. The KMC immediately on issuance of the "Taking over Certificate' or the issuance of "Conditional Taking-Over Certificate" Shall hand over the plant to the Contractor for Operation and Maintenance.

iii. All necessary repairs, preventive & breakdown maintenance, overhaul, replacements etc., shall be made during the O & M to maintain the plant at the status of formal handing over. Contractor shall be responsible for preventive repair, breakdown repair, comprehensive repair, for operation and maintenance during the 15 years period of O&M.

iv. At the end of O & M period the plant shall be handed over to the KMC in fully functional condition except normal wear and tear expected during the period of operation and maintenance.

v. The O & M price by the Tenderer shall include supply of all tools, tackles, spares, oil & lubricants, laboratory chemical, glassware, chemicals like chlorine, coagulants and polyelectrolyte etc.

vi. Insurance policy to cover accident/fire/earthquake risk will be provided by Tenderer on the cost of STPsduring 15 years O&M period. Insurance premium will be paid by Tenderer. &cost to be included in the offer for O&M.

vii. During O & M period cost of power consumed shall not be in the Contractor price and bills of electric power shall be paid by the KMC as per actual consumption.
viii. The scope of work shall but not limited to the following items:

- Operation and Maintenance including Mechanical, Electrical, Electronic, Civil, and all allied works.
- Preventive & breakdown maintenance of all electrical, mechanical & Electronic equipments.
- Replacement of electrical, mechanical & Electronic equipments which becomes beyond repair.
- Sampling and testing of influent wastewater based on the tests and frequency desired by the KMC's representative and in general in accordance with the CPHEEO manual on Sewerage and Sewage Treatment.
- Sampling and testing of additional samples for the day to day O & M of the STPs and as mutually agreed from time to time between the Contractor and the KMC's representative.
- Sampling of final treated sewage to ensure that the guarantee Parameters are as stipulated in the Bid document
- The sampling frequency to be as per relevant norms of Chhattisgarh pollution Control Board or higher as decided by KMC's representative. The KMC reserves right to collect samples at random at the will of the KMC through any agency nominated by him.
- The KMC shall have right to seek part of sample collected by the Contractor without any prior intimation to cross check the result on random basis, However, the analysis charges of such samples shall be borne by Contractor.
- Loading Unloading and Transportation of screening, dewatered sludge and wet grit out of treatment plant site at his cost as directed by KMC's representative. Transportation up-to leads of 20.0 km.
- The dewatered sludge could be collected and disposed of by the Contractor. To be used for organic manure and any revenue accruals by sale of sludge shall be to the benefit of the Contractor
- Maintenance of log books of all the equipments/instruments connected to the PLC/SCADA shall be forwarded at monthly intervals in the form of a hard copy as monitored by the PLC. Such records

are given regularly to the KMC in the form of hard copy at monthly intervals.

Updation of daily data in the prescribe format to the central SCADA as well as CPCB portal.

• The reports shall contain sufficient appropriate and adequate data to make the records meaningful and amenable to analysis for evaluating the performance of the plant as well as to help in O & M.

• Security of the campus and contents therein shall be Contractor's responsibility.

• The records maintained by the Contractor shall be produced periodically to the KMC's representative for proper monitoring. The KMC's representative's remarks shall be attended to on nest submission. Consolidated summary report shall be furnished to the KMC monthly, quarterly and yearly containing salient features.

• The Contractor shall Also, maintain history sheets of overhauling, maintenance, replacement of all the important electrical and mechanical equipment.

• The O & M shall include the appropriate preventive maintenance of equipment as per the Manufacturer's recommendation.

• All the equipment even standby supplied, installed and commissioned by the Contractor should be in operational/ functional condition throughout the O & M period. The Contractor shall take all preventive measures to maintain them in working condition.

• The frequency of break downs of various equipments shall be the least as far as possible. The total number of such re-occurrences shall not exceed three times per annum otherwise penalty shall be levied on the Contractor at the discretion of Engineer-in-chargeand as given in the penalty clause

• The operation, maintenance and repairs services shall be performed according to the standard practices or as per manufacturer recommendations.

(a) Down time:

• The plant shall never be operated at less than 50% of its design capacity due to maintenance and repair reasons, if adequate quantity of sewage is available.

• The period of such exceptional operation shall not exceed two consecutive days and shall not be more than three days a week otherwise penalty shall be levied on the Contractor at the discretion of Engineer-in-charge.

• The maximum downtime of the whole plant shall not exceed 24 hours.

• The periods for repairs and maintenance have to be communicated to the KMC's representative at least 5 calendar working days in advance.

• Equipment which needs repair to be carried out by Manufacturer/ Manufacturer's authorized representative, the down time shall not exceed 30 days otherwise penalty shall be levied on the Contractor at the discretion of Engineer-in-charge and as per penalty clause.

• KMC reserves the right to impose compensation, should there be any default by Contractor on this account.

• The penalty will be deducted in the next O & M invoice if adequate reasons are not furnished by the Contractor for delay.

(b) Operation of the plant as per O & M Manual

• The plant shall be operated according to the rules and procedures laid down in the O & M manual (as per CPHEEO MoUD Manual)

• The plant must be in position to Work at the design capacity at any time.

(c) OPERATION OF PUMPS

The following points should be observed while operating the pumps.

• Dry running of the pumps should be avoided.

• Centrifugal pumps if installed with negative suction should be primed before Starting.

• Pumps should be operated only within the recommended range of the head-discharge
• If pump is operated at a point away from duty point, the pump efficiency normally reduces.
• Operation near the shut-off point should be avoided, as it causes substantial recirculation within the pump, resulting in overheating of sewage in the casing and consequently, overheating of the pump.
• If the pumps are not having sufficient discharge then necessary modification is to be done as per manufacturer recommendations so that pumps will deliver required quantity of sewage.
• Voltage during operation of the pump-motor set should be within ±10 % of the rated voltage. Similarly, current should be below the rated current shown on the name plate of the motor.
• When parallel pumps are to be operated, the pumps should be started and stopped with a time lag between two pumps to restrict change of flow velocity to minimum and to
restrict the dip in voltage in the incoming feeder and should be adequate to allow the pump head to stabilize.
• When the pumps are to be operated in series, they should be started and stopped sequentially, but with minimum time lag. Any pump next in sequence should be started immediately after the delivery valve of the previous pump is even partly opened. Due care should be taken to keep open the air vent of the pump next in sequence, before starting that pump.
• The running of duty pumps and standby pumps should be scheduled so that no pump remains idle for a long period and all pumps are in ready-to-run condition. Similarly, the running schedules should be ensured so that all pumps do not wear equally needing simultaneous overhaul.
• If any undue vibration or noise is noticed, the pump should be stopped immediately and the cause for vibration or noise should be checked and rectified.
• Generally, the number of starts per hour shall not exceed four. Frequent starting and stopping should be avoided as each start causes overloading of motor, starter, contactor and contacts. Although overloading lasts only for a few seconds, it reduces the life of the equipment.
• Troubles in a sewage pumping station can be mostly traced to the design stage itself. This is all the more true when too much grit is likely to come into the sewage pumping stations from sewage at monsoon time, which is difficult to handle. Hence proper care shall be taken to divert any storm water during monsoon periods.

(c) OPERATION of GATES, VALVES AND ACTUATORS

(d)

Sluice gates are commonly used to control sewage levels in STPs. Attention should be made to the following points for proper operation:

• Operate inactive sluice gates by smearing grease on stem threads.
• Clean sluice gate with wire brush and paint with proper corrosion-resistant paint.
• Ensure unobstructed operation of gate and headstock.
• Ensure that the spindle is not touching the stem guide.
• Remove foreign matter like paint, concrete, etc. in the fully open position of gate.

Dos for sluice gates

• Operate the gate at least once in every three months.
• Check the nuts of all construction and foundation bolts once in a year. Tighten the bolts, if loose.
• Examine the entire painted surface for any signs of damage to the protective paint.

Don’ts for sluice gates

• Do not remove lock plates until the gate has been properly installed.
• Do not keep the gate out of operation for more than three months.
• Do not forget to set the stop nut in the correct position.

- Do not disturb the adjustment of wedge block bolts/studs.
- Do not over torque the crank handle/hand wheel.

(e) OPERATION OF RAS/SAS, SLUDGE FEED PUMPS

Operators should check the following items:

- Inlet and outlet flow rate
- Noise or vibration
- Bearing housing temperature
- Running amperage
- Pump speed
- Pressure
- Check the level and condition of the oil in the gear reducer
- Check the shaft alignment
- Check the condition of all painted surfaces
- Visually inspect mounting fasteners for tightness
- Clean dirt, dust or oil from equipment surfaces
- Check all electrical connections
- Stop and start equipment, checking for voltage and amp draw and any movement restrictions because of failed bearings, improper lubrication or other causes
- Check the drive motor for any unusual heat, noise or vibration
- Check mechanical seals and packing for leakage or wear

(f) OPERATION OF CENTRIFUGE DECANTORS

Centrifugation is the process of separating solids from liquids by the process of solid liquid separation, enhanced by centrifugal force. A centrifuge can thicken or dewater the sludge with only a minor change in the weir setting (Also, called pond setting). Likewise, it can dewater sludge to a moderate consistency at low polymer dose or produce very dry solids using higher polymer dosages.

- Sludge Type and Quality

  The operation of the wet end of the plant determines the quality of the sludge, which, in turn, greatly affects the dry end.
- Polymer Activity and Mixing with the Sludge

  If the polymer does not react well with the sludge, performance suffers. In addition, the polymer closer to or further from the centrifuge will affect performance.
- Polymer Type and Dosage

Some polymers are designed to obtain drier cakes than others do. Likewise, the dosage will Increase and decrease with cake dryness. Some polymers become less effective at higher dosages. This will be apparent from a quick jar test or observing that adding more polymer results in either poorer operation or the same operation.

- Hydraulic Loading
- Centrifuges are less limited by the volume of water that passes through the centrifuge than filtration devices. As a result, thinner feed sludge will have less effect on performance than in filtration devices.
- Solids Loading
- The solids residence time is important. If there is more sludge to de-water, there will be less solids residence time and therefore wetter solids, all else being equal.
- Process Control

• Stop sludge and polymer feed to the centrifuge
• Flush with treated sewage until the centrate is clear and the torque level begins to drop
• Turn the centrifuge off
• Continue flushing at 25% of normal feed flow until the centrifuge reaches 7 –800 r/min.
• Turn off the lubrication system and cooling water when the unit has completely stopped Maintenance

During operation, the operator should check for the following:
• The oil level and the flow of oil to the bearings in circulating oil systems
• Flow of cooling water and oil temperature, to ensure it is operating in the proper range
• Machine vibration
• Ammeter reading on the bowl motor
• Bearing temperatures, by touching them
• System for leaks
• Centrate quality
• Because the centrifuge will shut itself down in the event of a fault, the operator typically only looks at the mechanical parameters once per shift

(g) CLEANLINESS

• The Contractor and their personnel shall maintain a high degree of awareness in operation and maintenance of the plant and all relevant safety codes and procedures.
• At all times the plant, its equipment and surrounding shall be kept clean and in order inducing the buildings, floors, walls, roofs, windows and garden etc.

(h) PREVENTIVE MAINTENANCE

• The preventive maintenance shall be carried out according to the preventive maintenance schedule of the plant.(annexure I)
• The regular staff may be reinforced with short-term specialists by the Contractor for special maintenance tasks, after duly informing the KMC's representative of the need and the schedule.

(i) REPAIRS

• Repairs shall be made as and when needed very promptly on the spot or at the Contractor's / Manufacturer's workshop. The need of repair on the spot or at the Contractor's workshop has to be defied in co-ordination with the KMC's representative and according to the status of spare parts availability.
• The power consumed for repairing of the plant and equipments is recoverable from O & M charges payable to the Contractor and as per concern field of engineer in charge. Replacement of electrical & mechanical equipments which becomes beyond repairs

(j) SPARE PARTS

• The Contractor shall keep a reasonable stock of spare parts so that the down time of equipment can be kept within the limits specified.
• The contents of the stock and the reorder level of the inventory have to be approved by the KMC's representative.

(k) TRANSPORTATION

All necessary transportation shall be arranged and made by the Contractor at his own expense. For better communication internet facility is provided throughout the entire operation & maintenance period on his own cost.

(l) OIL, GREASE, LUBTRICANTS, CHEMICAL & CONSUMABLES

The Contractor has to ensure that there is always sufficient stock of 15 days of Oil, Grease, Lubricants

consumables, and laboratory chemicals.

General Obligations

• The Contractor shall operate and maintain the entire plant under this Contract for the period specified in this Contract.

• The Contractor will submit a detailed operation and maintenance plan for approval of KMC's representative.

• All operation and maintenance activities shall be carried out strictly in accordance with the approved plan.

• If for any reason the sewage standards are not met and the penalty is imposed by MPCB, the same shall be recovered from the Contractor's payable amount. However,KMC reserves right to terminate the Contract on statutory ground or default of the Contractors.

• It is the responsibility of Contractor to insure entire equipments and installation throughout the operation & maintenance period on his own cost.

• The contractor shall provide telephone, internet & communication facility within the plant premises The services shall include but not be limited to the flowing items:

a) Operation and maintenance of the Sewage Treatment Plant from the inlet chamber up to disposal into channel leading to creek.

b) Training for O & M staff designated by KMC as per requirement.

c) Generation and maintenance of periodic reports.

Operation

(a) Operational services

- The Contractor shall operate all the components of projects and the complete Sewage Treatment Plant and associated services on a continuous 24-hous basis. The Contractor shall operate and utilize the control and monitoring system provided, if found necessary, he shall make adjustment (within the operation range) of the control system and equipment, so that the plant operation matches the treatment process requirements.
- If it is determined that the facility is not capable of meeting the design Parameters for any reason beyond the Contractor's control and not attributable to him, the Contractor shall determine the specific cause of failure/abnormality in the plant functioning and report to the KMC's representative and seek his directive on the necessary corrective action to be taken /adopted.
- The Contractor will be required to furnish the details of electricity consumption in the format prescribed by the KMC's representative.
- All consumables, Polyelectrolyte, Chemical and spare required in operating and maintaining the plant in good condition shall be provided by the Contractor.
- The screenings grit, dewatered sludge and other garbage generated in the plant shall be removed from the site on periodic basis. No accumulation of such residues will be permitted within the Sewage Treatment Plant campus without application by Contractor giving valid reasons as well as permission of KMC's representative. For this purpose, contractor shall provide two (2no.) closed truck with drivers dedicated for the transportation grit, sludge and other garbage form the plant. These vehicles shall be made available for the plant use till the completion of O & M period of the contract. The vehicles shall be the property of contractor after completion of O & M period. However, during O & M period, all expenses towards the fuel, maintenance and all other charges towards these vehicles shall be borne by the contractor. The Contractor shall clarify that such residues are in conformity to Environmental regulation / rules in force.

- The KMC's representative may, if required , decide the mode and timing of disposal of such residues in consultation with concerned Environmental and Civic Authorities and such directions shall be promptly followed by the Contractor, both in letter and spirit, without any reservations promptly and without any impact on the quoted and awarded and awarded O&M price and other costs. The loading, unloading and transportation cost of these shall be borne by the Contractor and shall be included in the price quoted by the Contractor for O&M for a period of 15 year.
- The Contractor at his own expense shall provide all tools, cleaning and housekeeping equipment, security and safety equipment.

Laboratory Services

a) The Contractor using the existing facility shall perform all tests, sampling and analysis regularly as stipulated in the Bid document and as required by the regulatory agencies and as directed by engineer-in-charge.

b) Electronic display showing values of BOD, COD, PH of raw sewage at inlet & treated Sewage at outlet shall be maintained.

Manpower

a) The Contractor shall provide the required qualified managerial, technical supervisory, laboratory, administrative and non-technical personnel and labour necessary to operate and maintain the treatment plant and the premises in a safe way and efficiently on a continuous 24 hours basis for the full term of the O & M period.

b) The qualification and capability of Contractor's personnel shall be appropriate for the tasks they are assigned to perform.

c) The staff provided shall possess the necessary skills and trained in the operation of the plant prior to assign to the Work.

d) If in opinion of the KMC's representative a person of Contractor's staff is considered to be inadequately trained and skilled or otherwise inappropriate for the assigned task and KMC's representative may inform the Contractor in writing, the Contractor shall replace him with a person of appropriate skills and training for the task, approved by the KMC's
representative, immediately of being so informed.

e) The prime requirement is that the plant should operate by the minimum staff and personnel The Tenderer shall propose in their Bid a staff management structure for operation and maintenance of works.

f) The suggested structure of operation & maintenance staff (minimum) at each plant shall be as follows:

Sr. No.	Description	Qty.
1	Plant-in-charge	1
2	Chemist	1
3	Shift Operator (PLC & SCADA)	4
4	Supervisor	2
5	Electrician	2
6	Fitter	2
7	Centrifuge operator	1
8	Chlorine operator	1
9	Helper	8
10	Gardener/Sweeper	6

11	Security Guards	6
12	Helpers and operators at Wet wells & Diversion weirs	As Required

However, Tenderer shall employ additional manpower to get specified output. The cost of the same shall be borne by the Tenderer. In addition to the above personnel, the Contractor shall provide the necessary secretarial support; printing and publishing services office furniture and office are followed including weekly rests, rotation of duties etc. The Curriculum Vitae and joining latter of the key personnel only (Sr. No 1, 2 3,4 and 5 from the above list) shall be submitted to the KMC's representative for acceptance.

g) Normal time duty hours for the Contractor's O &M personnel shall be notified by the Contractor and if necessary be modified in consultation with the KMC's representative.

h) A shift schedule shall be established by the Contractor and approved by the KMC's representative to ensure the presence of necessary number of Contractor's staff for duty at site 7 days a week, including holidays.

i) In the event it becomes necessary for more than one of the Contractor's key personnel to be absent from the plant, the Contractor shall provide a qualified replacement at his own expense and ensure that specified project duty coverage is maintained.

j) The Contractor shall include in his cost medical and accident insurance expenses of all the staff employed by him along with all provision of the labour welfare acts prescribed from time to time by the state and central government

k) Adequate insurance cover shall Also, be maintained during O &M period for all KMCs as well as casual temporary employees and visitors.

l) KMC is not liable for any compensation on arising due to any accident/ mishap of any nature occurring in the plant premises.

Safety

The Contractor shall be responsible for safety of his staff during O & M of the plant and shall procure, provide and maintain all safety equipment necessary for satisfactory O & M such as gloves, boots, mats, safety belts, masks, respiratory system for chlorine operation, etc.\

1. The Contractor shall utilize awareness procedures in every element of operation and maintenance.
2. The Contractor shall emphasize site safety including adoption of maintenance.

a. Safe working procedures, cleanliness and care of the plant as a whole

b. Accident and hazardous conditions prevention and reporting

c. Shall impart safety training to all members at regular intervals, especially for new comers.

d. Shall provide Notice Boards and display boards at appropriate locations, detailing precautions to be taken by O & M personnel to Work in conformity to regulations and procedures and by the visitors to the plant.

e. Shall notify the KMC's representative immediately if any accident occurs whether on-site or off site in which Contractor is directly involved and results thereof any injury to any person, whether directly concerned with the site or a third party. Such initial notification may be verbal and shall be followed by comprehensive report
within 24 hours of the accident.

3. The Contractor may refuse entry into the plant, to all personnel's including KMC's representative on grounds of safety and person not carrying proper identification.
4. Personnel shall be permitted entry into the plant only on disclosing their identity and those authorized personnel including KMC's representative shall be issued identity cards with photographs

by the Contractor, this Also, includes casual visitors who shall be issued a temporary visitors entry permit.

Reporting

a. The Contractor shall prepare consolidated monthly reports on plant operation and maintenance and submit the same to the KMC's representative within first 7 working days of the next calendar month.
b. The daily reports are to be prepared and retained at site (in soft and hard copies) for inspection.
c. Overall reporting formats shall be approved by KMC's representative and may have to be modified from time to time as required and approved by KMC's representative.
d. Contractor may have to prepare and submit additional reports on particular matters and incidents having special significance as and when required by the KMC's representative.

Maintenance

• General Obligations

(i) The Contractor shall ensure the continuity of the plant operations and that the breakdown or the deterioration in performance of the plant are minimized by a preventative maintenance schedule.
(ii) The maintenance schedule of all critical components shall primarily comprise of preventative and break down maintenance.
(iii) Regular preventative operational maintenance comprises of planned and regular maintenance carried out by the Contractor on a day-to-day basis, including cleaning,
lubricating, minor adjustment, together with the preventive and corrective maintenance plan for those items of the plant and equipment within the treatment works which have been commissioned and made operational.
(iv) Breakdown maintenance comprises of any unplanned maintenance required.
(v) Non-commissioned assets / components of the plant if any shall have to undergo a regular "non-operational& storage maintenance".
(vi) The Contractor shall carry out the maintenance of the plant installations in accordance with the requirements of the O & M Manual and the equipment manufactures instructions and only approved grades of lubricants will be used. The frequency of lubrication, adjustments to be made regularly and recommended spare parts by the equipment/machine/ instrument manufactures/supplier shall always be carried out and appropriate inventory shall be held in store.
(vii) The Contractor shall maintain a maintenance log of all repairs, oil & lubricant changes carried out for each equipment's maintenance Log Card.

• Building and Site Maintenance

The Contractor shall be responsible for:

I. The total maintenance of building and all electrical, ventilation, plumbing and drainage installation in the building.
II. Housekeeping and cleaning of all buildings
III. Preventive and breakdown maintenance of the site water and wastewater services, cabling and earthing systems Lift maintenance, air conditioning and the site road lighting system., The upkeep of landscaped areas, tree plantation and flower pots etc.,
IV. Maintenance of the communication system of the plant.
V. All buildings, exposed equipments, units shall be painted at the end of every year of O & M.
VI. Routine housekeeping maintenance shall be carried out in accordance with procedures.
VII. Normal breakdown maintenance shall be attended to within a period of 3 working days.

VIII. Any unusual breakdown due to forces of nature covered under insurance shall be inspected to and attended to only after being permitted to do so by the insurance agency in writing.
IX. The painting of entire building (plastic coat) and other electro- mechanical equipments, civil structural components shall be done in every year at his cost by the Contractor if found deteriorated by the Engineer-in-charge.

• Training

(a) The Contractor shall be responsible for instruction and training of all his personnel in all aspects of plant operation and maintenance till the end of the operation and maintenance period.
(b) The Contractor shall Also, be responsible for training personnel nominated by the KMC. Such person shall submit their CVs to the Contractor for assessment for assignment of respective work.
(c) The training will be imparted to skilled personnel possessing a basic qualifications as stipulated by the KMC's representative which shall be similar to those possessed by the Contractors personnel, will operate the plant at the expiry of the Contract, this shall be done in the last six months of the operation and maintenance Contract.
(d) The Contractor shall make available for this purpose competent staff as well as proposed schedule information that may be necessary for effective execution for the training programme.
(e) The contractor shall Also, responsible for giving training to its staff for proper operation of chlorine plant in normal as well as in emergency condition.
(f) The training shall be organized in three (3) stages as follows :
i. Basic technical training education to be carried out during the final stages of the erection period of the Contract through literature, manuals, handouts demonstration at site, etc.
ii. Intensive on the job training during commissioning and maintenance period.
iii. Examination at the end of the training and only those persons who qualify should be permitted to operate the plant.
(g) By the end of this training period, these personnel should be able to carry out their respective duties efficiently under the supervision of KMC's representatives and supervisory staff of the KMC.
(h) The Contractor shall provide at his cost all local transportation, literature, computers, CDs and other related hardware and stationery to be used by trainers and trainees during the training period.

• Operation and Maintenance Records

The Following are a typical sample form of records (not an exhaustive and comprehensive) that are required to be maintained by the O & M Contractor. The details of complete records shall be prepared and submitted by the O & M Contractor the KMC's representative for approval prior to commissioning.

a) Record of Screen Chamber

The record of screen chamber contains the information about the duration of operation of manual and mechanical screen and quality of Screenings discharges from the plant. This record shall be kept by the Shift-in-charge and contains data on plant functioning.

Month			Year		
Date	Mechanical Screen	Manual Screen	Quantities of Screenings based on No. of	Officer on Duty	Operators

			Wheel Barrows		
	Hours of Operation per day	Hours of Operation per day	No. of Wheel Barrow filled	Quantity of Screenings (Cum/d)	

b) Record of Grit Chamber

The grit chamber record sheet contains the information about the operations of individual grit channels, as well as volume of grit collected and removed. This record is kept by the KMC's representative and contain basic data on plant functioning.

Month				Year		
Date	Girt Mechanism		No. of Wheel Barrow/Trailer filled	Girt Collection In m2/d	Operator	Officer on Duty
	1	2				
Organic Content in the Grit to be analysed once every week						
Grit in degritted sewage to be preformed one a month						

c) Performance of SBR Sludge Unit

The performance data sheet shall contain the records of the analytical results at the inlet and outlet all the parameters. These Parameters are pH, Dissolved Oxygen, BOD, COD, TSS, TN, NH3N, TP, pH and Temperature. The log sheet shall be provided by the Tenderer as per their process requirement. Raw and Treated sewage shall be recorded daily for the following Parameters.

Sr. No	Parameter	Raw Sewage	Treated Sewage
1.	Flow		
2.	Temperature		
3.	BOD		
4.	COD		
5.	TSS		
6.	VSS		
7.	DO		
8.	TN		

9.	NH3N		
10.	TP		
11.	pH		
12.	SVI		

d) Dewatered Sludge

The record of sludge discharge from the sludge dewatering unit shall contain the duration of pump operation and the quality and quantity of sludge dewatered.

This record shall be maintained by the KMC's representative and contains basic data on plant functioning.

Month				Year		
Date	Centrifuge Duration Per day	Total Sludge Dewatered m3/d	Total Solids (mg/l)	Dewatering Machine used	Operator	Officer on Duty

e) Pumping Station annual inspection report

Pumping Station annual inspection report						
Date						
Mechanical		General condition of equipment				
		Sewage pump			Sump Pump	Remarks
		No.1	No.2	No.3		
1.	Pump					
	Bearings					
2.	Gates					
	Gate operator (Manua)					
	Gate Operator (motor)					
	Stems					
3.	Crane & hoist					
4.	Siphon breaker					
5.	Trash racks					
	Drive chains					
	Bearings					
	Gear Reducers					
Electrical		Date				
1.	Motors					
2.	Motor bearings					
3.	Switchgear controls					
4.	Control Panel					
General						
1.	Water Levels	Elevation		Remarks		
	Forebay					
	Sumps					
	Building and grounds	Date				

		Remarks
1.	Sump	
2.	Forebay	
3.	Discharge Chamber	
4.	Gatewell to river outlet	
5.	Structures	
6.	Fire extinguisher	
7.	Tools & cabinets	
8.	Painting	
9.	Caulking	
10.	Grating, rails & ladders	
11.	Water system and plumbing	
12.	Louvers & Ventilators	
13.	Windows	
14.	Doors	
Remarks		

f) Other Records

- The Contractor shall maintain detailed record of consumption of Polyelectrolyte, Chlorine, Coagulants, dewatering polymer and other scrubbing chemicals (if used)
- Record of dewatered sludge transported out of the plant site shall be maintained. Similarly record of material movement shall Also, be maintained as appropriate and approved by KMC's representative.
- These records shall be available to the KMC's representative for scrutiny and copies shall be furnished on demand.
- During O & M period tests for BOD, SS, COD, TN, NH3N, Phosphates and pH,VSS, SVI shall be done daily on composite samples.
- The results of these Parameters shall have compliance of the guaranteed values.
- The Contractor shall Also, maintain the records for daily, monthly and annual reporting to the KMC enabling the KMC to review Contractor's performance during 15 year O & M period.

Appendix # 1
Operation and Maintenance Schedule
FOR 33.00 MLD CAPACITY SEWERAGE TREATMENT PLANT AT PRAGATI NAGAR KORBA.

WETWELL (Sump)

Name of Equipment	Name of Part	Action to be Taken	Schedule of Action				Remark
			Daily	Weekly	Monthly	Yearly	
Coarse Screen 1 & 2	Gear Box	Oiling			✓		Tivella Oil SC 320
	Main Chain	Greasing	✓				H.P.Multipurpose Grease
	Gear Box Chain	Greasing		✓			H.P.Multipurpose Grease
	Chain Aligment				✓		Check & Set right
Belt Conveyor	Gear Box	Oiling			✓		Tivella Oil SC 320
	Rollers	Oiling			✓		Tivella Oil SC 320
	Belt Alignment	Check the alignment of Belt & adjust		✓			Check & Set right
Gates & Valves	Spindles	Greasing			✓		H.P.Multipurpose Grease
	Check nut	Greasing			✓		

DETRITOR							
Name of Equipment	**Name of Part**	**Action to be Taken**	**Schedule of Action**				**Remark**
			Daily	**Weekly**	**Monthly**	**Yearly**	
Inlet & Outlet Gates	Spindles	Greasing			✓		H.P.Multipurpose Grease
Fine Screen 1 & 2	Hydraulic Power Pack(Oil Tank)	Oil (fill when level is bellow minimum mark)		✓			Hydralic Oil Grade servo 68
	To & Fro Mechanism (Both the side of Screen)	Grease			✓		H.P.Multipurpose Grease
	Hose Connection	Check for Leakages & Tighten	✓				
Belt Conveyor	Gear Box	Oil (Check the Level & Top Up if required			✓		Tivella Oil SC 320
	Rollers	Oiling			✓		SAE 140
	Belt Alingment	Check the aligment of Belt & adjust		✓			Check & Set right

Name of Equipment	Name of Part	Action to be Taken	Schedule of Action	Remark	Name of Equipment	Name of Part	Action to be Taken
Detritor Mechanism 1 & 2	Motor Gear Box	Oiling			✓		Tivella Oil SC 320
	Worm & Worm Wheel	Oiling			✓		SAE 140
	Bronze Bushing	Greasing		✓			H.P.Multipurpose Grease
	Thrust Bearing	Greasing		✓			H.P.Multipurpose Grease
	Chain	Greasing		✓			H.P.Multipurpose Grease
	Bearing Housing	Greasing			✓		H.P.Multipurpose Grease
Screw Classifiers (Conveyor 1 & 2)	Gear Box	Oiling			✓		Tivella Oil SC 320
	Screw Shaft Bearings	Greasing			✓		H.P.Multipurpose Grease
	Chains	Greasing		✓			H.P.Multipurpose Grease
Organic Water Pumps	Bearing	Greasing			✓		Multipurpose Grease

BLOWER HOUSE

Name of Equipment	Name of Part	Action to be Taken	Schedule of Action				Remark
			Daily	Weekly	Monthly	Yearly	
	Cooling water to Jacket	Check cooling water supply to blower jackets. See cooling water line getting Hot	✓				If cooling water line found hot, open the union on return water line & allow hot water to follow out cleaning of jacket with chemicals once in a year for better heat transfer.
	Lubricating Oil	Check Oil Level fill Oil if level is bellow Redmark		✓			Oil Servo system 320
				✓			First oil replacement after 500 Hrs.there after every 4000 Hrs.
	BLOWERS 1-9						In case oil become black then replace it before 4000 hrs
	' V ' Belts	Check for looseness & wear			✓		Tighten the V belts if found loose. Replace in case of damaged.Complete set of belts should be replaced.

Name of Equipment	Name of Part	Action to be Taken	Schedule of Action				Remark
			Daily	Weekly	Monthly	Yearly	
	Foundation Bolts & other Nut Bolts	Tighter all the nut bolts					
	Suction Filters	Cleaning of Filters			✓		Clean with back blowing of air or remove the suction filters & clean with air & refit.
	End Covers of Blower Cosing	Check for Temperature		✓			Check for proper cooling water flow check the oil level & condition of oil. In case of dirty oil replace it. If water is less increase it.
	Safety Valves	Functioning of Safety Valves			✓		Check the safety valve for blowing

SBR TECHNOLOGY

Name of Equipment	Name of Part	Action to be Taken	Schedule of Action				Remark
			Daily	Weekly	Monthly	Yearly	
Process Air Valves	Gear Box	Greasing			✓		H.P.Multipurpose Grease
Splitter Box Air Box Air Valves	Spildles	Greasing			✓		H.P.Multipurpose Grease
	Foundation Bolt of Motorised Unit	Check Looseness			✓		Tighten if found loose.
Decanters	Foundation bolts sensors clamp bolts etc.	Check for looseness			✓		Tighten if found loose.
	Wear Plate	Check for looseness & Level			✓		Adjust the level & tighten the Nut- Bolts.
	Decanters	Cleaning surface			✓		Use jet pump
	Position sensors	Observe the position	□		✓		If any change observed ,stop decanter & inform SFC
	Float switch	Cleaning			✓		
	Vibrations	Obeserve for vibrations			✓		In case of exessive vibration or abnormal sound remove the pump & check for further action.
	SAS pumps delivery valves	Spindles Greasing			✓		H.P.Multipurpose Grease
Gates & Valves	Actuators	Grease Tube				2 Times	grease tube to be replaced
	Motor Gear Box	Oiling				2 Times	
RAS Pumps & SAS Pumps		Gland leakages			✓		Tighten the gland in case of leakeges.

CHLORINE CONTACT TANK

Name of Equipment	Name of Part	Action to be Taken	Schedule of Action				Remark
			Daily	Weekly	Monthly	Yearly	
Service Water Pumps	Foundation Bolts	Check for looseness					Tighten if found loose.
	Air Lock	Check for Air Lock					Remove air lock by priming.
Booster Pumps	Bearing	Greasing			✓		Multipurpose Grease
Chlorinators	Gas piping	Check Gas leaks with amonia tester			✓		
	Ejectors	Check Gas leaks with amonia tester			✓		
	Chlorine cylinder	Check Gas leaks with amonia tester			✓		
		Check Gas pr.Constant low pr means cylinder is empty			✓		

Name of Equipment	Name of Part	Action to be Taken	Schedule of Action				Remark
			Daily	Weekly	Monthly	Yearly	
Chlorinators	Flexible Connector tubes All vent & vaccum polyethelene tubing	Replace lead cylinder washer with every new change of cylinder			✓	□	As required
		Replace				✓	
		Replace				✓	
	Flowmeter,rate valve	Clean & replace O rings & gasket			✓		
	O Ring In ejector	Replace			✓		
	Strainer in ejector water supply line	Clean & replace O rings & gasket				✓	
Caustic Circulation Pump	Bearing Housing	Oiling			✓		Bearing oil 320
Caustic ReCirculation Tank	1) In case of Chlorine Leakages	As Required					Start the air blower near tonners start cuastic recirculation pump till chlorine leackege is attended.
	2) In Normal case	As Required					Circulate the cuastic solution for 15-20 Mins.by starting caustic recirculation pump - once in a week. **NOTE : CLEAN EVERY SIX MONTHS**

CENTRIFUGE

Name of Equipment	Name of Part	Action to be Taken	Schedule of Action				Remarks
			Daily	Weekly	Monthly	Yearly	
Main Bearing	Greasing	Before first start lubricate the Bearings			✓		Alfa laval 61203671 - 23 BP - energrease LC - 2 100 Grams. At each nipple
Conveyor Bearings	Lubricating Oil	Check Oil level if required Add Oil			✓		Stafoil mereta 320 replace ofter 2000 Hrs.
Gear Box	Greasing	Lubricate spline			✓		Alfa laval 61203671 - 33 & Tex cladpremium 2
Spline (of Shaft & Hub)	Check for looseness	Looseness & Tighten				**2 Times**	First 72 Hrs. & there after every 2000 Hrs.
' V ' Belts	Check for looseness	& Tightness if required				**2 Times**	
Foundation Bolts	Check for looseness	& Tightness if required				**2 Times**	

ALWAYS ENSURE TO CLEAN BEFORE STARTING & STOPPING THE MACHINE

NOTE: - Periodic pest control of Offices & Buildings shall be done.

Name of Equipment	Name of Part	Action to be Taken	Schedule of Action				Remarks
			Daily	Weekly	Monthly	Yearly	
Air Blowers	Lubricating Oil	Check Oil Level			✓		Oil Servo system 320, Top up if oil level is below red mark. Replace oil after 500 running Hrs.(1st time) then replace oil after every 4000 Hrs.
	Foundation Bolts & Other Nut-Bolts	Check for tightness			✓		Tighten if found loose.
	Suction Filter	Cleaning of Filters			✓		Clean with back blowing of air or remove the suction filters & clean with air & refit.
	End Covers & Casing	Check for Temperature			✓		Check the oil level & Condition of oil.
	Safety Valves	Functioning of Safety Valves			✓		Test the safety valves for blowing.
Sludge Pumps	'V' Belts	Check for looseness & wear			✓		First tightening of v belts to be done after 48 Hrs. & there after once in a month.
	Bearing Housing	Greasing			✓		H.P.Multipurpose Grease
Dosing Pumps	Lubricating Oil	Check Oil Level if required Add Oil			✓		Servo system 220
Agitators	Gear Box	Oiling			✓		Tivella Oil SC 320

Preventive & Breakdown Maintenance for Electrical & Instrumentation Equipments

Electrical and Instrumentation installation details

Electrical System :

The plant has 33 KV supply from CSPDCL.

The electrical system is as follows

1) RMU IP6 630 Amps
2) CT/PT and metering unit
3) 2 Nos of 2 MVA Transformers
4) PCC with bus coupler system and APFC (with 2 Incomers 3200Amps with 50 KVR x 20 Nos)
5) 4 nos. of MCC's :
   a. MCC 1 for Raw sewage Pumps (breaker 1600 Amps Typically 175 HP soft starters – 8 nos.)
   b. MCC 2 : For Blowers (breaker 2500 Amps Typically for 215 HP VFD – 3 nos.& soft starter 6Nos)
   c. MCC 3 : MCCB 400 Amps For Automated Gates and valves, RAS, SAS Pump (RAS 20 HP&SAS 7 HP starter)
   d. MCC 4 : MCCB 400 Amps Centrifuge and sludge handling system (30 KW x 5 Nos)
6) Main HT Panel – 11 kV supply
7) Main Lighting Panel.
8) Street lighting Panels
9) LDB's for diff areas
10) Earthing Grid.
11) Street Lighting + Plant Lighting + Office Lighting.

Generally, Starters below 10 HP are DOL

10 HP to 90 HP Star/ Delta,

Above 90 HP Soft starters / VFD.

The soft starters can be electronic or FCMA type.

The total plant is operated by PLC with remote I/O's.

The PLC is connected to SCADA system , with online UPS. Printer etc.

Following types of instruments are used for plant automation.

1) Ultrasonic Level Transmitter – 6 nos.
2) Ultrasonic Clamp On type flow transmitter – 1 nos
3) DO Transmitter – 6 nos
4) Hydrostatic Level transmitter – 6 nos
5) Float switch – 6 Nos

Apart from above All the energy meters are with RS485 MODBUS connectivity.

Basic Preventive Electrical Maintenance Required

1) RMU, Metering Unit:

Cleaning with vacuum cleaner for total removal of dust on components, bus system: Every Month

2) Transformer:

External Cleaning: Every Month

Oil Filtration/Oil replacement: Once in year or after every fault

Cleaning of Bushings: Every six months.

1500 KVA DG Set Maintenance at two locations

3) PCC:

a. Cleaning with vacuum cleaner for total removal of dust on components, bus system : Every Month

b. Checking of tightness of power connections; Six monthly (or after observing increase in temp.)

c. Checking / cleaning/ replacement (if required) of moving contact parts, contact elements of contactors, : Every 3 months.
d. Replacing of push buttons switchgears, indicating lamps etc.

4) MCC:

e. Cleaning with vacuum cleaner for total removal of dust on components, bus system: Every Month
f. Checking of tightness of power connections; Six monthly (or after observing increase in temp.)
g. Checking / cleaning/ replacement (if required) of moving contact parts, contact elements of contactors, : Every 3 months.

5) PLC Panel:

h. Cleaning with vacuum cleaner for total removal of dust on components, modules relay boards, power supplies : Every Month
i. Checking / cleaning/ replacement (if required) of moving contact parts, contact elements of relays : Every 3 months.

6) Earth Pits & Earthing Grid:

j. Checking of tightness of connections ; Six monthly
k. Checking of Earth resistance: Every 12 months.
l. Watering the Pits : Every Month

7) Instruments:

As recommended by manufacturer in the maintenance manual.
Specifically cleaning of membrane every month & replacement of membrane for DO transmitter every 6-8 months.

Appendix # 2

Reporting Schedules

ATTACHMENT – 1

DAILY SUMMERY OF OPERATION AT SEWAGE PUMPING STATION

Date: - ----------

Name of Equipment		Wet Well Level in meter	Energy Consumption			Time Power Failure	Diesel Consumption of DG Set	Remark
Set No.	Hours of Operation		Initial Reading	Final Reading	Total Consumption			
Raw Sewage Pumps no - 1								
Raw Sewage Pumps no -2								
Raw Sewage Pumps no -3								
Raw Sewage Pumps no -4								
Raw Sewage Pumps no -5								
Raw Sewage Pumps no -6								
Raw Sewage Pumps no 07								
Raw Sewage Pumps no 08								
Coarse Screen no-1								
Coarse Screen no-2								
Screw Conveyor								

ATTACHMENT – 2

DAILY SUMMERY OF OPERATION AT SEWAGE TREATMENT PLANT

Date: - ----------

Name of Equipment		Wet Well Level in meter	Energy Consumption			Time Power Failure	Diesel Consumption of DG Set	Remark
Set No.	Hours of Operation		Initial Reading	Final Reading	Total Consumption			
RAS Pump No- 1								
RAS Pump No -2								
RAS Pump No -3								
RAS Pump No -4								
RAS Pump No -5								
RAS Pump No -6								
SAS Pump No- 1								
SAS Pump No -2								
SAS Pump No -3								
SAS Pump No -4								
SAS Pump No -5								
SAS Pump No -6								
Decanter no - 1								
Decanter no – 2								
Decanter no - 3								
Decanter no - 4								

ATTACHMENT – 3

Sewage Quality Mentoring at Sewage Treatment Plant.

Date :- ----------

Set No.	Location of Sample	Date and Time of			Influent		Effluent		Effluent Standard		Remark
		Collection	Analysis	Report	Parameter	Value	Parameter	Value	Parameter	Value	

ATTACHMENT – 4

Sewage Quality Monitoring at Sewage Treatment Plant.

Sewage Treatment Plant in Sector ---------- in Node ----------

Date :- ----------

Sr .No .	Time of Receipt of Complaint		Name, Address, Telephone number of Complainant	Details of Complaint	Complaint Received by		Signature of Junior Engineer/ Manager	Complaint Passed on			Redressal of Complaint			Signature of Junior Engineer/ Manager
					Name	Signature		Name	Date	Time	Name	Date	Time	

Summary: -

a) Back log of complaints on the day.
b) Number of complaints received during the day
c) Total number of complaints.
d) Number of Complaints attended during the day.
e) Number of complaints not attended at the end of the day.

ATTACHMENT – 5: Desilting Operating Schedules

Sr. No.	Unit	Date of Start	Date of Completion	Length of desiltted sewer	Amount of silt removed	Place of disposal	Junior Engineer Signature
1.	Sewerage						
2.	Wet Well of pumping Station						
3.	Grit Chambers						
4.	Any other unit						

Appendix # 3
OPERATOR STAFF REQUIREMENT

Personnel

Position/Designation	Minimum Qualification	Minimum Experience	
		Years	Nature
Plant-in-charge	Degree in Mechanical /Electrical/ Civil or Environmental Engineering	5	Experience in handling operation and maintenance of sewage treatment plant
Chemist	M. Sc. or B.Sc. in chemistry	5	Experience in handling an Industrial laboratory
Fitter / Electrician	ITI Certificate in trade of Mechanic/Electrician / Wireman trade/plumbing	5	Experience in handling workshop / pumping station / Installation of electrical and mechanical equipment
Shift Operator	Graduate with science or any other discipline with knowledge of computer is essential	5	Experience in handling automated industrial plant

The positions and designation of key staff in this list are indicative and for guidance only.
The Tenderer shall propose the positions. Designation, number and other specifications of the key staff it considers essential to perform the functions in this work. Tenderer shall employ additional manpower to get specified output.

Sr. No.	Description	Qty
1	Plant-in-charge	1
2	Chemist	1
3	Shift Operator	4
4	Supervisor	2
5	Electrician	2
6	Fitter	2
7	Centrifuge operator	1
8	Helper	8
9	Gardener/Sweeper	4
10	Security	4

ATTACHMENT 2: SALIENT FEATURES OF MAJOR LABOUR LAWS

Salient Features of Some Major Labour Laws Applicable to Establishments Engaged in Building and other Construction Works

a)	Workmen Compensation Act 1923 :- The Act provides for compensation in case of injury by accident arising out of and during the course off employment.
b)	Payment of Gratuity Act 1972 :- Gratuity is payable to an employee under the act on satisfaction of certain conditions on separation if an Employee has completed 5 years' service or more or a death the rate of 15 days wages for every completed years of service The Act is app liable to all establishments employing 10 or more employees.
c)	Employees P. F. and Miscellaneous Provision Act 1952:- The Act Provides for monthly contributions by the employer plus workers @ 10% Or 8.33% the benefits payable under the Act are ---
i)	Pension or Family pension on retirement or death as the case may be
ii	Deposit linked insurance on the death in harness of the worker
iii	Payment if PF accumulation on retirement /death etc .
d)	Maternity Benefit Act 1951 :- The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc
e)	Contract Labor (Regulation & Abolition) Act 1970 :-The Act provides for certain welfare measures to be provided by the Operator fails to pr vide, the same are required to be provided by the Principal owner by law. The Principal Owner is required to take Certificate of Registration and the Operator is required to take License from the designated Officer. The Act is applicable to the establishment of Operator of Principal Owner if they employ 20 or more contract labour
f)	Minimum Wages Act 1948 :- The employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Building , Roads. Runaways are scheduled employment
g)	Payment of Wages Act 1936 :- It lays down as to by what date the wages are to be paid, when it will be paid and what deduction can be made from the wages of the workers.
h)	Remuneration Act 1979:- The Act provides for payment of equal wages for work of equal nature to Male & Female workers & for not making discrimination against Female employees in the matter of transfers training and promotions etc
i)	Payment of Bonus Act 1965 :- The Act is applicable to all establishment employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages to employees drawing Rs 3500/- per month or less. The bonus to be paid to employees getting Rs 2250/-per month or above up to Rs 3500/- per month shall be worked out by taking wages as Rs 200/- per month only. The Act does not apply to certain establishment. The newly set-up establishment are exempted for five years in certain circumstances. Some of the State Government have reduced the employment size from 20 to 10 for the purpose of applicability of this Act.
j)	Industrial Disputes Act 1947 :- The act lay down the machinery and procedure for resolution of Industrial disputes in what situations a strike of lock out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.
k)	Industrial Employment (Standing Order) Act 1946:- It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the State and Central Government to 50) The Act provides for laying down rules governing the conditions of employment by the employer on matters provided in the Act and get the same certified by the designated Authority.
l)	Trade unions Act 1926 :- The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities
m)	Child Labour (Prohibition & Regulation) Act 1986 :- The Act prohibits employment of children below 14 years of age in certain occupations & processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labor is prohibited in Building And Construction Industry.

n)	Inter- State Migrant workmen's (Regulation of Employment & Condition of Services) Act 1979 :- The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in other state) The Inter-state migrant workmen in an establishment to which this Act becomes applicable are recruited to be provided certain facilities such as housing medical aid traveling expenses from home up to the establishment and back, etc.
o)	The Building and Other Construction Workers (Regulation of Employment and conditions of Service)Act 1996 and the Cess Act of 1996 :- All the establishment who carry on any building or other construction work and employees 10 or more workers are covered under this act . All such establishment are required to pay Cess at the rate not exceeding 2% of the cost construction as may be modified by the Government. The employer of the establishment is required to provide safely measures at the Building or construction work & other welfare measures such as Canteens First Aid facilities Ambulance Housing accommodations for workers near the work place. The employer to whom the act applies has to obtain a registration certificate from the Registering Officer appointed by the Government
p)	Factories Act 1948 :- The Act lays down the procedure for approval at plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 person or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process.
q)	As per the Chhattisgarh Contract Labour Act Rules 1971, for Equal work and Equal Pay : General Body has passed Resolution No. 1716 dated 06/08/2007 for payment to contract labour. The payment to contract labour shall be paid as per above General Body Resolution.

8.0 APPROVED MAKES

8.1 CIVIL ITEMS

SL. NO.	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
1	Cement (OPC) 43 Grade / 53 Grade	As per IS
2	Cement (SRC)	As per IS
3	Cement (White)	As per IS
4	Cement (PPC)	As per IS
5	Bricks	Ordinary Burnt Clay Bricks of any brand conforming to IS: 1877 with minimum Crushing Strength of 40 Kg/cm2 and Water Absorption Ratio restricted to 25% for Bricks used in Panel Walls and 20% for Bricks used in Load Bearing Walls
6	Mild, Tor Steel, CRS Steel	As per IS
7	Structural Steel	As per IS
8	Screws	GKW Nattlefold, Oxidised
9	Dash Bolt Fasteners	Fischer, Hilti
10	Ceramic Tiles	Spartex, Kajaria, Nitco, Johnsons, Somany, Pedder
11	Glazed Tiles (1st Quality)	H & R Johnson, Kajaria, Spartex, Naveen, Rommano, SomaniPilkingtm, ECL
12	Granite Tiles	Bell Granito, Naveen, H & R Johnson, RAK Ceramics – Dubai, Restile Ceramic
13	Glass Mosaic Tiles	Bisazza India, Pino Bisazza
14	Paver Blocks	Conwood Prefab, Hindustan Prefab or equivalent
15	Adhesives	Pidilite, Fairmate, Bal Adhesive, MC Bauchemie, Cementone India, Fosrock, Sunanda Speciality Coating
16	MS Door Frames & Shutters (With Galvanising)	Agew, Ferrosteel, Sen Harvic, Weldoors, YashashriPolyextrusion
17	Door Shutters (Wooden)	Kutty, Anchor, Classic, Goyal, Timber Techniks, Sejpal Doors, Wood Designs, YashashriPolyextrusion, Anand Wood Crafts, Northern Doors
18	Door Shutters (FRP) & Plastic	Everest fibre glass Industries, Unipals India, Advance Marketing, YashashriPolyextrusion, Sintex
19	Hardware (Handles, Hinges, Mortice Locks)	Shalimar, Sobeet, Vijayan, Navbharat Brass Works, CIEF, AmarbhoyDossaji
20	Aluminium Windows	Aluminite, Aluplex, Almech, Indrajit Associates, Aldoweit, Crystal Corporation, Indal, Jindal, Ajit India
21	Night Latch	Godrej, Sobeet, Vijayan, Yale
22	Paints:	
	a. Internal	Snowcem, Asian, ICI, British Paints, Shalimar, Nerolac, Burger, Jenson & Nicholson
	b. External	NITCO Paints, Killick Nixon, Hindustan Colours and Chemicals, Supreme, Shalimar, Burger, Jenson & Nicholson, Super Snowcem.
23	Synthetic Plaster Finish	Nitco, Accro, Damani Dye Stuff, Supreme, Renova
24	Waterproofing Works	India Waterproofing Co., Likproof India, Overseas Waterproofing Co.

25	Waterproofing Compound	Accoproof, Pediproof, CICO, Impermo, Vamiplas 302, Vamiproof 101 & 102
26	Glazing	Float Glass of Modi , Asahi , Saint Gobain
27	M.S. Rolling Shutters (With Galvanising)	Swastik, Standard, Shudwar
28	Aluminium Grills	DECO, Alumnigrille
29	Aluminium Joinery	Crystel Corporation, Alumlite, Aluplex, Alm
30	Anti-stripping Agent	Yuva, BE 100
31	Chemical Admixtures and Compounds for RCC and Mortar	MC Bauchemie, Krishna Conchem Products, Sunanda Chemicals, Pidilite, Fairmate, Fosroc, Sika Qualcrete
32	Anti-Corrosive Paint	Krishna Conchem Products, CICO Chemisol Adhesive, Shalimar, Burger
33	Sanitary ware	Hindustan, Parry, Cera, John Gas, Jotisum
34	Flushing Cistern	Flush Line or equivalent Approved ISI Manufacturers
35	Sanitary Fittings and Fixtures	Mark, Jaguar, Gem, Dripless, Kingston, Essco, Metro, EssEss
36	Lead for Lead Joints	Approved ISI Manufacturers
37	Rubber Ring	Approved ISI Manufacturers
38	Stainless Steel Sink	Nirali, Tuff, Diamond, Kingston, Neel Kamal
39	SW Gully Trap and Stone ware Pipes	Perfect, Sonya, Girco, Elecon, Rajura
40	Cast Iron Covers	RIFCO, Mohit Steel, Ashok Iron Works, JayswalNeco
41	Piling Works	Kvaerner, Afcons, Michigan Engineering, Larsen & Toubro, DBM Geotechnics, Meher Foundations, Safe Foundations, Simplex
42	Fire-fighting Works	Monsher, Mather & Platt, Bells Controls, Nitin Fire, Rahul Fire
43	Elevators	Otis, Mitsubishi, Kone, Bharat Bijlee, Schindler
44	Sodium Nitrate	Devica Chemicals or equivalent Approved ISI Manufacturers
45	Sodium Silicate	DevicaChemicals or equivalent Approved ISI Manufacturers
46	Marine Plywood	Anchor, Kitply
47	Neeru	Swastic Instant Neeru or equivalent Approved ISI Manufacturers
48	Lime for Whitewash	As directed by Engineer-in-charge
49	Tarfelt	Shalimar, Lloyds
50	Lightening Conductor	Approved ISI Manufacturers
51	Teak Wood	C.P. Teakwood, First Quality with following Tolerances. Sap Wood to the extent of 25% Wrap to the extent of 10 mm in 3m Knots/meter
52	S.W. Pipes	Burn & Co., Perfect Potteries, Navroji Vakil, Kashimira
53	CI Soil Pipes & Fittings as per IS : 3989/84	NECO, CENTRI
54	G.I. Pipes Class “C”	TATA, Zenith, Jindal, Suryaprakash
55	G.I. Fittings	Approved ISI Manufacturers
56	Gate Valve / Non Return Valve	Sant, Zoloto, Leader

57	S.W. Pipes	Rajura or other Approved ISI Manufacturers
58	Flush Valve	Jaguar ,EssEss
59	Water Meter	Capstan or other Approved ISI Manufacturers

8.2 ELECTRICAL ITEMS

SL. NO.	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
1	S.F.U., Breakers	L&T, Siemens, GE, Schneider
2	Distribution Boards	MDS, Siemens, Schneider, Hager
3	Indicating Digital Meters	AE, Meco, L&T, Conzerv
4	Crimping Lugs, Glands of Double Compression Type	Dowells, Jainson, Lotus, Braco
5	Jelly filled Telephone Cables	Finolex, Universal, RPG
6	Tag Block with Boxes	Krone
7	Rossets	ITL, Tele Connectors India
8	MCB, RCCB	MDS, Siemens, Schneider, Hager
9	Main L.T Panels, PDB, LDB	Incorporating L&T, Siemens, GEC, Schneider Switchgear Components, Chavare Engineering Pvt. Ltd.
10	Switches and Sockets	MDS (Leagrand), Schneider, Anchor, Cona, ROMA
11	PVC Copper Wires (FRLS Grade)	Sundeep, Finolex, RR Kabel, LAPP, Polycab
12	Motors	Siemens, ABB, Bharat Bijlee, Crompton, Kirloskar, Texmo, NGEF, Alstom
13	Cable Glands and Lugs	Dowell, Lotus, A.G. Electricals, Siemens
14	Cat-6 Lan Wire	Lucent, LAPP, AMP
15	PVC Pipe	Diamond, Precision (PPI), Asian
16	Lighting Fixtures	Wipro, Phillips, Clipsal, Crompton, Bajaj, K-Lite, Keselec Shredder
17	Fans & Air-Circulators	Crompton, Bajaj, Almonard, Usha, Cinni, Rallies, Orient, Khaitan
18	Distribution Transformer 11 KV, 433V	Crompton, Kirloskar, Emco, BHEL, Bharat Bijlee, Voltas, Andrew Xule, Pactil, NGEF, Voltamp
19	11 KV VCB Breaker & Panel	ABB, Schneider, Siemens, Alstom, Jyoti, Kirloskar, Crompton
20	Relays	ABB, Siemens, Alstom (AREVA), Schneider, L&T
21	11 KV SF6, Insulated 3-Panel, 4-Panel extensible type RMU	Crompton, ABB, Siemens, Alstom, Schneider, L&T
22	ACB 8-Way, Feeder Pillar 6-Way, 4 Way & Mini Pillars	Popular Brass Metal Works, ABAK, Manish, Fitwell, Super Panel, Control & Switchgear, Chavare Engineering Pvt. Ltd.
23	Fuse Base	Siemens, L & T, Popular Brass Metal
24	Control Cables	LAPP, Finolex
25	Batteries	Amar Raja, HBL Knife, Exide, Emco
26	11 KV End Termination & Straight through Joint	Raychem, Xicon, Danson
27	Measuring Instruments	MECO, IMP, KEW, Rishiline (L&T), Conzerv

28	PVC Insulated Cable for Working Voltage up to 1.1 KV as per IS: 694: 1990	Finolex, Asian, Polycab, Reliance, Fixolite, Torrent, Universal, Fortgloster, Vardhaman, Fixolite, Macro, CCI
29	XLPE – LT Cables as per IS:7098 Part – I: 1988	CCI, Asian, Finolex, Torrent, Macro, Fixolite, KEI, Polycab with Nitrogen Corring, Gloster
30	XLPE – HT Cables as per IS:7098 Part II – 1985	CCI, Asian, Finolex, Torrent, Macro, Fixolite, Polycab, Vardhaman
31	PVC Insulated (HD) Cable up to 1.1 KV as per IS:1554 Part I – 1988	Torrent, Macro, Vardhaman, Finolex, CCI, Asian, Polycab
32	Air Conditioners	Samsung, LG, Voltas, Carrier
33	Lamps HPMV,HPSV Metal Hallide Lamps & Accessories	Vallient, Fixolite, Bajaj, Philips
34	MCB,ELCB,RCCB,HRC	Indo Asian, MDS, Datar
35	T. W. Boards & Blocks	Double Folding Polished Board shall be in one Piece. Block up to 8” x 10” shall be in two Pieces
36	T. Switch S.P. or 2-Way S.A. to I.S.A.	Khosla, Keycee, GNE, Modern, Kalki
37	Three Pin Socket: 5A to 15A	Khosla, Keycee, Standard, Ellora
38	Ceiling Rose	Khosla, Keycee, Ellora, Oshan, Modern
39	Ring Main Unit, HT, Switch and Fuse Unit	MEI, South Andrew Yule or Department approved
40	C.T. / P.T.	Department approved
41	Auto Transformer Starter	MEI, Kilburn, JMP, Siemens, Andrew Yule, GEC, KEC
42	Trivector Meter	Department approved
43	Measuring Instrument	IMP, AE, UE, MECO, FE, Rishiline (L&T), Conzerv
44	Current Transformer	AE, Gilbert & Maxwell, IMP, Siemens, SEGC (C.S.), VM Electric or Department approved
45	PVC Conduits, PVC Pipes, HDPE Pipes	Garware, Finolex, Shakti, Circlearc, Popular, Prince
46	GOD Switches and Dropout Fuse Outfit	Kiran, Pactil, Atas or Department approved
47	Chain Pulley Block	Elephants, Herculas, WMI
48	Lugs	Dowels, Lotus, AG Electricals
49	Motor Protection Relays	Universal, Thresold, E.E., L&T, Minilac, Siemens, C&S. Telemechanique, Indo-Asian
50	Feeder Pillar,Mini Pillar	Popular Brass Metal Works, Anil Electrical Industries or Department approved
51	MCB & MCB, D.B.	MDS, Siemens, EE, Telemechanique, Havells, Indo-Asian, Standard, Versa Trip, Helcon, Safeline, Datar, Schneider
52	ELCB	Datar, MDS, Standard, GE, Telemechanique, Havells, Safex, HH-ELCON, Naptune, Gutts, Indo-Asian, Siemens, GE, Schneider
53	PVC Wires, Copper Aluminium Conductor, Flexible Cables	Philco, Phyroflux, Paragon, Polyplast, V-Plast, Apex, Silvex, Delta, Pagoda, Spacecab, HMT, Ralicab, Finolex
54	HRC Fuses	L&T, Indo Asian, Siemens, Havells, ARCON, Standard, Samrat
55	Fuse Switches, SW Fuse	L&T, Siemens, Crompton, Telemechanique, Indo-Asian, Havells, HH-ELCON, Standard, KEW, Kalki, Sentinel, Stenly, Samrat, Schneider
56	Switches, Sockets	Kalki, CPL, Anchor, Precision, MK, HME, EEW

57	Cable Glands	HME, EEW, Conzerv& Department approved,
58	HC Fuse Distribution Board	CPL, EE, EssEss, Stenly, KEW, Kalki, Standard
59	Air, Oil Circuit Breakers (HT,LT)	Kilburn, Easun, MEI, Jyoti, Andrew Yule, Siemens, L&T, GEC, Soutern, BHEL, Telemechanique, Crompton & Department approved
60	Energy Meters	Jaipur or Department approved
61	Capacitors	GEC, KhatauJunkar, Crompton, L&T, Momaya, Madhav, Atlanta, Prabhodhan, Maladay, Asian, Schneider, EPCOS, (S+M) or Department approved
62	Steel Tubular Poles	Indian Electric Poles, Bombay Tubes, Nityanand, Rajan Tubes or approved ISI Manufacturers
63	GI Pipes, Poles	Zenith, Tata, Bharat, Jindal, Suryaprakash
64	Terminal Box, Bracket, Junction Box, Control Pillar	ELM, United, DVK or Department approved
65	Street Lighting Luminaries	Bajaj, Crompton, Philips, Genelec, Keselac, ELM, Mysore, Wipro, GE-Apar, Canara, Glolite, Indo-Asian
66	Chokes, Ignitors	Bajaj, Crompton, Philips, Genlec, Keselac, GE-Apar, Glolite, ECE, Indo-Asian
67	Power Contactors	L&T, Siemens, Bharat Cutter & Hammer, Telemechanique, HH-ELCON, Kirloskar, Crompton
68	Lamps	Bajaj, Crompton, Philips, Cema, HMT, Electron, Surya, Mysore, Sylvania-Laxman, Solarson, ECE, Indo-Asian
69	Rotary Selector Switches	L&T, Siemens, Kaycee, EE, BISONS (ELM), Schneider
70	Post Top Lantern	Philips, Crompton, Glolite, Bajaj, Parimal, Tulip, Keselec, ECE, Genlec, ELM, Wipro, Indo-Asian
71	Street Light Controller, Timer	L&T, (TSQ 100) 24 hrs. Dial, ELM, GIC
72	ASCR Conductors	Department approved
73	Alternators	Kirloskar, Jyoti, NGEF, AVK-SEGC, KEL, Caterpiller, Stamford, CG Newage
74	Diesel Engines	Kirloskar, Greaves Cotton, Cummins, Ashok Leyland, Cater Piller, Perkins, Volvo, Sterling Wilson, Mahendra&MahendraPowerica
75	Cable Jointing Kit	Raychem, Xicon, Benson, Mahindra (Push on) M Seal
76	Pole Paint	Jenson & Nicholson, Asian (S+M), Nerolac
77	Fluorescent Fixtures	Bajaj, Crompton, Philips, GEC, Genelec, Mysore, Wipro, Glolite, Litwell, Prestolite, Indo-Asian
78	Analyzers	Forbes Marshall, Endress& Hauser, Yokogawa
79	Level Switch, Level Indicator	Levcon, Revathi, Fitzer. S.B. Electro-Mechanical. Endress & Hauser, P&F, Fisher Rosemount, Forbes Marshall
80	Flow Meter – Magnetic, Ultrasonic	Endress & Hauser, Fisher Rosemount, Forbes Marshall
81	Soft Starters	Allen Bradly, Schneider, Innovative Tecno
82	Motors	Bharat Bijlee, Crompton, ABB, Siemens, Kirloskar, NGEF
83	Electrical Panels	Interlec, Positronocs, Jay Switchgear, Chavare Engineering, L&T, Siemens, ABB, Schneider, Crompton, Spark Electro

8.3 ELETROMECHANICAL & INSTRUMENTATION WORK

SL. NO.	MATERIAL, WORK	SUPPLIER, MANUFACTURER, VENDOR, AGENCY
1	Mechanical Screens– Coarse & Fine	Dorr-Oliver, Voltas, Emco, KCP, Batliboi, Jash, Shivpad, Johnson, Huber
2	Detritus Mechanism	Dorr Oliver, Voltas, Emco, KCP, Batliboi, Shivpad
3	Pumps: Horizontal Centrifugal	Kirloskar, Kishor, Johnson, KSB, Grundfos, Worthington, Mather & Platt, Jyoti, Homa
4	Pumps: Submersible	Su Motors, Kishor, Kirloskar, KSB, Grundfos, Homa, Jyoti, Dharani, Flowmore, ABS
5	Pumps Sewage	Kishor, Aqua, Wilo
6	Pumps: Vertical Turbine	Kirloskar Brothers Limited, WPIL, Mather & Platt, Jyoti, Homa, Flowmore
7	Pumps: Screw (Positive Displace / Progressive Cavity Type)	Roto, Ramo, Flosys, Alfa Helical, Tushaco, Netzsch
8	Pumps: Chemical Dosing (Positive Displacement Type)	Milton Roy, Swellore, Shapotools, Prominent, Sandur, Roto
9	Air Blowers	Kay International, Swam, Everest
10	Air Compressor	Ingersoll Rand, Elgi
11	Fine Bubble Membrane Diffusers	EDI, OTT, Rehau, SSI
12	Chlorinators	Metito, Chloro Control, Industrial Devices, Pennwalt
13	Submersible Mixers	ABS, Grundfos, ATE, Grundfos, WILO
14	Agitators	Dorr-Oliver, Voltas, Emco, KCP, Batliboi, Shivpad, Fibre & Fibre, Standard Engineers, Helx
15	Centrifuges	Alfa Laval, Hiller, Humbolt, Pennwalt
16	Belt Filter press	Dorr Oliver, Triveni, Andritch, Siemens
17	Chain Pulley Block, Electrical Hoist, JIB Crane	Elephant, Hercules, WMI, Indef, Brady & Morris
18	Pipes:	
	GI Pipes	Tata, Zenith, Indus tubes, Swastic, Jindal
	SS Pipes	As per IS
	CI Pipes	As per IS
	DI Pipes	As per IS
	PVC Pipes	As per IS
	UPVC Pipes	As per IS
	HDPE Pipes	As per IS
	RCC Pipes	As per IS
19	Sluice Gate	Voltas, Emco, KCP, Batliboi, Jash, Yeshwant, IVC, Durga
20	Valves: Butterfly, Non-Return, Knife Gate, Gate, Ball, Globe, Diaphragm, Plug	Audco, BDK, Crane Process Control, Fouress, Intervalve, IVC, Jash, Kirloskar, Vaas, H Sarker
21	MCC	Interlec, Positronocs, Jay Switchgear, Chavare Engineering, L&T, Siemens, ABB, Schneider, Crompton, Spark Electro

22	Variable Frequency Drive (VFDs)	ABB, Nord, Mitsubishi
23	PLC	Allen Bradley, Mitsubishi, GE, Siemens, Messung, Honeywell, Schneider
24	SCADA	Allen Bradley, Ellipse, Wonderware
25	Pressure Gauges	H.Guru, Gluck
26	Level Switches, Level Transmitters	Levcon, Revathi, Fitzer. S.B. Electro-Mechanical, Endress & Hauser, P&F, Fisher Rosemount, Forbes Marshall
27	PH / ORP Meters, Flow Meters, DO Meters etc.	Endress & Hauser, Fisher Rosemount, Forbes Marshall, Yokogawa
28	TOC, Turbidity, MLSS & other Analysers	Hach, ABB, GE, Yukogawa, Fisher Rosemount, Forbes Marshall
29	DISC FILTER	Yucheon International, Siemens, Huber
30	Ozonator	KAUFMANN/ SEWEC / ORAIPL/ TOSHIBA / MITSUBISHI

9.0 TECHNICAL SCHEDULES

The schedule formats given on following pages for technical details of the bidders are to be necessarily filled in by the bidders. Bidder must fill these schedules.

However,, the bidder, should feel that the formats or items are not sufficient to cover all types of plant, machinery, automation system etc. that are to be provided by him he is free to provide additional formats for the other items. Those formats However, must provide all technical details of items supplied, to enable the employer to scrutinize the adequacy or functionality of these items in the plan. However,, no financial data or cost is to be indicated in the Technical Proposal as the same are to be indicated in a separate financial proposal.

DETAILED SPECIFICATIONS APPLICABLE FOR ALL SUB WORKS WHEREVER AND WHENEVER APPEARS IN THIS NIT OTHER THAN RESPECTIVE SPECIFICATIONS APPEARED UNDER RESPECTIVE SUBWORKS

CHAPTER – 1
TECHNICAL SPECIFICATIONS

1. TECHNICAL SPECIFICATIONS – GENERAL

1.1 General

1.1.1 General Notes

The KMC requires that all goods and materials to be used in the works are new unused, of the most recent or current models and incorporate all recent improvements in design and material.

Only the KMC's Requirements and design brief are specified in the following section. These are not restrictive. The Contractor has to draft, the technical specification and the specification of standards for goods, materials and workmanship with recognized codes and standards.

1.1.2 Submittals

The submittals include but is not limited to work required to comply in accordance with general and specified procedures for transmittal of submissions; submission review and subsequent actions; schedule of submissions; resubmission; construction schedule; coordination of drawings; submission of drawings; insert and sleeve location drawings; reproduction of submitted drawings; sample; and construction photocopies.

1.1.3 Design, Drawings, Documents and Data

1.1.3.1 General Obligations

The Contractor shall carry out, and be responsible for, the design of the Works. Design shall be prepared by qualified designers/professionals who comply with the criteria stated in the KMC's Requirements. The Contractor undertakes that the designers shall be available to attend discussions with the Engineer In-charge at all reasonable times during the Contract Period. The designs and drawings shall be got approved from IIT/NIT, prior to the final approval from the competent authority at the cost of the contractor. If during the approval any change or suggestion is made by the competent authority then the same has to be got corrected by IIT/NIT and then the final approval shall be given.

1.1.3.2 Basic Design Parameters

The bidder is required to examine and check the KMC's design criteria, specifications etc., as included in the Bid documents to confirm their correctness in its bid and to assume full responsibility for them.

1.1.3.3 Submission of Design Calculations, Drawings and Other Documents by the Contractor

(a) After signing the Contract, within 28 days from the date intimated by the KMC to proceed with the work, the Contractor shall supply to the Engineer In-charge 6 (six) hard copies (along with workable soft copies in a CD) each of the design calculations for the process and sizing of all components of the plant including mechanical and electrical equipment, supported by flow diagrams, and general arrangement drawings, reference catalogues /literature of manufacturers, other reference documents used for the design purpose, for

approval of the Engineer In-charge . The Contractor shall incorporate all necessary comments of the Engineer In-charge in the above design and drawings, if any, and shall re-submit further 6 (six) copies each of the revised design and drawings within 14 (fourteen) days for final approval of the Engineer In-charge. The Contractor shall thereafter submit 6 (six) copies each of the approved design and workable soft copies of all approved designs, calculations and drawings. The entire cost shall be borne by the Contractor and the KMC does not hold reliability on this account at any cost and any time.

(b) Design calculations and drawings shall be submitted in sequence as per schedule to be drawn and agreed upon mutually, immediately after submission of the general arrangement drawing. The entire process of submission of all such documents by the Contractor in initial copies and final copies after approval of the Engineer In-charge shall be completed within 90 days from the date of the work order. These documents shall cover:

Site Plan.
Layout Plan and hydraulic flow diagram, process design, P & I diagram
Architectural Drawings
GA drawing of each / individual unit
Detailed structural design and good for execution drawings pertaining to all components of the plant and other associated works.
Drawings showing the size, position and other necessary details of all mechanical and electrical equipment and fixtures.
Wiring diagrams, pressure control, pumps and motor control gear particulars.
Details of foundations, position of openings, etc., for the pumps, motors, starting cubicles, LT/HT panels, etc.
Elementary diagram and manufacturers' shop and part drawings for all equipments.
Services like internal illumination and ventilation, building water supply, sanitation and plumbing, area lighting, etc.
Landscaping & Plant beautification plan
Any other design and drawings to fulfil the KMC's requirement.

1.1.3.4 Format of Drawings

All drawings submitted for approval shall be ISO standard size sheets. Every drawing shall have a title block in the bottom right corner showing:

KMC's Name :
Contract No. :
Consultant :
Contractor :
Project :
Drawing Title :
Drawing Number :
Revision Number :
Date :

Each drawing shall bear the signature of the Project Manager on behalf of the Contractor to the effect that the drawing whether his own or from any other source has been checked by the Contractor before submission to the department.

Each revision shall be properly recorded to show the number, date, specific description of revision(s) carried out, and signature of the Project Manager in the revision block. The Contractor shall be responsible for incorporating all the comments issued by the Engineer In-charge.

1.1.3.5 **Construction Documents**

1.1.3.6 **As-Built Drawings**

The Contractor shall prepare, and keep up-to-date, a complete set of "As Built" records of the execution of the Works, showing the exact "as built" location, sizes and details of the work as executed, with cross references to relevant specifications and data sheets. These records shall be kept on the Site and shall be used exclusively for the purposes of this Sub-clause. Two hard copies shall be submitted to the Engineer In-charge prior to the Tests on Completion.

In addition, the Contractor shall prepare and submit to the Engineer In-charge "As Built drawings" of the Works, showing all Works as executed. The drawings shall be prepared as the Works proceed, and shall be submitted to the Engineer In-charge for his inspection. The Contractor shall obtain the consent of the Engineer In-charge as to their size, the referencing system, and other pertinent details.

Prior to the issue of substantial completion Certificate, the Contractor shall submit to the Engineer In-charge one soft copy, workable CD, one full-size original copy of the relevant "As Built Drawings", and any further Construction Documents specified in the KMC's Requirements. The Works shall not be considered to be completed for issue of substantial completion certificate until such documents have submitted to the Engineer In-charge .

1.1.3.7 **Coordination Drawings**

Coordination drawings shall be prepared and shall comprise composite section drawings showing coordination of mechanical and electrical work to structural work. The composite drawings shall be in sufficient detail to show overall dimensions of ductwork, piping, conduit, and related items and clearance between structural members, lighting and related features for review and approval of relative locations of work in allocated spaces. The drawings shall indicate any conflicts of clearance problems between various trades. Coordination drawings shall be submitted to the KMC's Representative. Coordination drawings will not be submitted for approval but for review only.

1.1.3.8 **Equipment and Interconnection Diagram**

Equipment room layout drawings shall be based on actual requirements of equipment furnished and be consolidated for all trades, shall be to scale and shall show all pertinent structural and penetration features and other items, such as electrical cabinets, which affect available space. All mechanical and electrical equipment including electrical conduits, accessories, ductwork and piping shall be shown to scale in plan and Also, in elevation and / or section and resolve any conflicts or clearance problems. Physical descriptions of the various mechanical and electrical items shown on these drawings shall be submitted concurrently.

1.1.3.9 **Quality**

Proof of quality of manufacture and reliability in field application. Such proof will normally constitute evidence that the product / equipment has been manufactured by the manufacturer, or fabricator of the quality assured for a unit or item over a period of time and has an established field service record. It shall include installation locations, dates and year of operating service. If there is no experience for an identical unit or

item it may relate to a similar unit or item by the same manufacturer.

1.1.3.10**Manufacturer's Data**
Manufacturer's data shall include catalogue cuts, brochures, circular, specifications, equipment operations and maintenance manuals and other printed information in sufficient detail and scope to verify compliance to the requirements.

1.1.3.11**Performance Data**
Performance Data shall include certified curves of equipment responses and performance characteristics as required.

1.1.3.12**Parts and Special Tools Lists**
a) Parts lists shall include a complete list of component parts of an item of equipment together with an expanded view or equivalent means to identify the parts.
b) Special Tools lists shall include all tools and devices required for assembly, disassembly, operation and maintenance of the equipment and an indication of the use of each item.
c) The lists shall further identify the sources of manufacture and supply of consumable supplies and those parts, special tools and supplies that are normally furnished with the purchase of the equipment or are specified to be furnished.

d) In additions, a list shall be provided showing items recommended by the manufacturer to support normal maintenance based on the manufacturer's anticipated life cycle of the part for continuous normal operation.

1.1.3.13**Certificates of Compliance**
Certificate of compliance shall include material or product manufacturer’s statement that the supplied items or systems conform to the specifications.

1.1.3.14**Test Repor**ts
Test reports shall be provided as required and as follows:
a) Shop tests shall show the results of required shop tests of equipment or systems certified in writing by the manufacturer or its authorized Representative. However, the KMC / its representative along with consultant is free to visit and inspect the equipment and systems at manufacturing unit before dispatch. The cost toward such inspections shall be borne by the contractor.
b) Field test reports shall show the results of required field tests and compliance with approved procedures and shall be certified in writing.

1.1.3.15**Maintenance Instructions**
Maintenance instructions shall cover finish material including but not limited to hard-surfaced materials. Instructions shall include cleaning, tarnishing, dents and stains from various chemicals.

1.1.4 **Submission Review and Subsequent Action Procedures**
i) Submission will be returned by the KMC's Representative to the Contractor indicating the appropriate action to be taken by the Contractor as follows:
a) Except in cases where local jurisdictional authority approval is required to validate a particular submittal, fabrication, manufacturer, construction or purchasing may proceed.

b) The submission does not comply with contract requirements, and fabrication, manufacturer and construction shall not proceed. The Contractor shall make revisions and resubmit. The Contractor has 14 calendar days from date of receipt of advice of the Engineer In-charge as to compliance with his comments and to resubmit drawings evidencing such compliance.

ii) Failure of the Contractor to process submissions for review shall not relieve the Contractor of his responsibilities under the contract.

iii) Do not proceed with work dependent on submissions until the submissions have been verified by the Contractor and reviewed by the KMC. Making good work which has proceeded in error because of non-compliance with these requirements shall be at the Contractor's expense. Review of Resubmissions shall not relieve the Contractor of his responsibility for execution of the works in accordance with contract document.

iv) The Contractor shall not be relieved of responsibility for deviations from the contract or errors of any kind in the submissions or from the necessity of furnishing work required by the contract which may have been omitted from the submissions reviewed by the Engineer In-charge. The Engineer In-charge's review of individual items in submissions shall not be constructed as a review of the complete assembly in which it functions.

v) No authorization of an increase in total contracting price or time or completion shall be implied by comments marked on submissions or submission transmittals by the Engineer In-charge.

vi) Review of submission shall not absolve the Contractor from the responsibility of correctly locating all items in the works.

vii) KMC's approval of substitutions, alternatives and deviations:

Whenever and wherever the Contractor proposes to make substitutions to the specified construction method or process or proposes the use of non-specified manufacturer's, products or to deviate from the material specified, the Contractor must make a full submission as required in the contract. The Contractor is advised that only the KMC has the final authority to approve or reject proposed substitutions, alternates and / or deviations from the contract.

1.1.5 **Construction Photographs**

i) Work shall include progress photographs for each work of construction taken each month made by a professional photographer.

ii) Photographs shall show general extent of the works by both exterior and interior views. Each viewpoint will be selected and the number of monthly repetitive photographs taken from exactly the same viewpoint as decided by the owner's authorized representative.

iii) Submit six 200mm x 254mm glossy colour prints of each photograph to the KMC authorized representative at the first of each month duly attached / pasted in the Progress Report.

iv) Title and mount each photograph per the KMC's authorized representative's requirements. As a minimum include on title: Project name, direction of view, and date when taken.

v) Video shooting during major construction stages of plant or at least once every month must be carried out by the contractor and shall be submitted to the KMC / authorized representative.

1.1.6 **Quality Assurance**

The Contractor shall institute a quality assurance system to demonstrate compliance with the requirements of the Contract. Such system shall be in accordance with the details stated in the Contract. Compliance with the quality assurance system shall not relieve the Contractor of his duties, obligations or responsibilities.

Details of all procedures and compliance documents shall be submitted to the Engineer In-charge for his information before each design and execution stage is commenced. When any document is issued to the Engineer In-charge, it shall be accompanied by the signed quality statements for such document, in accordance with the details stated in the Contract. The Engineer In-charge shall be entitled to audit any aspect of the system and require corrective action to be taken. The quality assurance system and the audit of any aspect of system and necessary corrective action shall be at contractor's risk and cost.

Quality assurance shall include, but shall not be restricted to as noted herein.
The Quality Assurance system should ensure the quality and quantity continuously through monitoring systems as envisaged in Project Management and Construction proforma so as to give daily progress report, labour / manpower deployed, quantity executed on periodic basis, observations thereof through following proforma placed at the end of this subsection.

- Bar bending schedule
- Pour Card
- Post Concreting check ups
- Form work check up
- Tests on materials

1.1.6.1 **Quality Asuncion General**

i) Maintain continuity of quality assurance surveillance throughout fabrication of products and execution of work.
ii) Submit details of quality assurance tests and methods inclusive of the specification.
iii) Perform inspection and testing in accordance with specified reference standards, or as otherwise approved by the KMC's Representative.
iv) Calibrate measuring and testing devices periodically against certified standard equipment. Calibration shall be verified by inspection firm.

1.1.6.2 **Quality Assurance Of The Works On Site**

i) Provide an assurance system to ensure quality assurance by phased inspection as follows:

a) Preparatory Phase Inspection
Perform inspections prior to commencement of each part of the works which shall include a review of requirements with the supervisors directly responsible for that part of the works. Such review shall be in the form of written statements of the processes to be followed and critical characteristics, tests and similar evaluations which will be a part of inspection procedures. Verify that products incorporated with that part of the works which have been tested and applicable submissions have been made for control testing. Verify that preceding work has been completed and approved. Verify products incorporated with that part of the works conform to submission data and Contract requirements and that necessary materials and equipment are easily and readily available.

b) Continuing Inspection

Perform inspection on a continuing basis as each part of the works commences and on a regular basis to ensure constant compliance with the tender requirements.

ii) Provide samples of materials to be tested in required quantities at locations where testing is performed.

iii) Provide labour, instruments, testing devices, facilities and required shelter at the site:
a) To determine ambient and material temperature by thermometers with Celsius scale.
b) To determine relative humidity of air and moisture content of materials.
c) To facilitate inspection and tests.
d) For obtaining and handling of samples at site and plant.

iv) Upon receipt of items at the job site, the Contractor's quality assurance representative at the site shall be responsible on receipt of items at the site for noting damage suffered by them during transit and for directing that they be replaced.

v) The Contractor shall be responsible for protecting and maintaining items on the site free from damage during storage, erection, installation and maintenance.

vi) When it is discovered on inspection that work is proceeding with incorrect materials or methods, ensure that corrections are immediately made and that improperly complete work is replaced.

1.1.6.3 **Quality Assurance of Off-Site Works**

i) The Contractor shall impose quality assurance methods at the location of manufacture, fabrication and assembly of items to be incorporated in the works to ensure that they conform to requirements of the Contract Documents. This quality assurance shall not apply to proprietary catalogue production products except as may be deemed necessary by the Contractor or as directed by the KMC's Representative.

ii) The Contractor's quality assurance representative off-site shall be responsible for the release of items for transit to the job site.

iii) In addition to the Contractor shall provide notice to the KMC's representative in writing at least 4 weeks in advance of packing of every batch of product components or assemblies so that the KMC or KMC's Consultants and their designated representatives may have opportunity at his / their choice of inspecting any such product components or assemblies prior to transportation at the cost of the bidder.

1.1.6.4 **Schedule of Quality Assurance Operations**

Provide the KMC's Representative with a minimum of three copies of a schedule of quality assurance operations, both on-site and off-site, to outline the procedures, instructions and reports which will be used, as follows:

i) Quality assurance organization.
ii) Qualifications of quality assurance personnel.
iii) Authority and responsibilities of each quality assurance person.
iv) Schedule of inspections and tests with personnel assigned to each task and duration of each task.
v) Schedule of required services to be provided by inspection and testing firms.
vi) Co-ordination required in order that quality assurance is integrated.

vii) Test methods which will be utilized.
viii) Methods of performing and documenting quality assurance operations.

1.1.6.5 **Tests Required By Jurisdictional Authorities**

i) The Contractor shall be responsible for inspection and testing required by jurisdictional authorities in conformance with the performance requirements.

If the Engineer In-charge so desires, he may delegate inspection and testing of materials or Plant by an independent body / agency. Any such delegation shall be effected for this purpose shall be considered as an assistant of the Engineer-in- Charge. Notice of such appointment (not being less than 14 days) shall be given by the Engineer In-charge to the Contractor.

1.1.6.6 **Quality Assurance Reports**

I) Document each test and inspection on a report and submit the report in triplicate to the KMC's Representative.

ii) Reports shall be in an approved format and shall certify off-site items produced correctly for on-site work of installed correctly, as applicable. Similarly, the report shall certify items that are defective with a statement of records on corrective measures taken.

iii) Include on each report the purpose of the inspection or test, a description of methods used, observations made and personnel involved.

iv) The Contractor shall Also, maintain in the approved format a log book of all tests performed which shall include the date of test, type of test and the results of the test.

v) If inspection and testing procedures are sub-contracted to an approved inspection and testing firm, only copies of test reports signed by the approved inspection and testing firm will be acceptable.

SITE FORMATS

DAILY PROGRESS REPORT

Name of the Project:												
Sr. No	Activity	Start	Finish	Quantity	Unit	Work Done Till		Work Done on		Cumulative work Done		Overall
						Target	Actual	Target	Actual	Target	Actual	Completion

MANPOWER DEPLOYMENT STATUS			PLANT & EQUIPMENTS		MATERIAL RECEIPT		
Sr. No	Category	Nos.	Category	Nos.	Item	Quantity	Remarks
1	Mason		Excavator JCB				
2	Carpenter		Excavator POCLAIN				
3	Fitter		Dumper				
4	Plumber		Batching Plant				
5	Operator		Concrete Mixer				
6	Painter		Concrete Pump				
7	Electrician		Vibrator				
8	Mechanic		Welding Machine				
9	Welder/Rigger		De-watering Pumps				
10	Mate		Cube testing Machine				
11	Male Mazdoor		Compressor				
12	Tapker (Stone cutting)		Rock Splitter				
13	Helper		Cutting & Bending Machine				
	TOTAL						

Structure / Building:		Date:		
Location:		Approximate Quantity:		Remarks
Sr. No.	Description of Item	Observation		
		Contractor's Engineer	Engineer In-charge	
1	Block masonry and concrete surface are found clean, free from duct loose material, oil, grease, mortar droppings, nails, steel wooden pieces,			

	wire etc.			
2	Joints in blocks masonry are racked to a depth of 10mm			
3	Surface to be plastered is made sufficiently damp.			
4	Unavoidable projections in masonry and concrete is chiselled			
5	Hacking on concrete surface is sufficiently deep and distance between hacking is not more than 25-40mm			
6	Any leakage's observed before plastering.			
7	If yes, leakages have rectified.			
8	Joints between concrete surface and masonry are properly filled with cement mortar or sealant before applying plaster.			
9	Joints, concealing and repaired areas are covered with chicken mesh of 300mm wide.			
10	Mark up is made before plaster at interval not more than the size of bottom ------ to be used.			
11	Grading of sand, silt and dust are within the permissible limit.			
12	Thickness of single coat plaster is not less than 12mm and not more than 15mm			
13	Door frames are free from cracks, knots etc.			
14	6 Nos. hold fast fixed properly			
15	Frames are fixed in plumb			
16	All above points checked and permitted to start plaster			
	Observations			
	Plaster is in line and level, the difference in plumb is not more than 2mm			
	Neeru finish is of 2mm to 3mm and is applied over the plaster when it has just hardened			
	Curing is done on neeru plaster by slightly sprinkling water.			
	After Neeru finish the room dimensions are checked and they are of size ……mm x ……mm x ……. Mm.			
Signature of Contractor's Engineer Signature of Engineer In-charge				

FORM WORK CHECK LIST

Name of Project :

Client :

Contractor : Inspection Required on :

Name of Building:

Concrete Element &Location : Date :__/__/__ Time:__-__

Approved Drawing No. : Inspection Request No. :

Y=Yes, N=No and Na= Not Applicable. Date :__/__/__ Time :__-__

Sr. No.	Name of Activities	Contractor's Engineer	Engineer In-charge
1	Formwork design/ drawing/ sketch approved including de-shuttering arrangements.		
2	Trial panel approved (if required)		
3	Formwork alignment correct		
4	Formwork level correct		
5	Formwork dimensions correct		
6	Formwork member quality acceptable.		
7	False work member sizes correct		
8	Face boarding/ plywood/ metal thickness correct		
9	Joints between panels closed (no gaps)		
10	Joints between panels flush (no steps/ lips)		
11	Panel flatness acceptable		
12	Tie rod material sizes/ spacing/ material correct		
13	Tie rods tight, face cone flush		
14	Box outs, cast -in –items, ducts fixed correctly, securely		
15	Chamfers/ fillets sizes, straightness, fixing acceptable.		
16	Formwork clean		
17	Formwork release oil material approved		
18	Formwork release oil applied correctly		
19	Contraction / expansion joint preparation satisfactory		
20	Shutter vibrators (if required) location and fixing arrangements approved.		
INSPECTED BY: (Contractor's Engineer)		APPROVED BY: (Engineer In-charge)	

Name: Sig. & Date	Name: Sig. & Date

SLUMP TEST REGISTER

Name of Project :
Client :
Contractor :

Sr. No.	Date/ Time	Mix/Grade of Concrete	Location of Concrete Pouring	Slump in mm	Contractor's Engineers Sign.	Engineer-In-Charge

BRICK TESTING REGISTER
(DIMENSIONAL TOLERANCE)

Name of Project :
Client :
Contractor :

Date of Test:

1. Dimensions of Brick

Make:……
Limits as per CPWD specifications for Class 10

Length of 20 bricks
Width of 20 bricks
Height of 20 bricks

Length :
Width :
Ht./ thickness :

INSPECTED BY: (Contractor's Engineer)	APPROVED BY: (Engineer In-charge)
Name: Sig. & Date	Name: Sig. & Date

DAILY PROGRESS REPORT

Name of Project : ……..

Client : M/s ……..,

Contractor : M/s ……..,

Name of Unit : …….. Date: __/__/__

S.NO.	ITEM DESCIPTION	UNIT	PREVIOUS QTY.	WORK DONE	CUM. QTY.	REMARKS
1	Excavation					
2	Anti Termite Treatment					
a)	Footing					
3	PCC					
a)	Footing					
4	RCC					
a)	Footing					
b)	Pedestals					
c)	Columns					
d)	Plinth					
e)	Walls					
5	RCC M-25					
a)	Pedestals					
b)	Column					
6	Shuttering					
7	Reinforcement					
8	Water proofing					
9	Brick work in foundation					
a)	Brick work in plinth					
b)	Brick work in SS					
10	Plastering					
11	Flooring					
a)	Mosaic					
b)	Kota stone					
c)	CC flooring					
d)	Granite					
12	External Finish					
13	Painting					
14	Doors & windows					
a)	Aluminium					
b)	Steel					

Labour deployed

MASON	CARPENTER	FITTER	HELPER	UNSKILLED

BAR BENDING SCHEDULE

Name of Project : ……..
Client : M/s ……..,
Contractor : M/s ……..,
Name of Unit : …….. Date: __/__/__
DRG. NO. : ……..

MEMBER	BAR NO.	DIA OF BARS	NO. PER MEMBER	NO. OF MEMBER	TOTAL NO. OF BARS	CUTTING LENGTH	TOTAL LENGTH	SHAPES

Calculated by

Checked By

CONCRETE POUR CARD

Name of Project :
Client :
Contractor :
Name of Building :
Concrete Element & Location:
Approved Drawing No. :

Inspection Required on :

Date :__/__/__ Time:__-__

Inspection Request No. :

Y=Yes, N=No and Na= Not Applicable.

Date: __/__/__ Time: __-__

S.No.	Name of Activities	Contractor's Engineer	Engineer in charge
1	Method statement approved		
2	Batching Plant/ mixers in working order		
3	Standby Batcher in working order.		
4	Water, coarse aggregates, cement, sand, admixture approved.		
5	Water, coarse aggregate, cement, sand, admixture stock sufficient.		
6	Concrete conveying arrangement available in working condition.		
7	Formwork approved		
8	Reinforcement approved		
9	Concrete gang present: including carpenter, steel fixer, mechanics and electricians.		
10	Access provided		
11	Safety arrangements sufficient		
12	Lighting provided		
13	Communication between various points provided.		
14	Arrangements for arranging suspension stoppage of concrete provided.		
15	Curing arrangements made		
16	Laboratory notified.		

INSPECTED BY: (Contractor's Engineer) Name: Sig. & Date	APPROVED BY: (Engineer In-charge) Name: Sig. & Date

REINFORCEMENT INSPECTION CHECK LIST

Name of Project :
Client :
Contractor : Inspection Required on :
Name of Building:
Concrete Element & Location: Date :__/__/__ Time:__-__
Approved Drawing No. :

Inspection Request No. :
Y=Yes, N=No and Na= Not Applicable. Date: __/__/__ Time: __-__

S.NO.	Name of Activities	Contractor's Engineer	Engineer In-charge
1	Working drawings checked and approved		
2	Location revision being used		
3	Bar schedules approved		
4	Reinforcement steel material approved		
5	Bar bending and cutting satisfactory		
6	All corroded bars rejected		
7	Bar sizes correct		
8	Bar spacing correct		
9	Bar lap lengths correct		
10	Bar laps at correct locations		
11	Bar ties as specified and pre-coated binding wire used.		
12	Bar assembly rigid and adequately supported.		
13	All bars crossing tied up with binding wire		
14	Cover to bottom bars correct		
15	Cover to top bars correct		
16	Cover to side bars correct.		
17	Cover blocks approved including fixing		
18	Only approved cover blocks used.		
19	Quality & size of Binding wire approved.		

INSPECTED BY:	APPROVED BY:
(Contractor's Engineer)	(Engineer In-charge)
Name:	Name:
Sig. & Date	Sig. & Date

POST CONCRETE CHECK LIST

Name of Project :
Client :
Contractor : Inspection Required on :
Name of Building:
Concrete Element &Location : Date :__/__/__ Time:__-__
Approved Drawing No. :

Inspection Request No. :

Y=Yes, N=No and Na= Not Applicable. Date :__/__/__ Time :__-__

S. NO.	Name of the Activities	Contractor's Engineer	Engineer in charge
1	Concrete started on		
2	Concrete completed on		
3	Curing satisfactory		
4	Cube strength		
5	Concrete surface condition		
6	Any repairing required		
	Remarks for Rectification by ENGINEER-IN-CHARGE Concrete Quality Acceptable : Yes/ No		

INSPECTED BY: (Contractor's Engineer) Name:	APPROVED BY: (Engineer In-charge) Name:

Sig. & Date	Sig. & Date

CHAPTER – 2

SUBMITTALS

2.1 DESCRIPTION

This section covers additional requirements for submittals and forms a part of all other sections in which submittals are required. It is subjected to General Conditions of Contract.
Submittal requirements to be included:
1. CPM Progress Schedule
2.Samples
3. Material lists and equipment
4.Factory test reports
5.Certificates
6. Laboratory test reports

2.2 SUBMITTAL REQUIREMENTS

CPM Progress Schedule

Within 30 days of award of the tender, submit a critical path method analysis for construction progress control and make such revisions as are required for approval. Clearly indicate all construction activities, sub activities and mile posts on a time oriented basis, with the critical path fully identified for all activities. Update and resubmit the charts monthly, flag all slippage's and mile posts and attach a narrative description of the proposed corrective actions to the resubmitted charts. Include the following minimum information for each activity and critical path item:

i. Date and initial submittal, as applicable.
ii. Ordering dates for long lead time items.
iii. Dates for materials on site.
IV. Testing and clean up.
V. Final completion and handing over.

2.3 SAMPLES

The Contractor has to submit samples of all materials used for the work prior to start the works and get the approval of the Engineer in charge. Label or tag each sample or set of samples, identifying the manufacturer's name and address, brand name, catalogue number, project title and intended use.

2.4 MATERIAL LISTS AND EQUIPMENT DATA

The Contractor has to submit all material lists. Equipment lists etc. well in advance before starting the work and get the approval from the Engineer in charge.

CHAPTER - 3
SITE PREPARATION

3.1 BENCH MARKS

Permanent bench marks at least one in every kilometre, shall be fixed carried from nearest KMC Bench marks before any work is started by the contractor in any section; These benchmarks shall be fixed away from the field of work so as not to be disturbed during the contract Period and shall be accurately fixed in concrete pillar/pedestal . No separate payment shall be paid towards fixing of bench marks. `

3.2 CLEARING SITE OF LARGE TREES, STRUCTURES ETC.

This shall include the removal of large trees, stumps, structures, services such as cables, water supply, sewerage, storm water drains etc. or parts thereof lying along the alignment of sewer. The contractor should inform the Engineer in charge before removing trees, structures, other services and structures etc. well in advance. Large trees and other valuables are the property of the Government and it should be properly stacked along the side of the road and conveyed to the place as per directions of the departmental Engineer. The cutting of trees or demolitions of structure are done in such a way that it should not disturb the traffic and pedestrians.

3.3 REMOVAL OF TOP SOIL, SHRUBS AND OTHER VEGETATION

The work has to be tackled in between two adjacent manholes only. All shrubs, vegetation and other plants shall be removed and cleared from the selected stretch of the site. All debris and unsuitable material up to a depth of 30 cm between ground level or road level shall be removed. All debris and unsuitable material shall be carted away from the site as per the direction of departmental engineer. The payment against this item as per Bill of Quantities includes loading, unloading, carting the material to a site selected by the contractor at his own cost.

3.4 PREPARATORY WORK, SIGHT-RAILS AND BONING STAVES

The centre line of the trench is first marked out on the ground duly driving pegs at convenient intervals. Before commencement of earth work excavation, levels shall be taken along the centre line of the proposed sewer at intervals of say 10 m and at the manhole locations. A longitudinal section (LS) of the profile of the ground surface showing the proposed sewer, indicating the gradients and giving the invert levels of the sewer as well as the manholes is provided with the tender. This L.S may be updated by the contractor and approved by the Engineer before taking up the work.

The width of the trench to be excavated is marked on both sides of the centre line and excavation lines cut out.

Two wooden posts 100 mm x 100 mm x 1800 mm high shall be firmly, erected/fixed across the centre line i.e. on either side at nearly equal distance, from the centre line and sufficiently clear of

all intended excavation such that the poles/posts are not disturbed during the course of execution of the work. These posts are so arranged and fixed that a sight-rail when fixed at a level against these posts shall cross the centre line of sewer or centre of the manhole, as the case may be.

The sight-rail made from 250 mm wide x 40 mm thick wooden planks shall be screwed to the poles. The sight-rails shall be truly horizontal. The centre line of the sewer shall be marked on the sight-rail by fixing a nail or otherwise as determined by the Engineer. The sight-rails may be fixed about 1.25 m above the ground, which is convenient distance for sighting by a levelling instrument. The sight-rails have to be so fixed that when a line sighted along the top edge of the sight-rails shall represent the true fall or gradient of the proposed sewer. This gradient is transferred below the ground level by means of boning-rod. Boning is carried out between the sight-rails with the help of a cord or a rope extended from nail to nail fixed on the sight-rails.

Boning rods with cross section 75 x 50 mm of various lengths shall be prepared with wood. Each length shall be a certain number of meters and shall have fixed tee-head. (A cross piece of 450x 100 mm is to be fixed with nails at the top of the boning rod so as to form shape like a Tee-square) and a cross piece about 300 mm long fixed at the bottom of the boning staff. The distance between the top of Tee head and the cross piece shall depend upon the site requirements viz, Dia of pipe, depth of cutting, level of sight-rail, designed level of sewer, etc. The boning rod must be marked on two sides to indicate its full length. According to the circumstances of each case, a suitable length of boning rod, duly fixing the cross piece, will be determined upon the reduced level of the invert of pipe at each sight-rail.

The sight-rail and vertical posts shall be perfectly square and planed smooth on all sides and edges. This arrangement of erecting poles with sight-rail shall be done at suitable intervals depending on the site requirements, as directed by the Engineer. The posts and rails must in no case be removed until the trench is excavated, the pipes are laid and permission given to proceed with the filling in.

1.5 PROBING PITS

Before starting the excavation of trenches, the contractor shall dig probing pits of size 1 m x 1 m and 1.5 m deep including road cutting at every 100 m interval along the alignment to accurately locate and determine the position of existing utilities and obstructions. The contractor shall refill the probing pits in layers of 15 cm with excavated earth up to the original ground level. In all cases the probing pits are to be excavated in accordance with the specification for excavation, refilling etc. No separate payment will be made for these probing pits.

1.6 UTILITIES PROTECTION

All utilities within the site, such as water, storm and sewage mains, shall be ascertained by probing pit results at various intervals.

All utility lines and structures, whether indicated on the drawings or not, which are to remain in service shall be protected by the contractor from any damage likely to result from his operations.

Relocation wherever necessary, shall be with the approval of the Engineer and the Utility Authority. Payment will be made as per the Bill of Quantities only for relocating the utilities. Any damage to any utility resulting from the contractor's operations shall be repaired at the contractor's expense.

3.7 PAVEMENT REMOVAL

The contractor must inform the Engineer before the starting of work well in advance so that it can be communicated to other concerned departments. The contractor must provide and maintain proper and efficient traffic control system such as safety lamps, sign boards etc. operating day and night for the full duration of work. The KMC shall not be responsible under any circumstances for any mis happenings therefore. For the purpose of payment of removal of pavement, steel tapes are to be used and the measurement shall be taken jointly by the Engineer's representative and contractor or his representative. The width of trenches shall be as per table-1 and only such widths shall be taken into account for computing quantities for payment. For other elements of work such as manholes, making cross connections, fixing other appurtenances etc. the engineer shall prescribe the dimensions for removal of pavement from time to time.

3.8 MAINTENANCE OF TRAFFIC AND CLOSING OF STREETS

The work shall be carried out in such a manner which will cause the least interruption to traffic, and the road/street may be closed in such a manner that it causes the least interruption to traffic, Where it is necessary for traffic to cross open trenches, suitable bridges shall be provided. Suitable signs indicating that a street is closed shall be placed and necessary detour signs for the proper maintenance of traffic shall be provided.

3.9 INTERRUPTION TO SERVICE

No valve or other control of the existing services shall be operated without the permission of the authority.

3.10 WORK DURING NIGHTS

It is expected that the intensity of traffic is likely to be less in the nights from 22.00 hours to 5.00 hours. Hence, for efficient uninterrupted work, the contractor shall equip himself with the required manpower, materials, and machinery to do the work exclusively in the above periods alone. No separate payment will be made for doing the work in the nights. The contractor shall get prior approval from the Engineer-in-charge before starting the work during nights.

CHAPTER-4
EARTH WORK

4.1 DESCRIPTION

The work specified in this section includes the provision of all labour, machinery, construction equipment and other appliances required to perform all earth work shown on the drawing or otherwise specified or required, in a sound, workmanlike manner.

4.2 GENERAL

Excavation shall be required to be done for the following works:

a) Excavations for underground sewer lines.
b) Excavations for sewer lines below storm water drains.
c) Excavations for manholes, footings, pedestals etc.
d) No separate payment shall be made for removal of shrubs, grass, large and small bushes, trees, stumps and stems of trees cut, fencing including posts and gates.

4.3 SOIL INVESTIGATIONS

Soil analysis reports of proposed sewer alignment are available with KMC officials. Additional soil tests, if necessary, shall be carried out along the alignment and the soil boring logs shall be prepared by the contractor at his own cost. Where off-site materials have to be used, the contractor shall, if the Engineer desires make available certified soil test reports including information regarding sieve analysis, plastic limit, liquid limit, maximum density, optimum moisture content etc. from an approved testing laboratory.

4.4 CLASSIFICATION

The excavation work shall be classified into the following categories:

a) For sewer line trenches

i) Loamy, clayey soils like BC soils, red earth, ordinary gravels, hard gravel, mixture of gravel and soft disintegrated rock, ordinary gravel, stony earth and earth mixed with fair sized boulders, hard disintegrated rock or soft rock or conglomerate rock, to be removed by pick axes and crow bars,

ii) Hard rock and boulders to be removed only by chiselling and benching.

b) Manholes, pedestals etc.

i) Loamy, clayey soils like BC soils, red earth, ordinary gravels, hard gravel, mixture of gravel and soft disintegrated rock, ordinary gravel, stony earth and earth mixed with fair sized boulders,

hard disintegrated rock or soft rock or conglomerate rock, to be removed by pick axes and crow bars.

ii) Hard rock and boulders to be removed by benching and chiselling.

4.5 TRENCH EXCAVATION

GENERAL

Trench excavation means excavation of trenches into which the pipe is to be laid. The line and levels of trenches shall be as shown on the drawings or as may be directed by the Engineer in charge. Before Commencing trench excavation, the route of the trenches shall be pegged out accurately and the natural ground levels shall be agreed with the Engineer in charge.

4.6 WIDTH OF TRENCH

The width of trenches measured at the crown of the pipe shall permit adequate working space. The trenches shall be widened at sockets and other structures as may be found necessary. The widths to be adopted are shown in respective drawings. If the widths of actual excavation are more than the specified, it has to be made by the contractor with no separate payment. Care should be taken to avoid excessive trench widths and thereby increasing the load on the pipes.

4.7 DEPTH OF EXCAVATION OF TRENCH

The depths for the trenches will be calculated from the surface to the bed of the pipes and in case when a layer of bedding is to be placed below the pipe line, the depth to the bottom of the bedding will be paid. The depth of excavation for manholes shall be measured from the surface of the existing ground level to the bottom of foundation. No payment will be given beyond this depth.

4.8 MAXIMUM LENGTH OF OPEN TRENCH

The stretch of work to be tackled shall be limited to two adjacent manholes. However, the Engineer may permit only reasonable trench excavation in advance of the lengths between two adjacent manholes to ensure lying and jointing of pipes can reasonably be expected to be completed and the trench refilled not attention later than 3 days after excavation of the trench. The Contractor will not be permitted to keep trenches open for unduly long periods, creating public hazards. The Engineer's decision in this respect shall be final.

4.9 TRENCH SIDES

Loose boulders shall be removed from the sides of the trenches before allowing workmen into the excavation, and the trench sides shall be stabilized with screening or other methods approved by the Engineer. Trench slopes shall be kept moist where necessary to prevent local sliding as ordered by the Engineer.

4.10 WIDENING TRENCH AT JOINTS, ETC.

Any widening or deepening of the trench, whether in ordinary soil or rock, necessary to accommodate

curves, joints or bends as shown on the drawings or ordered by the Engineer shall be carried out by the contractor.

4.11 OVER-EXCAVATION OF TRENCH BOTTOMS

All excavation carried below the grades shown on drawings, shall be refilled with compacted bedding material at the Contractor's expense.

4.12 EXCAVATED MATERIAL

The material from the excavation shall be deposited on either side of the trench leaving clear berm on one side at least 40 cm wide or at such further distance from the edges of the trench as may be necessary to prevent the weight of materials from causing the side of the trench to slip or fall, or at such a distance and such a manner as to avoid covering fire-hydrants, sluice valves, manhole covers and the like and so as to avoid any wall or structure or causing inconvenience to the public or other persons or otherwise as the engineer may direct, till itis carted away.

The excavated soil should be so placed and handled as not to inconvenience the usual traffic, till it is carted away. The contractor should Also, provide necessary bridging over the excavated trenches for the house-holders and pedestrians to cross over and vehicular crossings if and where required at no extra cost; if the Engineer decides that there is no hindrance to traffic due to not carting away the excavated earth, he will give instructions to that effect.

The manhole frames and covers from the existing manholes shall be carefully removed and stored in a suitable place away from the trenches. The contractor should not break the manhole frames and covers while removing. The contractor is responsible for the safety of manhole frames and covers.

4.13 PIPE BEDDING

i) Granular Bedding

The bed of trenches shall be prepared as per drawing. Sand used for back fill shall be natural sand (free from cinders, ashes, slag, refuse, organic materials, boulders, rocks or stones) graded from fine to coarse. The total weight of clay in it shall not exceed 10%. All materials shall pass through a sieve of aperture size 6.30 mm.

ii) Concrete Bedding

This type of bedding is as per the drawing appended with the tender document, and is to be provided at locations shown in the Longitudinal Section drawings or as specified by the Engineer. A concrete bedding using M15 is to be adopted. The concrete work related to this specification is detailed in the specifications of concrete and allied works.

In case of sewers laying in storm water channels, the pipe shall be encased with reinforced cement concrete M15 grade with a minimum thickness of 150 mm all around or as per bedding drawing. if the clear distance between bed and pipe top is less than one meter.

4.14 TRENCH EXCAVATION IN HARD ROCK

If any material which in the opinion of the Contractor can be classified as rock, is encountered, he shall immediately inform the Engineer and the level, extent and description of the material encountered shall be measured jointly and recorded before excavation.

Only such proportion of material notified and measured which is certified by the Engineer as "rock", shall be paid for as rock excavation.

Excavation for trenches in rock shall be so carried out that the clearance between the pipe, when laid in position and the sides and trench bottom shall be kept to the minimum limits necessary to provide for specified thickness of bedding, and surround to the pipe as specified. Excavation outside the specified limits shall not be paid for and any additional expenses incurred in providing additional strength to the pipe to overcome the increased trench loads on account of increased width shall be at the Contractor's expenses.

4.15 EXCAVATION FOR APPURTENANCES

Excavation in trenches for foundation of manholes, pedestals etc. shall be as per the plan or as directed by the Engineer. The dimensions of the excavation shall be measured as the projection in plan of the outermost edges of the structure.

4.16 PUMPING SEWAGE OR DIVERSION BY GRAVITY AND DEWATERING

General
The works included in this Section are as follows:

1) Provision of all labour, equipment, materials etc. to ensure a safe and dewatered condition and free from sewage flow in all areas in which the work in this contract is to be executed.
2) Continuous operation of the dewatering systems is required to complete all portions of the works where dewatering and pumping of sewage is necessary to prevent inflow, collection of surface water or ground water, or sewage or to protect adjacent properties or constructions from damage resulting from a rise or fall of ground water levels or sewage.
3) Removal of the equipment when no longer required.

4.17 PUMPING SEWAGE

1) The existing sewer, which has to be replaced, and existing manhole which has to be dismantled or reconstructed, are having house connections which contribute sewage. The contractor is expected to tackle a stretch in between two adjacent manholes. The contractor should make arrangements as detailed below for pumping the incoming sewage to enable to dismantle manholes, approved sewers and reconstruct new manholes and relay new sewers in the same alignment.
2) Temporary pumps are to be installed and temporary pipes provided to pump sewage from upstream manhole selected by him to a downstream manhole. Alternatively, it can be diverted by the gravity, if possible.
3) Temporary pumps should Also, be installed and temporary pipes provided to intercept the sewage flows entering the sewers and manholes from house connections and pump out or divert by gravity, if possible, into a downstream manhole. Alternatively, the sewage coming from house connections can be diverted, if possible, by gravity through pipes or channels into the nearest manhole.
4) Suitable precast/prefabricated cisterns have to be provided to intercept incoming sewage at manholes and house connections in which pumps can be installed.
5) This pumping arrangement and diversion arrangement has to be kept functional till the stretch of sewer is completed and commissioned. Stand-by pumping equipment may be kept in safe to ensure continuous pumping of the sewage so that the existing sewerage system is functional during the period of relaying the new sewer.

4.18 PUMPING OUT WATER

The contractor shall provide and work at his own cost all pumps, engines and machinery requisite to keep the trenches for the sewers or foundations and all other excavations clear of water, whether subsoil water, storm water, sewage, leakage from tanks, wells, drains, sewers, water mains or pipes etc., so that there may be no accumulations of such water and that no setting out may be done, no masonry may be laid, no concrete deposited, no joints made and no measurements taken in water.

The pumping shall be continued so long after execution of any portion of the work and repeated so after as the Engineer may consider necessary. The pumps and power applied must be such as the Engineer may consider necessary for the work to set. The pumps and power applied must be such as the Engineer may determine to be sufficient to any particular time, or he may himself supply pumps and power at contractor's expense, so he may stop the work altogether until he is satisfied and also, impose a fine upon the contractor.

4.19 KEEP EXCAVATION CLEAR OF WATER

Where ground water is encountered or anticipated the contractor shall provide sufficient pumps to handle the ingress of water and must provide and maintain in working order. Standby pumping units are to be made available and employed in the event of mechanical failure. The contractor must Also, arrange for night and day operation of the pumps wherever necessary to ensure that the work proceeds at all times.

4.20 BARRICADING, WATCHING, LIGHTING

The parts of the barricading shall be of timber, securely fixed in the ground not more than 2.50 m apart. They shall not be less than 10 cm in diameter and not less than 1.5 m above the surface of the ground. There shall be two rails, one near the top of the posts and the other about 0.50 m above the ground and each shall be of 5 cm to 10 cm in diameter and sufficiently long to run from post to post to which they shall be tied with strong ropes. The method of projecting rails beyond the posts and tying together where they meet will not be allowed on any account. All along the edges of the excavated trenches, a bund of earth about 1 m high shall be formed when so required by the Engineer for further protection. Proper provision shall be made for lighting at night and watchmen shall be kept to see that this is properly done and maintained. In addition to the normal lighting arrangements the contractor shall provide, whenever such work is in progress, battery operated blinking lights (6 volts) in the beginning and end of a trench with a view to provide suitable indication to the vehicular traffic. The contractor shall Also, provide and display special boards printed with fluorescent prints indicating the progress of work along-the road. In the event of the contractors not complying with the provisions of the clause, they will be imposed a fine at Rs.500/- per day. Further, in all such cases the work may be carried out departmentally at the risk and cost of the contractor. The contractor shall be held responsible for all claims for compensation as a result of accident or injury to person and non-provision of red flags.

The contractor shall at his own cost provide all notice boards before opening of roads as directed by the Engineer.

Arrangements shall be made by the contractors to direct traffic when work is in progress. No separate payment shall be paid for this item of work.

4.21 REFILLING TRENCHES

1) With a view to restrict the length of open trenches, on completion of the pipe, laying operations, refilling of trenches shall be started immediately by the contractor. Pipe laying and testing shall follow closely upon the progress of trench excavation and the contractor shall not permit unreasonable excessive lengths of trench excavation to remain open while awaiting testing of the pipe line.
2) The trench shall be filled by borrowed gravel up to at least 30 cm. above the top of pipe, back filling is to be done keeping at least 90 cm. length of pipe open at the joints, for verification of joints for water tightness during testing.
3) Care shall be taken while back filling, not to injure or disturb the pipe. Filling shall be carried out simultaneously on both the sides of the pipes so that unequal pressure does not occur.
4) Walking or working on the completed pipeline shall not be permitted unless the trench has been filled to a height of at least 30 cm over the top of the pipe except as may be necessary for tamping, etc., during back filling work.
5) Filling-in shall be done in layers not exceeding 150 mm in thickness accompanied by adequate watering, ramming, etc., so as to get good compaction up to 300 mm above the top of the pipe. Above this level, useful excavated earth free from boulders shall be placed in layers of 225 mm, watered and compacted by tamping. Wherever pipe is laid in the storm water channel, total refilling shall be done with borrowed earth.
6) The trench shall be refilled so as to build up to the original ground level, keeping due allowance for subsequent settlement likely to take place.

7) Before and during the backfilling of the trench, precautions shall be taken against the floatation of the pipeline due to the entry of large quantities of water into the trench causing an uplift of the empty or the partly filled pipeline.
8) In case of sewers laid in storm water channels, after refilling is done, the bed of the channel to the extent trench width shall be made with cement concrete of grade M15 with a thickness of 150mm.
9) Optimum Moisture Content (OMC) test to be carried at trench section and Maximum Dry Density (MDD) test for the refilled soil in trench to confirm the proper compaction up to 95% of maximum dry density.

4.22 REFILLING THE ROAD SURFACE

After the backfilling is completed, the contractor shall restore the surface of the trench over the pipe to that road surface existing prior to excavation, i.e., either bitumen or cement concrete as the case may be and verified from the adjacent surface. This will be paid as per the Bill of Quantities. The width for the payment of road cutting or restructuring will be only as per the direction of the Engineer. The work of restructuring of road surface either by bitumen or cement concrete shall be as described in chapter Road restoration.

4.23 SUBSIDENCE IN FILLING

Should any subsidence take place in the filling at any place of work i.e. at manholes and over pipe trenches and road surface whatsoever during contract, the contractor shall make good the same at his own cost or the engineer may with or without notice to the contactor make good the same in any way and with any material that he may think proper, and at the expense of the contractor. The engineer may Also, if he anticipates the occurrence of any subsidence, take necessary action deemed fit in which case Also, the expenses therefore shall be charged to the contractor.

4.24 DISPOSAL OF EXCAVATED MATERIALS

Excavated materials shall be used for refilling etc. and surplus earth shall be disposed off to the outskirts of corporation safely with all leads and lift as directed by the engineer in charge for which no separate payment will be made.

4.25 ALL WORKS TO BE CLEAR, CLEAN AND PERFECT

The contractor, after completion of entire work and before seeking settlement of his final bill, shall prove at his expense that the entire line is clear, clean and perfect in the presence of the Engineer or his authorized subordinate. He should provide suitable instruments, appliances etc., and pass them through the pipes and shall show that water passes freely through the entire reach from higher end to lower end.

Note: Necessary precautions such as those indicated hereunder may be taken by the contractor while checking the completed sewer line for its effective functioning, wherever required.

The manholes should be kept open, as required for one hour prior to the starting of checking operations and should be so kept open during the whole duration of checking operations. This is to be done for allowing the gases to escape, naturally. In order to prevent the fire and explosions, .endangering the life, properties, sewers and other utility services due to presence of combustible gases, no lighted match sticks or other similar material should be thrown in the manhole.

Meshes should be placed over the opened manholes to prevent pedestrians etc., from falling in. Likewise, caution boards printed in fluorescent letters such as "DANGER MANHOLE IS KEPT OPEN" etc., shall be provided.

4.26 MEASUREMENT AND PAYMENT

The payment of excavation shall be made on quantity basis as per the actual dimensions of the trench excavated limited to the width shown in the drawings.

a) Trench excavation

The length of the trench excavation shall be measured along the centre line of pipe at various depths stated in the Bill of Quantities, the total length being segregated into stretches according to the various depths of excavation contained in the Bill of Quantities to fall into the specified categories. Within each stretch the depth applicable shall be within the range specified in Bill of Quantities.

The depth of excavation shall be measured from the top of the trench at the centre before excavation up to the bottom of the bedding under the pipe. If no bedding is provided, the measurement shall be to the level of the bottom of the pipe line. The width of the trench shall be measured on the basis of vertical side walls and the specified widths. No additional payment shall be made for the widening at sockets, specials, hunching or surrounds beyond the dimensions specified.

b) Structures

Measurement for structure excavation shall be made as per the projection in plan of the outermost edges of the, structure as per the plan at the bottom.

c) Rock excavation

The depth of rock excavation measured for payment shall not exceed the corresponding depth in ordinary excavation plus 150 mm both for structure. and trench excavations.

In all above cases, no payment will be made for additional selected fill, lean concrete, bedding cradling or hunching concrete that may be specified or ordered by the Engineer as a consequence of excavating beyond the limits specified in the contract documents or ordered by the Engineer.

d) Disposal of excavated material

All the excavated material shall be carted away and the contractor shall be paid as per the Bill of Quantities and it includes loading, unloading, transporting to a site as per Engineers directions.

If the Engineer decides that there will be no hindrance to traffic by not carting away the excavated material, he will give direction accordingly. In such case, payment will be restricted to only such quantities carted out.

CHAPTER 5

CONCRETE AND ALLIED WORKS

5.1 GENERAL

The quality of materials and method and control of manufacture and transportation of all concrete work irrespective of mix, whether reinforced or otherwise shall conform to the applicable portions of this specification.

The Engineer in-charge shall have the right to inspect the source/s of material/s, the layout and operation of procurement and storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and Engineer-in-charge's approval obtained, prior to starting of concrete work. However, this shall not relieve the contractor with any of his responsibilities and all the materials, which do not conform to the specifications, will be rejected.

5.2 APPLICABLE CODES

The following specifications, standards and codes, including all official amendments/revisions and other specifications & codes referred to therein to therein, should be considered a part of this specification. In all cases the latest issue/edition/revision shall apply. In case of discrepancy between

this specification and those referred to herein this bid document, this specification shall govern.

5.2.1 Materials

IS: 269 - Specification for 33 grade ordinary Portland cement
IS: 455 - Specification for Portland slag cement.
IS: 1489 - Specification for Portland-pozzolana cement.
IS: 8112 - Specification for 43 grade ordinary Portland cement.
IS: 12330 - Specification for Sulphate resisting Portland cement.
IS: 383 - Specification for coarse and fine aggregates from natural sources for concrete.
IS: 432 - Specification for mild steel and medium tensile steel (Parts-I & II) bars and hard-drawn steel wires for concrete reinforcement.
IS: 1786 - Specification for high strength deformed steel bars and wires for concrete reinforcement.
IS: 1566 - Specification for hard-drawn steel wire fabric for (Part-I) concrete reinforcement.
IS: 9103 - Specification for admixtures for concrete.
IS: 2645 - Specification for integral cement waterproofing compounds.
IS: 4990 - Specification for plywood for concrete shuttering work.

5.2.2 Material Testing

IS: 4031 - Methods of physical tests for hydraulic cement. (Parts-1 to 13)
IS: 4032 - Method of chemical analysis of hydraulic cement.
IS: 650 - Specification for standard sand for testing of cement.
IS: 2430 - Methods for sampling of aggregates for concrete.
IS: 2386 - Methods of test for aggregates for concrete. (Parts-I to VIII)
IS: 3025 - Methods of sampling and test (physical and chemical) water used in industry.
IS:6925 - Methods of test for determination of water-soluble chlorides in concrete admixtures.

5.2.3 Materials Storage

IS: 4082 - Recommendations on stacking and storing of construction materials at site.

5.2.4 Concrete Mix Design

IS: 10262 - Recommended guidelines for concrete mix design.
SP: 23 - Handbook on Concrete Mixes. (S & T)

5.2.5 Concrete Testing

IS: 1199 - Method of sampling and analysis of concrete.
IS: 516 - Method of test for strength of concrete.
IS: 9013 - Method of making, curing and determining compressive

strength of accelerated cured concrete test specimens.

IS: 8142	-	Method of test for determining setting time of concrete by penetration resistance.
IS: 9284	-	Method of test for abrasion resistance of concrete.
IS: 2770	-	Methods of testing bond in reinforced concrete.

5.2.6 Equipment

IS:1791	-	Specification for batch type concrete mixers.
IS:2438	-	Specification for roller pan mixer.
IS:4925	-	Specification for concrete batching and mixing plant.
IS:5892	-	Specification for concrete transit mixer.
IS:7242	-	Specification for concrete spreaders.
IS:2505	-	General Requirements for concrete vibrators: Immersion type.
IS:2506	-	General Requirements for screed board concrete vibrators.
IS:2514	-	Specification for concrete vibrating tables.
IS:4656	-	Specification for form vibrators for concrete.
IS:11993	-	Code of practice for use of screed board concrete vibrators.
IS:7251	-	Specification for concrete finishers.
IS:2722	-	Specification for portable swing weigh batchers for concrete (single and double bucket type).
IS:2750	-	Specification for steel scaffoldings.

5.2.7 Codes of Practice

IS:456	-	Code of practice for plain and reinforced concrete.
IS:457	-	Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
IS:3370	-	Code of practice for concrete structures for storage of liquids. (Parts-I to IV)
IS:3935	-	Code of practice for composite construction.
IS:2204	-	Code of practice for construction of reinforced concrete shell roof.
IS:2210	-	Criteria for the design of reinforced concrete shell structures and folded plates.
IS:2502	-	Code of practice for bending and fixing of bars for concrete reinforcement.
IS:5525	-	Recommendation for detailing of reinforcement in reinforced concrete works.
IS:2751	-	Code of practice for welding of mild steel plain and deformed bars used for reinforced concrete construction.
IS:9417	-	Specification for welding cold worked bars for reinforced concrete construction.
IS:3558	-	Code of practice for use of immersion vibrators for consolidating concrete.
IS:3414		Code of practice for design and installation of joints in building.
IS:4326	-	Code of practice for earthquake resistant construction of building.

IS:4014 - Code of practice for steel tubular scaffolding. (Parts-I & II)
IS:2571 - Code of practice for laying in-situ cement concrete flooring.
IS:7861 - Code of practice for extreme weather concreting.
Part-I : Recommended practice for hot weather concreting.
Part-II : Recommended practice for cold weather concreting.
IS:13920 - Ductile Detailing of Reinforced Concrete Structure subjected to seismic forces.
SP-16 - Design Aids for Reinforcement Concrete to IS: 456-1978
(S&T) - 1980
SP-24 - Explanatory Handbook on IS: 456-1978
SP-34 - Handbook on Concrete Reinforcement and Detailing
(S&T) – 1987

5.2.8 Construction Safety

IS:3696 - Safety code for scaffolds and ladders. (Parts-I & II)

IS:7969 - Safety code for handling and storage of building materials

IS:8989 - Safety code for erection of concrete framed structures.

5.2.9 Measurement

IS:1200 - Method of measurement of building and engineering works (Part I-28).

IS:3385 - Code of practice for measurement of civil engineering works.

5.3 MATERIALS FOR STANDARD CONCRETE

The ingredients to be used in the manufacture of concrete shall consist solely of Ordinary Portland Cement, and Sulphate resistant cement clean sand, natural coarse aggregate, clean water, and admixtures, if specifically called for on conditions at site warrant its use. Only river sand shall be used for all works.

5.3.1 Cement

The contractor will have to make own arrangements for procuring cement and steel.

The Contractor will have to make his own arrangements for transport from supplier godown and storage of adequate quantity of cement. Cement bags shall be stored in a dry enclosed shed (storage under tarpaulins will not be permitted), well away from the outer walls and insulated from the floor to avoid contact with moisture from the ground and so arranged as to provide ready access. Damaged or reclaimed or partly set cement will not be permitted to be used and shall be removed from the site. The storage bins and storage arrangement shall be approved by the Engineer-in-charge. Consignments of cement shall be stored as received and shall be consumed in the order of their delivery.
Cement held in storage for a period of ninety (90) days or longer shall be tested. Should at any time the

Engineer-in-charge have reasons to consider that any cement is defective, then irrespective of its origin, date of manufacture and or manufacturer's test certificate, such cement shall be tested immediately at the Contractor's cost at an approved laboratory and until the results of such tests are found satisfactory, it shall not be used in any work. Testing certificates for each batch of cement should be submitted by the contractor to the Engineer in charge, before starting the concreting work. The Contractor shall not be entitled to any claim of any nature on this account.

5.3.2 Aggregate

5.3.2.1 General

"Aggregate" in general designates both fine and coarse inert materials used in the manufacture of concrete (Vide BIS 456 & BIS 383) and confirming to tests as per BIS: 2386 (Part I to VI)

"Coarse Aggregate" is aggregate most of which is retained when passed through on 4.75 mm BIS sieve.

All fine and coarse aggregates proposed for use in the works shall be subject to the Engineer-in-charge's approval and after specific materials have been accepted, the source of supply of such materials shall not be changed without prior approval of the Engineer-in-charge.

Aggregates shall consist of natural sands, stone (crushed or uncrushed) and gravel from a source known to produce satisfactory aggregate for concrete and shall be chemically inert, non-flaky, strong, hard, durable against weathering, of limited porosity and free from deleterious materials that may cause corrosion of the reinforcement or may impair the strength and or durability of concrete. The grading of aggregates shall be such as to produce a dense concrete of specified strength and consistency that will work readily into position without segregation and shall be based on the "mix design" and preliminary tests on concrete specified later. Aggregate source shall be approved by BWWSSB.

Sampling and Testing

Samples of the aggregates for mixed design and determination of suitability shall be taken under the supervision of the Engineer in-charge and delivered to the laboratory, well in advance of the scheduled placing of concrete. Records of tests, which have been made on proposed aggregates and on concrete made from this source of aggregates, shall be furnished to Engineer in-charge in advance of the work, for use in determining aggregate suitability. The costs of all such tests, sampling etc. shall be borne by the contractor.

5.3.2.2 Storage of Aggregates

All coarse and fine aggregates shall be stacked separately in stock piles in the material yard near the work site in bins properly constructed to avoid inter mixing of different aggregates. Contamination with foreign material and earth during storage and while heaping the materials shall be avoided. The aggregates must be of specified quality not only at the time of receiving at site but more so at the time of loading into mixer. Rakers shall be piled in layers not exceeding 1.20 m in

height to prevent coning or segregation. Each layer shall cover the entire area of stockpile before succeeding layers are started. Aggregates that have become segregated shall be rejected.

5.3.2.3 Specific Gravity

Aggregates having a specific gravity below 2.4 (saturated surface dry basis) shall not be used.

5.3.3 Fine Aggregate

a.Fine aggregate shall consist of natural or crushed sand conforming to BIS 383 confirming to tests as per BIS 2386 part I to VI. The sand shall be clean, sharp, hard, strong and durable and shall be free from dust, vegetable substances, adherent coating, clay, alkali, organic matter, mica, salt, or other deleterious substances, which can be injurious to the setting qualities/strength/durability of concrete.

b. Screening and Washing: Sand shall be prepared for use by such screening or washing, or both, as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fraction.

Fineness Modulus: The sand shall have a fineness modulus of not less than 2.2 or more than 4.2. The fineness modulus is determined by adding the cumulative percentages retained on the following IS sieve sizes (4.75 mm, 2.36 mm, 1.18 mm, 600 microns and 150 microns) and dividing the sum by 100.

5.3.4 Coarse Aggregate

Coarse aggregate for concrete, except as noted above, shall conform to IS 383 & IS 2386. This shall consist of crushed stone and shall be clean and free from elongated, flaky or laminated pieces,

adhering coatings, clay lumps, coal residue, clinkers, slag, alkali, mica, organic matter or other deleterious matter.

Screening and Washing: Crushed rock shall be screened and or washed for the removal of dirt or dust coating, if so, requested by the Engineer in-Charge.

5.3.4.1

i) Coarse aggregate shall be either in single size or graded, in both cases the grading shall be within the following limits:

Sr.	Foreign Material	Percentage by weight	
		Uncrushed	Crushed
1	Material finer than 75 micron BIS Sieve	3.0	3.0
2	Coal and lignite	1.0	1.0
3	Clay Lumps	1.0	1.0
4	Soft Fragments	3.0	-
	Total	8.0	5.0

ii) The pieces shall be angular in shape and shall have granular or crystalline surfaces. Friable, flaky and laminated pieces, mica and shale, if present, shall be only within tolerance limits which will not affect adversely the strength and or durability of concrete. The maximum size of coarse aggregate shall be 40 mm for M-7.5 and M-10 and 20mm for M-15 to M-20 concrete, or as directed by the Engineer-in-charge or specified otherwise. The maximum size of coarse aggregate shall be the maximum size specified above but in no case greater than 1/4th of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of the form. For plain concrete the maximum size of aggregate shall be of 40 mm. For heavily reinforced concrete members, the nominal maximum size of the aggregate shall be 5 mm less than the minimum clear distance between the reinforcing main bars or 5 mm less than the minimum cover to reinforcement whichever is smaller.

5.3.4.2 Foreign material limitations

The percentage of deleterious materials in the aggregate delivered to the mixer shall not exceed the following:

Table 3: Foreign Material Limitations in Coarse Aggregate

5.3.5 Water

a. Water used for washing, mixing and curing shall be free from injurious amounts of deleterious materials. Potable water is generally satisfactory for mixing and curing concrete. Physical and chemical analysis of the water should be submitted to the Engineer-in-charge, before starting the work.
b. In case of doubt, the suitability of water for making concrete shall be ascertained by the compressive strength and initial setting time test specified in IS 456. The sample of water taken for testing shall be typical of the water proposed to be used for concreting, due account being paid to seasonal variation. The sample shall not receive any treatment before testing other than that envisaged in the regular supply of water proposed for use in concrete. The sample shall be stored in a clean container previously rinsed out with similar water.
c. Average 28 days compressive strength of at least three 15 cm concrete cubes prepared with water proposed to be used shall not be less than 90% of the average strength of three similar concrete cubes prepared with distilled water. The cubes shall be prepared, cured and tested in accordance with the requirements of BIS: 516.
d. The initial setting time of test block must be made with the appropriate test cement and the water proposed to be used. It shall not be less than 30 minutes and shall not differ by more than + 30

minutes from the initial setting time of control test block prepared with the appropriate test cement and distilled water. The test block shall be prepared and tested in accordance with the requirements of BIS: 4031.

e. Where water can be shown to contain an excess of acid, alkali, sugar or salt, Engineer-in-charge

Class	Preliminary Test N/mm²		Works Test N/mm²		Maximum Size Of Aggregate mm	Locations For Use
	At 7 Days	At 28 days	At 7 days	At 28 days		
M40	33.5	50.0	27.0	40.0	20	As indicated in the specifications or as required
M35	30.0	44.0	23.5	35.0	20	-do-
M30	25.0	38.0	20.0	30.0	40 or 20	-do-
M25	22.0	32.0	17.0	25.0	40 or 20	-do-
M20	17.5	26.0	13.5	20.0	40 or 20	-do-
M15	13.5	20.0	10.0	15.0	40 or 20	-do-

may refuse to permit its use. As a guide, the following concentrations represent the maximum permissible values.

1. To neutralise 200 ml sample of water, using phenolphthalein as indicator, it should not require more than 2 ml of 0.1 normal NaOH. The details of test shall be as given in BIS: 3025.
2. To neutralise 200 ml sample of water, using methyl orange as an indicator, it should not require more than 10 ml of 0.1 Normal HCl. The details of test shall be as given in BIS: 3025.
3. Percentage of solids, when tested in accordance with the method indicated below shall not exceed the following:

5.4CONTROLLED CONCRETE

All concrete in the works shall be “Controlled Concrete” as defined in IS: 456 except for M-7.5 and M-10 for which normal mix concrete shall be used. Whether reinforced or otherwise, all concrete works to be carried out under this specification shall be divided into the following classifications:

Note: It shall be very clearly understood that whenever the grade of concrete such as M-20, etc. is specified it shall be contractor’s responsibility to ensure the minimum crushing strength stipulated for the respective grade of concrete is obtained at works. Minimum cement content in the concrete used for liquid/water retaining strength shall be 390 kg/cu.m for 20 mm downgraded aggregate.

5.5 MIX DESIGN

5.5.1 General

This is essential for investigating the grading of aggregates, water-cement ratio, workability and the quality of cement required to give preliminary and works cubes of the minimum strength specified. The proportions of the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made. Determination of mix proportions shall be carried out according to "Recommended guidelines for Concrete Mix Design" conforming to IS: 10262.

Whenever there is a change either in required strength of concrete, or water-cement ratio or workability or the source of aggregates and/or cement, preliminary tests shall be repeated to determine the revised proportions of the mix to suit the altered conditions. While designing proportions, over-wet mixes shall always be avoided.

While fixing the value for water/cement ratio for preliminary mixes, assistance may be derived from the graph (Appendix A, BIS 456 showing the relationship between the 28 day compressive strengths of concrete mixes with different water/cement ratios and the 7-day compressive strength of cement tested in accordance with IS: 269.

5.5.2 Preliminary tests

Test specimens shall be prepared with at-least two different water/cement ratios for each class of concrete, consistent with work ability required for the nature of the work. The materials and proportions used in making preliminary tests shall be similar in all respects to those to be actually

employed in the works as the object of these tests is to determine the properties of cement, aggregates and water necessary to produce concrete of required consistency and to give the specified strength, it will be contractor's sole responsibility to carry out these tests and he shall therefore furnish to Engineer-in-Charge a statement of proportions proposed to be used for the various concrete mixes. For preliminary tests, the following procedure shall be followed.

Materials shall be brought to the room temperature and all materials shall be in a dry condition. The quantities of water cement and aggregates for each batch shall be determined by weight to an accuracy of 1 part in 100 parts.

Mixing concrete shall be done by hand (for small quantities, as directed by Engineer-in-Charge) or in a small batch mixer as per IS: 516 in such a manner as to avoid loss of water. The cement and fine aggregate shall first be mixed dry until the mixture is uniform in colour. The coarse aggregate shall then be added, mixed and water added and the whole batch mixed thoroughly for a period of not less than two minutes until the resulting concrete is uniform in appearance. Each batch of concrete shall be such a size as to leave about 10% excess concrete, after moulding the desired number of test specimens.

The consistency of each batch of concrete shall be measured immediately after mixing, by the slump test in accordance with IS: 1199. If in the slump test, care is taken to ensure that no water or other material is lost, the material used for the slump test may be re-mixed with the remainder of the concrete for making the specimen test cubes. The period of re-mixing shall be as short as possible yet

sufficient to produce a homogeneous mass.

The samples for compression tests of concrete shall be made as per IS: 516 on 15 cm cubes. Each mould shall be provided with a metal base plate having a plate surface so as to support the mould during filling without leakage. The base plate shall be preferably attached to the mould by springs or screws. The parts of the mould when assembled shall be positively and rigidly held together. Before placing concrete, the mould and base plate shall be cleaned and oiled. The dimensions and internal faces of the mould shall be accurate within the following limits. Height and distance between the opposite faces of the mould shall be of specified size +0.2 mm. The angle between the adjacent internal faces and between internal faces and top and bottom faces of mould shall be 90-degree +0.5 degree. The interior faces of the mould shall be plane surfaces with a permissible variation of 0.03 mm.

Concrete test cubes shall be moulded by placing fresh concrete in the mould and compacted as specified in IS 516.

Curing shall be as specified in IS 516. The cubes shall be kept in moist air of at least 90% relative humidity at a temperature of 27ºC + 2ºC for 24 hours +2 hours from the time of adding water to the dry ingredients. Thereafter they shall be removed from the moulds and kept immersed in clean, fresh water and kept at 27ºC +2 degree C temperature until required for test. Curing water shall be renewed every seven days. A record of maximum and minimum temperatures at the place of storage of the cubes shall be maintained during the period they remain in storage.

The strength shall be determined based on not less than five cube test specimens for each age and each water cement ratio. All these laboratory test results shall be tabulated and furnished to the Engineer-in-charge. The test results shall be accepted by the Engineer-in-charge if the average compressive strengths of the specimens tested is not less than the compressive strength specified for the age at which specimens are tested subject to the condition that only one out of the five consecutive tests may give a value less than the specified strength for that age. The Engineer-in-charge may direct the contractor to repeat the tests if the results are not satisfactory and also, make such changes, as he considers necessary to meet the requirements specified. All these preliminary tests shall be conducted by the contractor at his own cost in an approved laboratory.

5.6 PROPORTIONING, CONSISTENCY, BATCHING AND MIXING OF CONCRETE

The determination of the water cement ratio and proportion of aggregates to obtain the required strength shall be made from preliminary tests by designing the concrete mix. Controlled concrete shall be used on all concrete work complying with all the requirements of IS: 456. Cube tests shall be carried out by the contractor on the trial mixes before the actual concreting operation starts. Based on the strength of the concrete mix sanction for the use has to be obtained from engineer in charge.

If during the execution of the works it is found necessary to revise the mix because of the cube tests showing lower strengths than the required one due to inconsistency of quality of material or otherwise, The Engineer in charge shall ask for fresh trial mixes to be made by the contractor. No claim to alter the rates of concrete work shall be entertained due to such change in mix variations, as it is the contractor’s responsibility to produce the concrete of the required grade.

Great care shall be exercised when mixing the actual works concrete using the proportions of the

selected trial mix. The final concrete mix shall have the same proportions of cement, fine and coarse aggregates and water as that of the approved selected mix.

A reasonable number of bags should be weighed separately to check the Net weight, where the weight of cement is determined by accepting the manufacturer's weight per bag at the site. Proper control of mixing water is deemed to be of paramount importance. If mixers with automatic addition of water are used, water should be either measured by volume in calibrated buckets, tins or weighed. All measuring equipment shall be maintained in a clean serviceable condition and their accuracy periodically checked and certified and the Engineer-in-Charge's approval obtained.

The Engineer-in-Charge may require the contractor to carry out moisture content tests in both fine and coarse aggregates. The amount of the added water shall then be adjusted to compensate for any observed variations in the moisture contents. BIS: 2386 shall be referred to for determination of moisture content.

No substitution in material, used on the work or alteration in the established proportions shall be made without additional tests to show that the quality and strength of concrete are satisfactory. No alterations shall be permitted without the prior sanction of the Engineer-in-Charge.

5.7 MIXING OF CONCRETE

The mixing of concrete shall be strictly carried out in an approved type of mechanical Concrete mixer. The mixing equipment shall be capable of combining the aggregates. Cement and water within the specified time into a thoroughly mixed and uniform mass, and of discharging the mixture without segregation. The entire batch shall be discharged before recharging. Mixing periods shall be measured from the time when all of the solid materials are in the mixing drum, provided that all of the mixing water shall be introduced before one fourth of the mixing time has elapsed. The mixing time in no case shall be less than two minutes. The mixer speed shall not be less than 14 nor more than 20 revolutions per minute.

Mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency. Hand mixing of concrete shall not be permitted at all.

5.8 GRADE OF CONCRETE

The different grades of concrete specified shall conform to the strengths as required by IS: 456-2000.Standard deviation shall be calculated as stated in 14.5 of IS: 456-1978. The acceptable criteria for concrete shall be as stated in clause 15 of IS: 456 -1978.The assumed standard deviations as given in table 6 of IS: 456-1978 has to be followed and are given here under. However, the minimum cement content shall be as per "*Table 4: Grade of Concrete*" in this tender document.

Table 4: Grade of Concrete

In order to get a quick idea of quality of concrete the optional tests are conducted as stipulated in 14.1.1 of IS: 456-1978 and the results are analysed according to table 5 on page 41 of IS: 4561978.

5.8.1 Controlled Concrete

Controlled concrete shall be used on all concreting works except where specified otherwise the mix proportions for all grades of concrete shall be designed to obtain strengths corresponding to the values

specified in "*Table 5: Compressive Strengths at 28 days*" below for respective grades of concrete.

The maximum Water: Cement ratio for all controlled concrete works shall be as specified in IS: 456-1978 as Preliminary tests as specified in the BIS code and required by the Engineer-in-Charge shall be carried out sufficiently ahead of the actual commencement of the work with different grades of concrete made from representative samples of aggregates and cement expected to be used on the job to ascertain the ratios by weight of cement of total quantity of fine and coarse aggregates and the water cement ratio required to produce a concrete of specified strength and desired workability.

The minimum cement content for each grade of concrete shall be as per "*Table 6: Minimum Cement Content in Concrete*" below.

Table 6: Minimum Cement Content in Concrete

Grade of Concrete	Minimum Cement Content in Concrete
M 10	220 Kgs.
M 15	320 Kgs.
M 20	400 Kgs.
M 25	440 Kgs.
M 30	450 Kgs.

At least 4 (four) trial batches are to be made and 7 test cubes should be taken for each batch noting the slump on each mix. These cubes shall then be properly cured and two cubes for each mix shall be tested in a testing laboratory approved by the Engineer-in-Charge at 7 days and others at 28 days for obtaining the ultimate compressive strength. The test reports shall be submitted to the Engineer in charge. The cost of mix design and testing shall be borne by the contractor. On the basis of the preliminary test reports for trial mix, a proportion of mix by weight and water cement ratio will be approved by the Engineer in charge, which will be expected to give the required strength. Consistency and workability and the proportions so decided for different grades of concrete shall be adhered to during all concreting operations. If, However, at any time the Engineer-in-Charge feels that the quality of material, being used has been changed from those used for preliminary mix design, the contractor shall have to run similar trial mixes to ascertain the mix proportions and consistency.

The mix once approved must not be varied without prior approval of the Engineer-in-Charge. However, should the contractor anticipate any change in the quality of future supply of materials than that used for preliminary mix design, he shall inform the same to the Engineer in charge and bring fresh samples sufficiently ahead to carry out fresh trial mixes. The engineer in charge shall have access to all places and laboratory where design mix is prepared. Design mix will indicate by means of graphs and curves etc. the extent of variation in the grading of aggregates which can be allowed.

In designing the mix proportions of concrete, the quantity of both cement and aggregate shall be determined by weight. All measuring equipment shall be maintained in clean and serviceable condition and their accuracy periodically checked.

To keep the water cement ratio to the designed value, allowance shall be made for the moisture contents in both fine and coarse aggregates and determination of the same shall be made as frequently as directed by the Engineer-in-Charge. The determination of moisture contents shall be according to IS: 2386 (Part III)

Grade of concrete as per IS 456-1978	Minimum Compressive Strength Concrete in Accordance with IS: 516 (In kg/cm)			
	For 15 cm cube specimen at 7 days		For 15 cm cube specimen at 28 days	
	Work Test	Preliminary	Work Test	Preliminary
M15	100	135	150	200
M20	135	175	200	260
M25	170	220	250	320
M30	200	250	300	380

Table 7 : Strength Requirements of Concrete

5.8.2 Strength Requirements

Where ordinary Portland cement conforming to IS: 269 or Portland blast furnace slag cement conforming to IS: 455 are used the compressive strength requirements for various grades of concrete shall be as shown in table below. Where rapid hardening Portland cement is used the 28 days compressive strength requirements specified in Table- hereunder shall be met in 7 days. The strength requirements specified in table shall apply to both controlled concrete and ordinary concrete

Other requirements of concrete strength as may be desired by the Engineer in charge shall be in accordance with Indian Standard IS: 456 (latest revision). The acceptance of strength of concrete shall be as per clause 5.4 “Sample size and Acceptance Criteria” of IS: 456 (latest revision) subject to stipulation and/or modifications stated elsewhere in this specification if any.

Concrete work found unsuitable for acceptance shall have to be dismantled and replaced to the satisfaction of the Engineer-in–Charge by the contractor free of cost of the owner. No payment will be made for the dismantled concrete, the relevant Formwork and reinforcement, embedded mixtures etc. wasted in the dismantled portion shall be made. In the course of dismantling if any damage is done to the embedded items or adjacent structures, the same shall Also, be made good free of charge

by the contractor to the satisfaction of the Engineer in charge. If the water quantity has to be increased in special cases, cement Also, is increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete.

5.8.3 Workability

The workability of concrete shall be checked at frequent intervals by slump test. Where facilities exist and if required by the Engineer-in-Charge, Alternatively, the compacting factor test in accordance with IS: 1199 shall be carried out. The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of form work and round the reinforcement to give the required surface finish shall depend on the type and nature of the structure and shall be based on experience and tests. The limits of consistency for structures are as specified in the "

Table 8 : Limits of Consistency" below:

Table 8 : Limits of Consistency

5.8.4 Workmanship

All workmanship shall be according to the latest relevant standards. Before starting a pour, the contractor shall obtain the approval of the Engineer-in-Charge in a "Pour Card" maintained for this purpose. He shall obtain complete instructions about the material and proportion to be used, slump, workability of water per unit of cement, number of test cubes to be taken, finishing to be done and any admixture to be added etc.

5.9 SAMPLING AND TESTING CONCRETE IN THE FIELD

a) Facilities required for sampling materials and concrete including whether proof buildings to house the facilities in the field, should be provided by the contractor at no extra cost. The following equipment with operator shall be made available in serviceable conditions.

i. Concrete cube-testing machine suitable for 15 cm cubes of 100 tonnes capacity with proving calibration ring - 1 no.
ii. Cast iron cube moulds 15 cm size - 6 nos. (min)
iii. Slump cone complete with tamping rod - 1 set
iv. Laboratory balance to weigh up to 5 kg with sensitivity of 10 gm - 1 no.
v. BIS sieves for coarse and fine aggregates - 1 set
vi. Set of measures from 5 litres to 0.1 litre - 1 set
vii. Electric oven with thermostat up to 120^{o}C - 1 no.
viii. Flakiness gauge - 1 no.
ix. Elongation index gauge - 1 no.
x. Sedimentation pipette - 1 no.
xi. Calibrated glass jar 1.0 litre capacity - 2 nos.
xii. Glass flasks and metal containers - As required
xiii. Chemical reagents like sodium hydroxide, tannic acid, litmus paper etc. - As required
xiv. Laboratory balance of 2 kg capacity and sensitivity of 1 gm - 1 no.

b) No concrete of any kind may be placed until the field concrete testing laboratory as specified is provided to the satisfaction of the Engineer. The contractor shall notify the Engineer in advance of all concrete and concrete material testing as provided in the clause to provide the Engineer/his representative with an opportunity to witness all prescribed tests.

c) At least 6 test cubes of each class of concrete shall be made of every 50cum concrete or part thereof or from different batches as directed by Engineer-in-charge. Such samples shall be drawn on each day for each type of concrete. Of each set of 6 cubes, three shall be tested at 7 days age and three at 28 days age. The cubes must be casted from various batches to arrive at an average strength. The laboratory test results shall be tabulated and furnished to the Engineer. The Engineer will pass the concrete if average strength of the specimens tested is not less than the strength specified, subject to the condition that only one out of three consecutive tests may give a value less than the specified strength but this shall not be less than 90% of the specified strength.

d) Consistency: Slump tests shall be carried out as often as requested by the Engineer and invariably from the same batch of concrete from which the test cubes are made. Slump tests shall be done immediately after sampling.

5.10 CONCRETE TESTS

The Engineer-in-Charge, may order tests to be carried out on cement, sand, coarse aggregate, and water in accordance with the relevant Indian standards.

Tests on Cement shall include:

- Fineness test
- Test for normal consistency
- Test for setting time
- Test for soundness
- Test for tensile strength
- Test for compressive strength
- Test for heat of hydration (by experiment and by calculations) in accordance With BIS 269

Tests on Sand shall include:

- Sieve test
- Test for organic impurities
- Decantation test for determining clay and silt content
- Specific gravity test
- Test for unit weight and bulkage factor
- Test for sieve analysis and fineness modulus

Tests on Coarse Aggregate shall include:

- Sieve analysis
- Specific gravity and unit weight of dry, loose and rodded aggregate
- Soundness and alkali aggregate reactivity
- Petrography examination
- Deleterious materials and organic impurities

- Test for aggregate crushing value

Any or all these tests would normally be ordered to be carried out only if the Engineer feels the materials are not obtained and shall be performed by the contractor at an approved test laboratory The contractor shall bear the charges of these optional tests.
Concrete not made to the requirements of specification in all respects may be rejected by the Engineer-in-Charge in which case it shall be removed and reconstructed entirely at the expense of the contractor.

5.10.1 Load test on Members or any other tests

i. In the event of any work being suspected of material or workmanship or both, the Engineer-in-charge requiring its removal and reconstruction may order, or the contractor may request that it should be load tested in accordance with the following provisions.
ii. The test load shall be 125% of the maximum superimposed load for which the structure was designed. Such test load shall not be applied before 56 days after the effective hardening of concrete. During the test, struts strong enough to take the whole load shall be placed in position leaving a gap under the members. The test load shall be maintained for 24 hours before removal.
iii. If within 24 hours of the removal of the load, the structure does not show a recovery of at least 75% of the maximum deflection shown during the 24 hours under load, the test loading shall be repeated after a lapse of at least 72 hours. The structure shall be considered to have failed to pass the test if the recovery after the second test is not at least 75% of the maximum deflection shown during the second test. If the structure is certified as failed by the Engineer-in-Charge, the cost of all the new construction and the load tests shall be borne by the contractor.
iv. Any other tests, e.g. taking out in an approved manner concrete cores, examination and tests on such cores removed from such parts of the structure as directed by the Engineer-in-charge, sonic testing etc. shall be carried out by the contractor, if so directed, at no extra cost.

5.10.2 Unsatisfactory tests

Should the results of any test prove unsatisfactory, or the structure shows signs of weakness, undue deflection or faulty construction, the contractor shall remove and rebuild the member or members involved or carry out such other remedial measures as may be required by the Engineer-in-Charge.

5.11 ADMIXTURES

5.11.1 General

Admixtures may be used in concrete where required, only with the approval of the Engineer-in-Charge. How ever it should be seen that, with the passage of time, neither the compressive strength nor its durability is reduced. Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement or embedded steel parts. When calcium chloride is permitted

to be used, such as in mass concrete works, it shall be dissolved in water and added to the mixing water in an amount not to exceed 1.5% of the weight of the cement in each batch of concrete. When admixtures are used, the designed concrete mix shall be corrected accordingly. Admixtures shall be used as per manufacturer's instruction and in the manner and with the control specified by the Engineer-in-Charge.

5.11.2 Air Entraining Agents

Neutralized Vinson resin or other approved air in the concrete mix agents shall conform to the requirements of ASTM standard 6.260; Air Entraining Admixtures for Concrete. The recommended total air content of the concrete is 4% + 1%. The method of measuring air content shall be as per IS: 1199.

5.11.3 Water Reducing Admixtures

Water reducing lignosulfonate admixture may be added in quantities approved by the Engineer-in-charge. The admixtures shall be added in the form of a solution.

5.11.4 Retarding Admixtures

Retarding agents may be added to the concrete mix in quantities approved by the Engineer-in-Charge.

5.11.5 Water Proofing Agent

Water proofing agents shall conform to IS: 2645.

5.11.6 Other Admixtures

The Engineer-in-Charge may at his discretion allow the contractor to use any other admixture in the concrete.

5.12 PREPARATION PRIOR TO CONCRETE PLACEMENT, FINAL INSPECTION AND APPROVAL

a. Before the concrete is actually placed in position, the insides of the Formwork shall be inspected to see that they have been cleaned and oiled. Temporary openings shall be provided to facilitate inspection, especially at bottoms of columns and wall forms, to permit removal of sawdust, wood shavings, binding wire, dirt etc. Openings shall be placed or holes drilled so that these materials and water can be removed easily. Such openings/holes shall be suitably plugged later.
b. The various agencies shall be permitted ample time to install drainage and plumbing lines, floor and trench drains, conduits, hangers, anchors, inserts, sleeves, bolts, frames and other miscellaneous embedment to be cast in the concrete as specified or required or as is necessary for the proper execution of the work as specified in the drawings.
c. All embedded parts, inserts, etc. supplied by the PHED or the contractor shall be correctly positioned and securely held in the forms to prevent displacement during depositing and vibrating of concrete.
d. All anchor bolts shall be positioned and kept in place with the help of properly manufactured templates unless specifically waived in writing by the Engineer-in-charge.

e. Slots, openings, holes, pockets etc. shall be provided in the concrete work in the position specified in drawing or required or as directed by the Engineer-in-charge.
f. Reinforcement and other items to be cast in concrete shall have clean surfaces that will not impair bond.
g. Prior to concrete placement, all work shall be inspected and approved by the Engineer-in-Charge and if found unsatisfactory, concrete shall not be poured until after all defects have been corrected.
h. Approval by the Engineer-in-Charge of any and all materials and work as required herein shall not relieve the contractor from his obligation to produce finished concrete in accordance with the requirements of the specifications.
i. Rain or wash water: No concrete shall be placed in wet weather or on a water-covered surface. Any concrete that has been washed by heavy rains shall be entirely removed, if there is any sign of cement and sand having been washed away from the concrete mixture. To guard against damage, which may be caused by rains, the works shall be covered with tarpaulins immediately after the concrete has been placed and compacted before leaving the work unattended. Any water accumulating on the surface of the newly placed concrete shall be removed by approved means and no further concrete shall be placed thereon until such water is removed. To avoid flow of water over/around freshly placed concrete, suitable drains and sumps shall be provided. During summer season, temperature of water should be maintained, as per the criteria and for the same, icing should be done for concreting work.
j. Bonding Mortar: Immediately before concrete placement begins, prepared surfaces except Formwork, which will come in contact with the concrete to be placed, shall be covered with a bonding mortar as specified.
k. The corrosive matters on the reinforcement should be removed by means of wire brush.
l. Laitance should be removed by means of chiselling from top concrete layer which was earlier concreted.

5.13 TRANSPORTATION

5.13.1 General

All buckets, containers or conveyors used for transporting concrete shall be mortar-tight, leak proof irrespective of the method of transportation adopted; concrete shall be delivered with the required consistency and plasticity without segregation or loss of slump. However, chutes shall not be used for transport of concrete without the written permission of the Engineer-in-charge and concrete shall not be re-handled before placing.

5.13.2 Retempered or Contaminated Concrete

Concrete must be placed in its final position before it becomes too stiff to work. On no account, water shall be added after the initial mixing. Concrete, which has become stiff or has been contaminated with foreign materials shall be rejected and disposed off as directed by the Engineer-in-Charge.

5.13.3 Avoiding Segregation

Concrete shall, in all cases, be deposited as nearly as practicable directly, in its final position and shall not be re-handled to flow in a manner which will cause segregation, loss of materials, displacement

of reinforcement, shuttering or embedded insets, or impair its strength. For locations where direct placement is not possible, and in narrow forms, the Contractor shall provide suitable drop and "Elephant Trunks" to confine the movement of concrete. Special care shall be taken when concrete is dropped from a height, especially if reinforcement is in the way, particularly in column and the walls.

5.13.4 Placing by Manual Labour

Except when otherwise approved by the Engineer-in-Charge, concrete shall be placed in the shuttering by shovels or other approved implements, and shall not be dropped from a height more than 1.0 m or handled in a manner, which will cause segregation.

5.13.5 Placing by Mechanical Equipment

The following specification shall apply when placing concrete by use of mechanical equipment is warranted considering the nature of work involved. The control of placing shall begin at the mixer discharge. Concrete shall be discharged by a vertical drop into the middle of the bucket or hopper and this principle of a vertical discharge of concrete shall be adhered to throughout all stages of delivery until the concrete comes to rest in its final position.

5.13.6 Types of Buckets

Central-bottom-dump buckets of a type that provides for positive regulation of the amount and rate of deposition of concrete in all dumping positions, shall be employed. In placing concrete in large open areas, the bucket shall be spotted directly over the position designated and then lowered for dumping. The open bucket shall clear the concrete already in place and the height of drop shall not exceed 1.0 m. The bucket shall be opened slowly to avoid high vertical bounce. Dumping of buckets on the swing or in any manner, which results in separation of ingredients or disturbance of previously placed concrete, will not be permitted.

5.13.7 Placement of Restricted Forms

Concrete placed in restricted forms by barrows, buggles, cars, short chutes or hand shovelling shall be subject to the requirement for vertical delivery of limited height to avoid segregation and shall be deposited as nearly as practicable in its final position.

5.13.8 Chuting

Where it is necessary to use transfer chutes, specific approval of Engineer-in-charge must be obtained to type, length slopes, baffles, vertical terminals and timing of operations. These shall be so arranged that an almost continuous flow of concrete be obtained at the discharge and without segregation. Concrete should flow smoothly in the chute and there should not be any obstruction to the flow. To allow for the loss of mortar against the sides of the chutes, the first mixes shall have less coarse aggregate. During cleaning of chutes, the wastewater shall be kept clear of the forms. Concrete shall not be permitted to fall from the end of the chutes by more than 1.0 m. Chutes, when approved for use shall have slopes not flatter than 1 vertical, 3 horizontal and not steeper than 1 vertical, 2 horizontal. Chutes shall be of metal or metal lines end of rounded cross section. The slopes of all chute sections shall be approximately the same. The slopes of all chute sections shall be approximately the same. The discharge end of the chutes shall be maintained above the surface of the concrete in the

forms.

5.13.9 Placing by Pumping/Pneumatic Placers

Concrete may be conveyed and placed by mechanically operated equipment e.g., pumps or pneumatic placers only with the written permission of the Engineer-in-Charge at no extra cost. The slump shall be held to the minimum necessary for conveying concrete by this method.

When pumping is adopted, before pumping of concrete is started, the pipeline shall be lubricated with one or two batches of mortar composed of one part cement and two parts sand. Care shall be taken to avoid stoppages in work once pumping has started.

When a pneumatic placer is used, the manufacturer's advice on layout of the pipeline shall be followed to avoid blockages and excessive wear. Restraint shall be provided at the discharge box to cater for the reaction at this end. Manufacturer's recommendations shall be followed regarding concrete quality and all other related matters when pumping/ pneumatic placing equipment is used. It should be noted that no extra payment is made for these items, if required and directed by Engineer-in-Charge.

5.13.10 Concrete in layers

Concreting, once started, shall be continuous until the pour is completed. Concrete shall be placed in successive horizontal layers of uniform thickness ranging from 15 cm to 45 cm directed by Engineer-in-Charge. These shall be placed as rapidly practicable to prevent the formation of cold joints or planes of weakness between each succeeding layer within the pour. The thickness of each layer shall be such that it can be deposited before the previous layer has stiffened. The bucket loads or other units of deposit shall be spotted progressively along the face of the layer with such overlap as will facilitate spreading the layer to uniform depth and texture with a minimum shovelling. Any tendency to segregation shall be corrected by shovelling stones into mortar rather than mortar on to stones. Such a condition shall be corrected by redesign of mix or other means, as directed by the Engineer-in-charge.

5.13.11 Cover Blocks

Cover blocks of required size depending on the cover of the reinforcement as mentioned in the drawings should be prepared in 1:3 cement mortar with fine aggregates.

5.13.12 Bedding of layers

The top surface of each pour and bedding planes shall be approximately horizontal unless otherwise instructed. Top layer should be rough and with key for further extension of work.

5.13.13 Compaction

Concrete shall be compacted during placing with approved vibrating equipment until the concrete has been consolidated to the maximum practicable density, as specified in the IS, is free of pockets of coarse aggregate and fits tightly against all form surfaces, reinforcement and embedded fixtures. Particular care shall be taken to ensure that all concrete placed against the form faces and into corners of forms against hardened concrete at joints is free from voids or cavities. The use of vibrators shall be consistent with the concrete mix and caution exercised not to over vibrate the concrete to the point those segregation results.

5.13.13.1 Type of vibrators

Vibrators shall conform to BIS specifications. Type of vibrator to be used shall depend on the structures where concrete is to be placed. Shutter vibrators to be effective, shall be firmly secured to the formwork which must be sufficiently rigid to transmit the vibration and strong enough not to be damaged by it. Immersion vibrators in sufficient numbers and each of adequate size shall be used to properly consolidate all concrete. Tapping or external vibrating of forms by hand tools or immersion vibrators will not be permitted.

5.13.13.2 Use of Vibrators

The exact manner of application and the most suitable machines for the purpose must be carefully considered and operated by experienced men. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn when air bubbles cease to come to the surface. Immersion vibrators shall be withdrawn very slowly. In no case shall immersion vibrators be used to transport concrete inside the forms. Particular attention be paid to vibration at the top of a lift e.g. in a column or wall.

5.13.13.3 Melding Successive Batches

When placing concrete in layers, which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration blending and melding of the concrete between the succeeding layers.

5.13.13.4 Penetration of Vibrators

The immersion vibrator shall penetrate the layer being placed and also, penetrate the layer below while the under layer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.

5.13.13.5 Vibrating against Reinforcement

Care shall be taken to prevent contact of immersion vibrators against reinforcement steel. Immersion vibrators shall not be allowed to come in contact with reinforcement steel after start of initial set. They shall Also, not be allowed to come in contact with forms or finished surfaces.

5.13.13.6 Use of Form Attached Vibrators

Form attached vibrators shall be used only with specific authorization of the Engineer-in-Charge.

5.13.13.7 Use of surface vibrators

The use of surface vibrators will not be permitted under normal conditions. However, for thin slabs, surface vibrating by specially designed vibrators may be permitted, upon approval of Engineer-in-charge.

5.13.13.8 Stone Pockets and Mortar Pondages

The formation of stone pockets and mortar pondages in corners and against faces of forms shall not be permitted. Incase of these occurrences, they should be dug out, reformed and refilled to sufficient depth and shape for thorough bonding, as directed by the Engineer-in-charge.

5.13.14 Placement Interval

Except when placing with slip forms, each placement of concrete in multiple lift work, shall be allowed to set for at least 24 hours after the final set of concrete and before the start of a subsequent placement.

5.13.15 Special Provision in Placing

When placing concrete in walls with openings, in floors of integral slabs and beam construction and other similar conditions, the placing shall stop when the concrete reaches the top of the opening in walls or bottom horizontal surface of the slab, as the case may be. Placing shall be resumed before the concrete in place takes initial set, but not until it has had time to settle as determined by the Engineer-in-Charge.

5.13.16 Placing Concrete Through Reinforcing Steel

When placing concrete through reinforcing steel, care shall be taken to prevent segregation of the coarse aggregate. Where the congestion of steel makes placing difficult, it may be necessary to obtain Engineer in-Charge's permission for temporarily moving the top steel aside for proper placement & for restoring reinforcement as per drawing.

5.13.17 Bleeding

Bleeding or free water on top of concrete being deposited into the forms, shall be the cause to stop the concrete pour and the conditions causing this defect corrected before any further Concreting is resumed.

5.14 APPLICATION OF ARALDITE FOR BONDING OF NEW AND OLD CONCRETE

5.14.1 General

Araldite epoxy resins will be used to bond fresh concrete to concrete that is fully cured, to give a monolithic bond capable of transmitting high stresses when traditional bonding agents such as cement slurry cannot always be relied upon to provide good adhesion which is particularly the case when large areas are involved.

a. The Araldite based formulation shall be applied to suitably prepared concrete sub-strata and the fresh concrete poured as soon as possible, but always during the 'open time' of the adhesive.
b. Materials used shall be of best quality and approved by the Engineer-in-charge.
c. Manufacturer's instructions shall be followed in all respects.
d. No separate payment shall be paid for this item of work.

5.14.2 Formulation

Araldite GY250	100	Parts by weight
Hardener HY825	20	Parts by weight
Hardener HY830	20	Parts by weight
Hardener HY850	20	Parts by weight
Silica Flour	20	Parts by weight

5.14.3 Application

5.14.3.1 Preparation of the Substrata

To obtain good adhesion, it is necessary to have clean and sound substrata. Preparation can be carried out using a variety of techniques including chemical treatment and mechanical methods such as grinding, milling, abrading, planning and sand blasting. Dust and loose particles resulting from the pretreatment should be removed by vacuum cleaning or oil-free or blast.

5.14.3.2 Mixing

The resin and hardener should be thoroughly mixed in the dry filler. The mixed, ready to use adhesive should not contain lumps of unwetted filler and should be of uniform color. For a total weight of 1 kg or less hand mixing should be sufficient. For quantities in excess of 1 kg, the use of a mechanical mixer is recommended.

1. Pot life and 'Open time

'The pot life is the period during which the ready to use ARALDITE based formulation must be applied. After this period, the mix can no longer be worked and will have begun to set in its container. The table below indicates the pot life at different temperatures

Mix Temperature (Degree Celsius)	Pot life (minutes)
25	90
30	60
35	45

(The figures in this table are for batches less than 1 kilogram).

The 'Open time' is the maximum period of time allowable between application of the ARALDITE adhesive and pouring the fresh concrete. Exceeding the 'Open time' would result in considerably reduced adhesion. The adhesive should be applied to the pre-treated substrata as soon as the components have been mixed and fresh concrete poured immediately afterwards.

Accurate knowledge of the 'Open time' is essential in case the work is interrupted.

Table gives the 'Open time' of ARALDITE based formulations as a function of substrata temperature. In all cases, the adhesives shall be applied immediately after mixing. Any delay between mixing and application will reduce the 'Open time'. Fresh concrete must be poured before the adhesive begins to gel. New to old concrete bonding is not recommended at temperatures below 5°C, as curing cannot be assured under these circumstances

5.14.3.4 Methods of Application

The shape and size of the concrete structure will determine the method of application used. The ARALDITE based adhesive may be applied by hand using brushed, brooms or any other suitable applicator.

5.14.3.5 Suitability of Fresh Concrete

Best results are obtained when the water/ cement ratio of the new concrete is low as is practicable.

5.14.3.6 Coverage

One kilogram of the mixed ARALDITE adhesive including hardeners and filler covers an area of 2 to 3 sq.m. when applied with a stiff nylon bristle brush. However, the coverage is very much dependent on the finish in the concrete.

5.15 HANDLING PRECAUTIONS

Epoxy resins can cause irritation of the skin in sensitive person if incorrectly handled. Certain safety precautions must therefore be observed and those handling the resins and hardeners should be given suitable instructions. Those working with epoxy resins should, above all, be instructed that personal cleanliness at the place of work is essential. The resin and hardener should not be allowed to come into direct contact with the skin. The most effective protection is achieved by wearing rubber or polythene gloves, the latter having the advantage that they can be replaced when dirty. They are more pleasant to wear if cotton gloves are worn underneath. Parts of the skins, which have come into contact with the resin or hardener, should be washed with lukewarm water and a mild soap. Special cleaning creams may be used as they have proved to be highly suitable.

5.16 CONSTRUCTION JOINTS

a. A construction joint is defined as a joint in the concrete introduced for convenience in construction at which special measures are taken to achieve subsequent continuity without provision for further relative movement.
b. No concreting shall be started until the Engineer-in-Charge has approved the method of placing the positions and form of the construction joints and lifts. The construction joints shall be so located as not to impair the strength of the structure. Water stops shall be inserted as per clause 5.18
c. Concrete placed to form the face of a construction joint shall have all Laitance removed and the aggregate exposed prior to the placing of fresh concrete. The Laitance shall wherever practicable be removed by spraying the concrete where it is still green. The whole of the concrete surface forming part of the joint shall be hacked to expose the aggregate. Where aggregate is damaged during hacking, it shall be removed from the concrete face by further hacking. All loose matter shall be removed and the exposed surface thoroughly cleaned by wire brushing, air blasting or washing, leaving the surface clean and damp. Immediately before fresh concrete is placed, a 12 mm thick layer of sand/cement mortar mixed in the same proportions as in the concrete shall be spread in the horizontal face of the construction joint. A drier mix shall be used for the top lift of horizontal face of the construction joint. A drier mix shall be used for the top lift of horizontal pours to avoid Laitance. The new concrete shall be well worked against the prepared face before the mortar sets. Special care shall be taken to obtain thorough compaction and to avoid segregation of the concrete along the joint plane.

5.17 MOVEMENT JOINTS

1. Movement joints are defined as all joints intended to accommodate relative movement between adjoining parts of a structure, special provision being made where necessary for maintaining the water tightness of the joint. The contractor shall comply with the instructions of manufacturers of proprietary jointing materials and shall, if required by the Engineer-in-Charge, demonstrate that the jointing materials can be applied satisfactorily.
2. The surface of set concrete in a movement joint shall, as shown on the drawings, be painted with two coats of bituminous paint and new concrete shall be placed against it only when the paint is dry. Expansion joints shall be formed by a separating strip of approved preformed joint filler.
3. Caulking grooves shall be provided. At all joints where a caulking groove is formed, immediately prior to caulking, the groove shall be wire brushed and loose material removed and blown out by compressed air. After the groove has dried, it shall be primed and caulked with approved sealing compound applied in accordance with the manufacturer's instructions. At all caulked joints, the face of the caulking strip and a width of concrete on either side shall be painted with two coats of paint having the same base as the sealing compound.

5.18 WATER STOPS AND JOINT FILLERS

5.18.1 Water stops

a. At all construction, contraction and expansion joints in the water retaining structures and wherever specified or directed by the Engineer-in-Charge, water stops shall be provided. The water stops shall be PVC type or of any other equivalent material as approved by the Engineer-in-Charge. PVC water stops shall have a tensile strength of not less than 14 MN/sq.m and elongation at break of not less than 300%. Water stops shall not be exposed to direct sunlight for long periods. Before being concreted in water stops shall be cleaned of all foreign materials. Wherever provided, water stops shall be placed in such a manner that they are embedded in the adjacent sections of the panels for equal width.

b. As far as possible, jointing on site shall be confined to the making of butt joints in straight runs of water stops and all the joints should be monolithic. Where it is agreed with the Engineer-in-charge that it is necessary to make an intersection or change of direction of any joint, other than a butt joint in a straight run on site, a preliminary joint, intersection or change of direction piece shall be made and submitted to such tests as the Engineer-in-charge may require.

c. Flexible water stops shall be fully supported in the formwork, free of nails and clear of reinforcement and other fixtures. Damaged water stops shall be replaced and during concreting care shall be taken to place the concrete so that water stops do not bend or distort.

d. The different types of water stop to be used in liquid retaining structures will be as per "

5.18.2 Jointing fillers

Joint fillers shall be of durable, compressible and non-extruding material.

5.19 SEALING COMPOUNDS

Horizontal joints shall, where used in water-retaining structures be sealed with a cold pouring polysulphide rubber sealing compound of quality equal to, or better than serviced "Paraseal".

Horizontal joints in roofs, floors and other non-water retaining structures shall be sealed with an approved sealant with properties equal to or better than serviced "Paraplastic 41". Vertical joints and joints in the soffits of slabs in both water retaining as well as non-water retaining structures shall be sealed with a trowel or gun applied polysulphide rubber sealing compound such as serviced "Vertiseal" or equivalent. Sealing compounds shall be fully cured before water is permitted to come in contact. At 40 C, the curing time would be approximately 7 weeks for polysulphide compound

5.20 TOLERANCES IN CONCRETE SURFACES

- Concrete surfaces for the various classes of unformed and formed finishes specified in various clauses shall comply with the tolerances shown in Table hereunder, except where different tolerances are expressly required by the specification.

Dimension

Class of finish	Maximum tolerance (mm) in			
	Line & Level	Abrupt irregularly	Gradual irregularity	Dimension
U1	12	6	6	-
U2	6	3	3	-
U3	6	3	3	
F1	12	6	6	+12-6
F2	6	6	9	+12-6
F3	3	3	3	+6-

- In the table 'line and level' and 'dimension' shall mean the lines, levels and cross-sectional dimensions as specified and required.
- Surface irregularities shall be classified as 'abrupt' or 'gradual'. Abrupt irregularities include by shall not be limited to offsets and fins caused by displaced or misplaced formwork, loose knots and other defects in formwork materials, and shall be tested by direct measurement. Gradual irregularities shall be tested by means of a straight template for plane surfaces and 1.5 m long formed surfaces.

5.21 CURING, PROTECTING, REPAIRING AND FINISHING

5.21.1 Curing

All concrete shall be cured by keeping it continuously damp for the period of time required for complete hydration and hardening to take place. Preference shall be given to the use of continuous

sprays, or ponded water, continuously saturated coverings of sacking, canvas, hessain or other absorbent materials, or approved effective curing compounds applied with spraying equipment capable of producing a smooth, even textured coat. Extra precautions shall be exercised in curing concrete during cold and hot weather as outlined hereinafter. The quality of curing water shall be the same as that used for mixing concrete.

5.21.2 Curing with Water

Fresh concrete shall be kept continuously wet for a minimum period of 10 days from the date of placing of concrete, following a lapse of 12 to 14 hours after laying of concrete. The curing of horizontal surfaces exposed to the drying winds shall However, begin as soon as the concrete has hardened. Water shall be applied to formed surfaces immediately upon removal of forms. Quantity of water applied shall be controlled so as to prevent erosion of freshly placed concrete.

5.21.3 Continuous Spraying

Curing shall be assured by use of an ample water supply under pressure in pipes, with all necessary appliances of hose, sprinklers and spraying devices. Continuous fine mist spraying or sprinkling shall be used, unless otherwise specified or approved by the Engineer-in-charge.

5.21.4 Alternate Curing Methods

Whenever in the judgment of the Engineer-in-charge, it is necessary to omit the continuous spray method, a covering of clean sand or other approved means such as wet gunny bags, which will prevent loss of moisture from the concrete, may be used. No type of covering will be approved which would stain or damage the concrete during or after the curing period. Covering shall be kept continuously wet during curing period. For curing of concrete in sidewalks, floors, flat roofs of other level surfaces, the ponding method of curing is preferred. The method of containing the ponded water shall be approved by the Engineer-in-charge. Special attention shall be given to edges and corners of the slabs to ensure proper protection to these areas. The ponded areas shall be kept continuously filled with water during the curing period.

5.21.5 Curing Compound

Surface coating type-curing compounds shall be used only by special permission of Engineer-in-Charge. Curing compounds shall be liquid type white pigmented, conforming to US Bureau of Reclamation specification. No curing compound shall be used on surfaces where future blending with concrete, water of acid proof membrane or painting is specified.

5.21.6 Curing Equipment

All equipment and materials required for curing shall be on hand and ready for use before concrete is placed.

5.21.7 Protecting Fresh Concrete

Fresh concrete shall be protected from defacements and damage due to construction operations by leaving forms in place for an ample period. Newly placed concrete shall be protected by approved means such as tarpaulins from rain, sun and winds. Steps as approved by the Engineer-in-Charge shall

Also, be taken to protect immature concrete from damage by debris, excessive lading, vibration, abrasion or contact with other materials, etc. that may impair the strength and/or durability of the concrete. Workmen shall be warned against and prevented from disturbing green concrete during its setting period. If it is necessary that the workmen enter the area of freshly placed concrete, the Engineer-in-Charge may require that bridges be placed over the area.

5.21.8 Repair and Replacement of Unsatisfactory Concrete

5.21.8.1 General

Immediately after the shuttering is removed, the surface of concrete shall be very carefully gone over and all defective areas called to the attention of the Engineer-in-charge who may permit patching of the defective areas or also, reject the concrete unit either partially or in its entirety. Rejected concrete shall be removed and replaced by the contractor. Holes shall be filled with mortar composed of one part of cement to one and half parts of sand passing 2.36 mm IS sieve after removing any loose stones adhering to the concrete. Concrete surfaces shall be finished as described in specifications or as directed by the Engineer-in-charge. Superficial honey combed surfaces and rough patches shall be similarly made good immediately after removal of shuttering, in the presence of the Engineer-in-charge and superficial water and air holes shall be filled in. The mortar shall be well worked into the surface with a wooden float. Excess water shall be avoided. Unless instructed otherwise by the Engineer-in-charge, the surface of the exposed concrete placed against shuttering shall be rubbed down immediately on removal of shuttering to remove fine or other irregularities, care being taken to avoid damaging the surface. Surface irregularities shall be removed by grinding. If reinforcement is exposed or the honeycombing occurs at vulnerable positions e.g. ends of beams or columns, it may be necessary to cut out the member completely or in part and reconstruct. The decision of the Engineer-in-charge shall be final in this regard. If only patching is necessary, the edges being cut perpendicular to the affected surface or with a small undercut if possible. Anchors, tees or dovetail slots shall be provided whenever necessary to attach the new concrete securely in place. An area extending several centimetres beyond the edges and the surfaces of the prepared voids shall be saturated with water for 24 hours immediately before the patching material is placed.

5.21.8.2 Use of Epoxy

The use of epoxy for bonding fresh concrete used for repairs will be permitted upon written approval of the Engineer-in-charge. Epoxies shall be applied in strict accordance with the instructions of the manufacturer.

5.21.8.3 Method of Repair

Small size holes having surface dimensions about equal to the depth of the hole, holes left after removal of form bolts, grout insert holes and slots cut for repair of cracks shall be repaired as follows. The hole to be patched shall be roughened and thoroughly soaked with clean water until absorption stops. A 5 mm thick layer of grout of equal parts of cement and sand shall be well brushed into the surface to be patched, followed immediately by the patching concrete which shall be well consolidated with a wooden float and left slightly protrude of the surrounding surface. The concrete

patch shall be built up in 10 mm thick layers, after an hour or more, depending upon weather conditions, it shall be worked off flush with a wooden float and a smooth finish obtained by wiping with hessian. A steel trowel shall be used for this purpose. The mix for patching shall be of the same materials and in the same proportion as that used in the concrete being repaired, although some reduction in the maximum size of the coarse aggregates may be necessary and the mix shall be kept as dry as possible. Mortar filling by air pressure (gunniting) shall be used for repair of areas too large and/or too shallow for patching with mortar. Patched surfaces shall be given a final treatment to match the colour and texture of the surrounding concrete. White cement shall be substituted for ordinary cement, if so, directed by the Engineer-in-charge, to match the shade of the patch with the original concrete.

5.21.8.4 Curing of Patched Work

The patched area shall be covered immediately with an approved non-staining, water-saturated material such as gunny bags which shall
be kept continuously wet and protected against sun and wind for a period of 24 hours. Thereafter, the patched area shall be kept wet continuously by a fine spray, or sprinkling for not less than 10 days. All fillings shall be tightly bounded to the concrete and shall be sound, free from shrinkage cracks after the fillings have been cured and dried.

5.21.8.5 Approval by the Engineer-in-Charge

All materials, procedures and operations used in the repair work shall be subject to the approval of the Engineer-in-Charge.

5.21.9 Finishing

5.21.9.1 General

The type of finish for formed concrete surfaces shall be as follows, unless varied by the Engineer-in-Charge.

When the structure is in service all the surfaces shall receive no special finish, except repair of damaged or defective concrete, removal of fine and abrupt irregularities, filling defective concrete, filling of holes left by form ties and rods and clean up of loose or adhering debris. Surfaces which will be exposed to the weather and which would normally be level, shall be sloped for drainage. Unless a horizontal surface or the slope required is specified, the tops of narrow surfaces such as stair treads, walls, curbs and parapets shall be sloped across the width approximately 1 in 30. Broader surfaces such as walkways, and platforms shall be sloped about 1 in 50. Surfaces that will be covered by backfill or concrete, subfloors to be covered with concrete topping, terrazzo or quarry tiles and similar surfaces shall be smooth ascended and levelled to produce even surfaces. Surface irregularities shall not exceed 6 mm. Surfaces which will not be covered by backfill, concrete or tile toppings such as outside decks, floors of galleries and sumps, parapets, gutters, side-walks, floors and slabs, shall be consolidated, screened and floated. Excess water and laitance shall be removed before final finishing. Floating may be done

with hand or power tools and started as soon as the screened surface has attained a stiffness to permit finishing operations and these shall be the minimum required to produce a surface uniform in texture and free from screened marks or other imperfections. Joints and edges shall be tooled as specified or as directed by the Engineer-in-Charge.

5.21.9.2 Standard Finish for Exposed Concrete

Exposed concrete shall mean any concrete, other than floors or slabs, exposed to view upon completion of the works. Unless otherwise specified, the standard finish for exposed concrete shall be a smooth finish. A smooth finish shall be obtained with the use of lined or plywood forms having smooth and even surfaces and edges. Panels of forms shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms the joint marks shall be smoothed off and all blemishes, protections etc., removed leaving the surfaces smooth.

5.21.9.3 Integral cement concrete finish

When specified, an integral cement concrete finish of specified thickness for floors and slabs shall be applied either monolithic or bonded, as specified or directed by the Engineer-in-charge. The surface shall be tested with a straight edge and any high and low spots eliminated. Floating or trowelling of the finish shall be permitted only after all surface water has evaporated. Dry cement or a mixture of dry cement and sand shall not be sprinkled directly on the surface of the cement finish to absorb moisture or to stiffen the mix.

5.21.9.4 Rubbed finish

A rubbed finish shall be provided only on exposed concrete surfaces. Upon removal of forms, all fins and other projections on the surfaces shall be carefully removed, offsets levelled and voids and/or damaged sections immediately saturated with water and repaired by filling with a concrete or mortar of the same composition as was used in the surface. The surfaces shall then be thoroughly wetted and rubbed with carborundun or other abrasive. Cement mortar may be used in the rubbing, but the finished surfaces shall not be brush coated with either cement or grout after rubbing. The finished surfaces shall present a uniform and smooth appearance.

5.21.9.5 Protection

All concrete shall be protected against damage until final acceptance by the Engineer-in-Charge.

5.22 HOT WEATHER REQUIREMENT

a. All concrete work performed in hot weather shall be in accordance with IS: 456, except as herein modified.
b. Admixtures may be used only when approved by the Engineer-in-Charge.
c. Adequate provisions shall be made to lower concrete temperatures by cool ingredients, eliminating excessive mixing, preventing exposure of mixers and conveyors to direct sunlight and the use of reflective paint on mixers, etc. The temperature of the freshly placed concrete shall not be permitted to exceed 38 degrees centigrade.

d. Consideration shall be given to shading aggregate stockpiles from direct rays of the sun and spraying stockpiles with water, use of cold water when available, and burying, insulating, shading and/or painting white the pipelines and water storage tanks and conveyance.
e. In order to reduce loss of mixing water, the aggregate, wooden forms, subgrade, adjacent concrete and other moisture absorbing surfaces shall be well wetted prior to concreting, placement and finishing shall be done as quickly as possible.
f. Extra precautions shall be taken for the protection and curing of concrete. Consideration shall be given to continuous water curing and protection against high temperatures and drying hot winds for a period of at least 7 days immediately after concrete has set and after which normal curing procedures may be resumed.

5.23 PLACING CONCRETE UNDERWATER

a. Under all ordinary conditions, all foundations shall be completely dewatered and concrete placed in the dry. However, when concrete placement under water is necessary, all work shall conform to IS: 456 and the procedure shall be as follows:
   - **Method of Placement**: Concrete shall be deposited underwater by means of tremies, or drop bottom buckets of approved type.
   - **Direction, Inspection and Approval**: All work requiring placement of concrete underwater shall be designed, directed and inspected with due regard to local circumstances and purposes. All underwater concrete shall be placed according to specifications approved by the Engineer-in-Charge.

b.Special precautions shall be taken for prevention of lifting of concrete due to uplift pressure of subsoil water.

5.24 PRECAST CONCRETE

5.24.1 General

Precast concrete units, whether manufactured on or off site, shall comply in every way with the provisions of the contract for in situ concrete. Wherever possible, precast units shall be hydraulically pressed. When ready for incorporation in the works, precast units shall be responsible for the accuracy of the level, shape of the bed or platform. A suitable serial number and the date of casting shall be impressed or painted on each unit.

5.24.2 Striking Forms

Side shutters shall not be struck in less than 24 hours after depositing concrete and no precast unit shall be lifted until the concrete reaches strength of at least twice the stress to which the concrete may be subjected to at the time of lifting.

1.24.3 Precast Units

The lifting and removal of precast units shall be undertaken without causing shock, vibration or undue bending stresses to or in the units. Before lifting and removal takes place, contractor shall satisfy the Engineer-in-charge or his representative that the methods he proposes to adopt for these operations will not over-stress or otherwise effect seriously the strength of the precast units. The reinforced side

of the units shall be distinctly marked

5.24.4 Curing

All precast work shall be protected from the direct rays of the sun for at least 7 days after casting and during that period each unit shall be kept constantly watered or preferably be completely immersed in water if the size of the unit so permits.

5.25 SLOTS, OPENINGS, ETC.

5.25.1 General

Slots, openings or holes, pockets, etc., shall be provided in the concrete work in the approved positions or as directed by Engineer-in-charge. Short pipes with puddle collar shall be fixed in the sidewall of suction pipes. They shall be supplied at the appropriate time during construction. Any deviation from the approved drawings shall be made good by contractor at own expense, without damaging any other work. Sleeves, bolts, inserts etc., shall Also, be provided in concrete work where so required.

5.25.2 Grouting

5.25.3 *5.25.2.1 Standard Grout*

The proportions of grout shall be such as to produce a flowable mixture consistent with minimum water content and shrinkage. The grout proportions shall be limited as per "*Table 10: Proportions for Standard Grout*".

Sr.	Use	Grout thickness	Mix proportions	W/C ratio (max.)
1.	Fluid	Under 25 mm	One part Portland cement to one part sand	0.44
2.	25mm & over but less than 50mm	One part Portland cement to 2 parts of sand	One part Portland cement to 2 parts of sand	0.53
3.	Stiff Mix	50mm & over	One part Portland cement	0.53

Table 10: Proportions for Standard Grout

Sand shall be such as to produce a flowable grout without any tendency to segregate. Sand for general grouting purposes, shall be graded within the following limits

Sand for fluid grouts, shall have the fine material passing the 300 and 150 micron sieves at the upper limits

Passing BIS	2.36 mm sieve	95 to
Passing BIS	1.18 mm sieve	65 to 95%
Passing BIS	300 micron	10 to 30%
Passing BIS	150 micron	3 to 10%

specified above. Sand, for still grouts, shall meet the usual grading specifications for concrete laitance. Anchor bolts, anchor bolt holes and the bottoms of equipment and column base plates shall be cleaned of all oil, grease, dirt and loose material. The use of hot, strong caustic solution for this purpose will be permitted. Prior to grouting, the hardened concrete surfaces to be grouted shall be saturated with water. Water in anchor bolt holes shall be removed before grouting is started. Forms around base plates shall be reasonably tight to prevent leakage of the grout. Adequate clearance shall be provided between forms and base plate to permit grout to be worked properly into place. Grouting, once started, shall be done quickly and continuously to prevent segregation, bleeding and breakdown of initial set. Grout shall be worked from one side of one end to the other to prevent entrapment of air. To distribute the grout and to ensure more complete contact between base plate and foundation and to help release trapped air, link chains can be used to work the grout into place. Grout throughout holes in base plates shall be by pressure grouting. Variations in grout mixes and procedures shall be permitted if approved by the Engineer-in-charge

5.25.2.2 Non-Shrinking Grout for Equipment Foundation

Non-shrinking grout shall be used for grouting of machine base plates, anchor bolts, other anchoring devices and at locations where ordinary grouts are ineffective due to shrinkage. It shall be composed of a type of expansive hydraulic sheeting binder and select-graded aggregates. It shall have properties as per "*Table 11: Proportions for Non-Shrinking Grout*".

Sr.	Properties	Values
1.	Maximum gain size	6 mm
2.	Water % (for 80% flow)	15.17
3.	Density of hardened grout	2.27-2.30 gm/m1
4.	Compressive strength N/sq.mm - Minimum 3 days	23
	- 7 days	34
	- 28 days	45
5.	Expansion %	
	- Free	0.10-0.20
	- Restrained	0.08-0.12
	Restrained	0.08-0.12

Table 11: Proportions for Non-Shrinking Grout

Mixing, batching, cleaning, preparation of surface and curing of non-shrinking grout shall be done as per manufacturer's instructions.

5.26 INSPECTION

a. All materials, workmanship and finished construction shall be subject to continuous inspection and approval of the Engineer-in-Charge.
b. All materials supplied by the Contractor and all work or construction performed by the Contractor which is rejected as not being in conformity with the specifications and requirements, shall be immediately replaced.
c. All concrete shall be protected against damage until final acceptance by the Engineer-in-Charge.

5.27 CLEAN-UP

a. Upon completion of the concrete work, all forms, equipment, construction tools, protective coverings and any debris resulting from the work shall be removed from the premises.
b. All debris i.e. empty containers, scrap wood, etc., shall be removed to "dump" daily, or as directed by the Engineer-in-Charge.
c. The finished concrete surfaces shall be left in a clean condition satisfactory to the Engineer-in-Charge.
d.

5.28 RECORDS OF CONCRETING

An accurate and up to date record showing times, dates, weather and temperature conditions when various positions of all the concrete structures forming the works were concreted will be kept by the Engineer-in-charge and shall be countersigned by the Contractor. If the Contractor fails to sign the Engineer-in-Charge's record; it shall nevertheless be regarded as correct and binding on the Contractor.

The Contractor has to submit concrete pour card in duplicate duly to be signed to the Engineer-in-Charge for each type of concreting work. Contractor shall keep copy of it, after Engineer-in-Charge has checked and signed the pour card.

5.29 SUPPLY OF CEMENT

Contractor shall procure / purchase the cement and shall be stacked and well maintained as specified in the earlier sections. Contractor shall procure cement in those quantities required for maximum one month of concreting work and more than the prescribed time limit is not allowed. For any damage to cement, PHED will not be responsible and the damaged cement will not be used in the work.

5.30 FOUNDATION BEDDING, BONDING AND JOINTING

a. All surfaces upon or against which concrete will be placed shall be suitably prepared by thoroughly cleaning, washing and dewatering, as specified or as the Engineer-in-charge may direct, to meet the various situations encountered in the work.
b. Soft or spongy areas shall be cleaned out and backfilled with lean concrete or clean sand fill compacted.
c. Prior to construction of formwork for any item where soil will act as bottom form, approval shall be obtained from the Engineer-in-Charge for the suitability of the soil.

5.31 PREPARATION OF ROCK STRATA OF FOUNDATIONS

a. To provide tight bond with rock foundations, the rock surface shall be prepared and the following general requirements shall be observed.
b. Concrete shall not be deposited on large sloping rock surfaces. Where required by the Engineer-in-charge, the rock shall be cut to form rough steps or benches to provide roughness or a more suitable bearing surface.
c. Rock foundation stratum shall be prepared by picking, barring, wedging and similar methods which will leave the rock in an entirely sound and unshattered condition.
d. Shortly before concrete is placed, the rock surface shall be cleaned with high pressure water and air jet even though it may have been previously cleaned in that manner.
e. Prior to placing concrete, the rock surface shall be kept wet for a period of 2 to 4 hours unless otherwise directed by the Engineer-in-Charge.
f. Before placing concrete on rock surfaces all water shall be removed from depressions to permit thorough inspection and proper bonding of the concrete to the rock.

CHAPTER-6
FORMWORK

6.1 FIXING OF FORMWORK

All formwork shall be constructed of plywood or sheet metal Plywood used for form work shall be conforming to IS:4990i.e Specification for plywood for concrete shuttering works. The materials for form work shall got approved by the Engineer before starting the work. Form work shall be firmly supported, adequately strutted, braced and tied to withstand the placing and vibrating of concrete and the effects of weather. The tolerance on line and level shall not exceed 3 mm and the soffits of beams other than prestressed beams shall in the absence of any specified camber, be erected with an upward camber of 6 mm for each 3 meters of span.

The Contractor shall be responsible for the calculations and designs for the formwork, and if required, shall submit them to the Engineer for approval before construction on formwork to external faces which will be permanently exposed, all horizontal and vertical formwork joints shall be so arranged that joint lines will form a uniform pattern on the face of the concrete. Where the Contractor proposes to make up the formwork for standard sized manufactured formwork panels, the size of such panels shall be approved by the Engineer before they are used in the construction of the Works. The finished appearance of the entire elevation of the structure and adjoining

structures shall be considered when planning the pattern of joint lines caused by formwork and by construction joint to ensure continuity of horizontal and vertical lines. Faces of formwork in contact with concrete shall be free from adhering foreign matter, projecting nails and the like, splits or other defects, and all formwork shall be clean and free from standing water, dirt, shavings, chippings or other foreign matter. Joints shall be sufficiently watertight to prevent the escape of mortar or the formation of fins or other blemishes on the face of the concrete.

Formwork shall be provided for the top surfaces of sloping work where the slope exceeds fifteen degrees from the horizontal (except where such top surface is specified as spaded finish) and shall be anchored to enable the concrete to be properly compacted and to prevent flotation, care being taken to prevent air being trapped.

Openings for inspection of the inside of the formwork and for the removal of water used for washing down shall be provided and so formed as to be easily closed before placing concrete. Before placing concrete, all bolts, pipes or conduits or other fixtures which are to be built in shall be fixed in their correct positions, and cores and other devices for forming holes shall be held fast by fixing to the formwork or otherwise. Holes shall not be cut in any concrete without approval of the Engineer.

All exterior angles on the finished concrete of 90 degree or less shall be given 20 mm x 20 mm chamfers unless otherwise ordered by the Engineer.

No ties or bolts or other device shall be built into the concrete for the purpose of supporting formwork without the prior approval of the Engineer. The whole or part of any such supports shall be capable of removal so that no part remaining embedded in the concrete shall be nearer than 50 mm from the surface in the case of reinforced concrete and 150 mm in the case of un-reinforced concrete. Holes left after removal of such supports shall be neatly filled with well rammed dry-pack mortar.

Formwork in contact with the concrete shall be treated with a suitable non-staining mould oil to prevent adherence of the concrete except where the surface is subsequently to be rendered. Care shall be taken to prevent the oil from coming in contact with reinforcement or with concrete at construction joints. Surface retarding agents shall be used only where ordered by the Engineer.

6.2 REMOVAL OF FORMWORK

Formwork shall be so designed as to permit any removal without resorting to hammering or levering against the surface of the concrete. The periods of time elapsing between the placing of the concrete and the striking of the loads likely to be imposed on the concrete and shall in any case be not less than the periods shown in Table below. Where soffit formwork is constructed in a manner during and after such removal of a sufficient number of adequate supporting props in an undisturbed condition, the Contractor may, with the agreement of the Engineer, remove the formwork at the earlier times listed below provided that the props are left in position.

POSITION OF FORMWORK	DAYS FOR STRIKING
Walls	1
Sides of beams and columns	2
Slabs (Props left under)	3
Props to slabs (span not exceeding 4.5m)	7
Props to slabs (span exceeding 4.5 m)	1 4
Beams soffits (props left under)	7
Props to beams (span not exceeding 6 m)	1 4
Props to beams (span exceeding 6 m)	2 1

Notwithstanding the foregoing, the Contractor shall be held responsible for any damage arising from removal of formwork before the structure is capable of carrying its own weight and any incidental loading.

Striking shall be done slowly with utmost care to avoid damage to projections and without shock or vibration, by gently easing the wedges. If after removing the form work it is found that timber has been embedded in the concrete. It shall be removed and made good as specified earlier.

Reinforced temporary openings shall be provided, as directed by the Engineer, to facilitate removal of formwork which otherwise may be inaccessible.

The rods, clamps, form bolts, etc. which must be entirely removed from walls or similar structures shall be loosened not sooner than 24 hours not later than 40 hours after the concrete has been

deposited. Ties, except those required to hold forms in place, may be removed at the same time. Ties, withdrawn from walls and grade beams shall be pulled toward the inside face. Cutting ties back from the faces of the walls and grade beams will not be permitted.

For liquid retaining structures, no sleeves for through bolts shall be used nor shall through bolts be removed as indicated above. The bolts, in this case, shall be cut at 25 mm depth or more from the surface and then the hole shall be made good by cement sand mortar of the same proportions as the concrete just after striking the formwork.

6.3 FORMED SURFACES – CLASSES OF FINISH

Finishes to formed surfaces of concrete shall be classified as F1, F2, or F3, or such other special finish as may be particularly specified. Where the class of finish is not specified the concrete shall be finished to Class F1.

Formwork for Class F3 finish shall be lined with as large panels as possible of non-staining material with a smooth unblemished surface such as sanded plywood or hard compressed fibre board, arranged in a uniform approved pattern and fixed to back formwork by oval nails. Unfaced wrought boarding or standard steel panels shall not be permitted. Formwork for Class F2 finish shall be faced with wrought tongued and grooved boards or plywood or metal panels arranged in a uniform approved pattern free from defects likely to detract from the appearance of the surface.

Formwork for Class F1 finish shall be constructed in sheet metal. Surfaces subsequently to be rendered, plastered or tiled shall be adequately scrabbled or hacked as soon as the formwork is removed to reduce the irregularities to not more than half the thickness of such rendering, plastering or bedding for tiles and to provide a satisfactory key.

6.4 DIFFECTS IN FORMED SURFACES

Workmanship in formwork and concreting shall be such that concrete shall normally require no making good, surfaces being perfectly compacted and smooth.

If any blemishes are revealed after removal of formwork, the Engineer's decisions concerning remedial measures shall be obtained immediately. These measures may include, but shall not be limited to the following:

i) Fins, pinhole bubbles, surface dis-coloration and minor defects may be rubbed down with sacking immediately after the formwork is removed.

ii) Abrupt and gradual irregularities may be rubbed down with carborundum and water after the concrete has been fully cured. These and any other defects shall be remedied by methods approved by the Engineer which may include using a suitable epoxy resin or, where necessary, cutting out to a regular dovetails shape at least 75 mm deep and refilling with concrete over steel mesh reinforcement sprung into the dovetail.

6.5 HOLES TO BE FILLED

Holes formed in concrete surfaces by formwork supports or the like shall be filled with dry-pack mortar made from one part by weight of ordinary Portland cement and three parts fine aggregate passing IS sieve 1.18 mm. The mortar shall be mixed with only sufficient water to make the materials stick together when being moulded in the hands.

The contractor shall thoroughly clean any hole that is to be filled with dry-pack mortar and where the surface has been damaged, the contractor shall break out any loose, broken or cracked concrete or aggregate. The concrete surrounding the hole shall then be thoroughly soaked after which the surface shall be dried so as to leave a small amount of free water on the surface. The surface shall then be dusted lightly with ordinary Portland cement by means of a small dry brush until the whole surface that will come into contact with the dry-pack mortar has been covered and darkened by absorption of the free water on the surface. The surface shall then be dusted lightly with ordinary Portland cement by means of a small dry brush until the whole surface that will come into contact

With the dry-pack mortar has been covered and darkened by absorption of the free water by the cement. Any dry cement in the hole shall be removed.

The dry-pack material shall then be placed and packed in layers having a compacted thickness not greater than 15 mm. The compaction shall be carried out by use of a hardwood stick and a hammer and shall extend over the full area of the layer, particular care being taken to compact the dry-pack against the sides of the hole. After compaction, the surface of each layer shall be scratched the dry-pack fill and striking the block several times. Steel finishing tools shall not be used and water shall not be added to facilitate finishing.

6.6 TOLERANCES

Tolerance is a specified permissible variation from lines, grade or dimensions given in approved drawings. No tolerance specified for horizontal or vertical building lines or footings shall be construed to permit encroachment beyond the legal boundaries. Unless otherwise specified, the following tolerances will be permitted:

Tolerances for RCC Structures

i) Variation from the plumb
   a) In the lines and surfaces of columns, piers, walls 5 mm per 2.5 m or 25 mm, whichever is less.
   b) For exposed corner columns and other conspicuous lines
      In any bay or 5 m maximum 5 mm
      In 10 m or more 10 mm

ii) Variation from the level or from the grades indicated on the approved drawings
   a) In slab soffits, ceilings, beam soffit, and in arises
      In 2.5 m 5 mm

In any bay or 5 m maximum	10 mm
In 10 m or more	15 mm

b) For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines

In any bay or 5 m maximum	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, wall and partitions

In any bay or 5 m maximum	10 mm
In 10 m or more	20 mm

iv) Variation in the sizes and locations of sleeves, openings in walls and floors

Except in the case of and for anchor bolts	5 mm

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

a) Variation in dimension in plan

Minus	5 mm
Plus	10 mm

b) Misplacement or eccentricity

2% of footing width in the direction of misplacement but not more than 50 mm

c) Reduction in thickness

Minus 5% of specified thickness subject to a maximum of 50 mm

vii) Variation in steps

a) In a flight of stairs

Rise	3 mm
Tread	5 mm

b) In consecutive steps

Rise	1.5 mm
Tread	3 mm

Tolerances in other Concrete Structures

viii) All structures

a) Variation of the constructed linear outlines from established position in plan

In 5 m	10 mm
In 10 m or more	15 mm

b) Variations of dimensions to individual structural features from established positions

In 20 m or more	25 mm
In buried construction	50 mm

c) 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

d) Variation from level or grade indicated on approved 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

e) Variation in cross-sectional dimensions of columns, beams, buttresses, piers and similar members

Minus	5 mm
Plus	10 mm

ix) Footings for columns, piers, walls, buttresses and similar members

a) Variation of dimensions in plan

Minus	10 mm
Plus	50 mm

b) Misplacement or eccentricity

2% of footing width in the direction of misplacement but not more than 50 mm.

c) Reduction in thickness

5% of specified thickness subject to a maximum of 50 mm

x) Tolerance in other types of structures shall generally conform to those given in Clause 2.4 of Recommended Practice for Concrete Formwork (American Concrete Institute Act 347).

xi) Tolerance in fixing anchor bolts shall be as follows:

a) Anchor bolts without sleeves + 5 mm

b) Anchor bolts with sleeves + 5 mm for bolts up to 20 mm Dia
+ 3 mm for bolts above 32 mm Dia

c) Embedded parts + 5 mm in all directions

6.7 BRACING, STRUTS AND PROPS

Formwork shall be braced, strutted, propped and so supported that it shall not deform underweight and pressure of the concrete and Also, due to the movement of men and other materials. Bamboos shall not be used as props or cross bearers.

The formwork for beams and slabs shall be so erected that the formwork on the sides of the beams and under the soffit of slabs can be removed without disturbing the beam bottoms. Re-propping of beams shall not be done except when props have to be reinstated to take care of construction loads anticipated being in excess of the design load. Vertical props shall be supported on wedges or other measures shall be taken whereby the props can be gently lowered vertically while striking the formwork.

If the formwork for a column is erected for the full height of the column, one side shall be left open and built up in sections as placing of the concrete proceeds, or windows may be left for pouring concrete from the sides to limit the drop of concrete to 1.0 m as directed by the Engineer.

CHAPTER-7
REINFORCEMENT

7.1 GENERAL

Reinforcement shall be high strength deformed bars as per IS: 1786. Wire mesh or fabric shall be in accordance with IS:1566. Substitution of reinforcement will not be permitted except upon written approval from the Engineer.

7.2 STORAGE

The reinforcement shall not be kept in direct contact with the ground but stacked on top of an arrangement of timber sleepers or the like.

If the reinforcing rods have to be stored for a long duration, they shall be coated with cement wash before stacking and/or be kept under cover or stored as directed by the Engineer.

Fabricated reinforcement shall be carefully stored to prevent damage, distortion, corrosion and deterioration.

7.3 QUALITY

No re-rolled material will be accepted. If requested by the Engineer, the contractor shall submit the manufacturer's test certificate for the steel. Random tests on steel supplied by the contractor may be performed by the Engineer as per relevant Indian Standards. All costs incidental to such tests shall be at the contractor's expenses. Steel not conforming to specifications shall be rejected.

All reinforcements shall be clean, free from grease, oil paint, dirt, loose mill scale, loose rust, dust bituminous material or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used. No welding of rods to obtain continuity shall be allowed unless approved by the Engineer. If welding is approved, the work shall be carried out as per IS:2751 according to the best modern practices and as directed by the Engineer. In all cases of important connections, tests shall be made to prove that the joints are of full strength of bars welded. Special precautions, as specified by the Engineer, shall be taken in the welding of cold worked reinforcing bars and bars other than mild steel.

7.4 LAPS

Laps and splices for reinforcement shall be as per IS:456. Splices in adjacent bars shall be staggered and the locations of all splices shall be approved by the Engineer.

7.5 BENDING

Reinforcement bars supplied bent or in coils, shall be straightened before they are cut to size. Straightening of bars shall be done cold and without damaging the bars. All bars shall be accurately bent according to the sizes and shapes shown on the approved detailed working drawings/bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and re-bent in a manner that will injure the material; bars containing cracks/splits shall be rejected. They shall be bent cold, except bars of over 25 mm in diameter which may be bent hot if specifically approved by the Engineer. Bars which depend for their strength of cold working shall not be bent hot. Bars bent hot shall not be treated beyond cherry red colour (nor exceeding 845□C) and after bending shall be allowed to cool slowly without quenching. Bars incorrectly bent shall be used only if the means used for straightening and re-bending be such as shall not, in the opinion of the Engineer, injure the material. No reinforcement shall be bent when in position in the work without approval, whether or not it is partially embedded in hardened concrete. Bars having kinks or bends other than those required by design shall not be used.

7.6 FIXING

Reinforcement shall be accurately fixed by any approved means and maintained in the correct position shown in the approved Drawings by the use of blocks, spacers and chairs, as per IS:2502, to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing points shall be securely bound together at all such points with number 16 gauge annealed soft iron wire. The vertical distances required between successive layers of bars in beams or similar members shall be maintained by the provision of mild steel spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars.

7.7 NOMINAL COVER TO REINFORCEMENT

Nominal cover is the design depth of concrete cover to all steel reinforcements, including links. It is the dimension used in design and indicated in the drawings. It shall be not less than the diameter of the bar.

Minimum values for the nominal cover of normal weight aggregate concrete which should be provided to all reinforcement, including links depending on the condition of exposure described in Clause-8.2.3 and as given in Table –16 of IS:456/2000.

However, for a longitudinal reinforcing bar in a column nominal cover shall in any case not be less than 40 mm, or less than the diameter of such bar. In the case of columns of minimum dimension of 200 mm or under, whose reinforcing bars do not exceed 12 mm, a nominal cover of 25 mm may be

used.

For footings minimum cover shall be 50 mm.

Table-16 of IS:456/2000 – Nominal cover to Meet Durability Requirements

Exposure	Nominal Concrete cover in mm not less than
Mild	20
Moderate	30
Severe	45
Very severe	50
Extreme	75

The correct cover shall be maintained by cement mortar cubes or other approved means. Reinforcement for footings, grade beams and slabs on sub-grade shall be supported on pre-case concrete blocks as approved by the Engineer. The use of pebbles or stones shall not be permitted. The 28 days crushing strength of cement mortar cubes/pre-cast concrete cover blocks shall be at least equal to the specified strength of concrete in which these cubes/blocks are embedded.

The minimum clear distance between reinforcing bars shall be in accordance with

IS:456. **7.8 INSPECTION**

Erected and secured reinforcement shall be inspected and approved by the Engineer prior to placement of concrete.

7.9 WELDING OF REINFORCEMENT

Reinforcement which is specified to be welded shall be welded by any process which conforms with the requirements of IS:2751 and which the Contractor can demonstrate by bend and tensile tests will ensure that the strength of the parent metal is not reduced and that the weld possesses a strength not less than that of the parent metal. The welding procedure established by successful test welds shall be maintained and no departure from this procedure shall be permitted.

Welds in positions other than those shown on the approved Drawings shall not be permitted. Tack welding to lightly secure reinforcement in place will be permitted subject to approval of the Engineer.

7.10 SUPPLY OF REINFORCING BARS

Contractor shall make their own arrangements for the supply of steel reinforcement, MS bars/high yield strength deformed bars etc. required for the works. Further, the Contractor shall be responsible for payments of applicable duties and taxes etc.

CHAPTER 8

SEWER APPURTENANCES

8.1 MANHOLES

The manhole shall be provided with Brick manhole and RCC manhole depending upon diameter of sewers and depending upon the alignment of proposed sewer whether it is on road or in Storm Water Drain (SWD)

The Brick manhole and RCC manholes are defined with the following conditions.

- Brick manholes – up to 800 mm dia. pipe for all depths
- RCC manholes – 900 mm dia. pipe and above for all depths
- RCC manholes – In SWD, for all dia. of pipe and for all depths.

The Brick Manholes shall be constructed as per IS 4111- Part-1

(i) Location

Manholes shall be constructed at places as shown on relevant drawings and as directed by the Engineer-in-charge.

(ii) Excavation

Excavation, shoring, dewatering etc. for the pits of manholes shall be done in accordance with specification.

(iii) Bricks

Bricks used for construction of manholes shall conform to the relevant Indian Standards. They shall be sound, hard, homogeneous in texture, well burnt in kiln without being vitrified, table moulded, deep rod, cherry or copper coloured, of regular shape and size and shall have sharp and square and parallel faces. The bricks shall be free from pores, chips, flaws or humps of any kind. Over burnt or under burnt bricks shall be liable to rejection. The bricks shall give a clear ringing sound when struck. Unless otherwise noted in drawings. The class and quality requirements of bricks shall be as laid down in IS: 1077. The compressive strength of brick shall not be less than 3.5N/Sq mm or 35Kg/Sq cm.

The size of the brick shall be 23.0 x 11.5 x 7.5 or unless otherwise specified; but tolerance up to (+) 3 mm. in each direction shall be permitted. Only full size brick shall be used for masonry work. Brick bats shall be used only with the permission of the Engineer to make up required wall length or for bonding. Sample bricks shall be submitted to the Engineer for approval and bricks supplied shall conform to approved samples. If demanded by the Engineer, brick sample shall be got tested as per IS: 3495 by Contractor at no extra cost to the client. The bricks rejected by the Engineer shall be removed from the site of works within 24 hours.

(iv) Cement Mortar

Mortar for brick masonry shall be prepared as per IS: 2250. Manholes shall be constructed in brick masonry with cement mortar (1:4), 20 mm thick inside plaster and 12 mm thick outside plaster in CM 1:3, unless otherwise specified in items. Gauge boxes for sand shall be of such dimensions that one bag containing 50 Kg. of cement forms one unit. The sand shall be free from clay, shale, loan, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be as approved by Engineer. If so directed by the Engineer, sand shall be thoroughly washed, till it is free of any contamination.

For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry conditions. Water shall then be added and mixing continued to give a uniform mix of required consistency. Cement mortar shall be used within 25 minutes of mixing. Mortar left unused in the specified period shall be rejected.

Contractor shall arrange for test on mortar samples if so directed by the Engineer. Retempering of mortar shall not be permitted.

(v) Brick Masonry

All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. Brick work 230 mm. thick and over shall be laid in English Bond unless otherwise specified. For laying bricks, a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be pressed into the mortar and shoved into final position so as to embed the brick fully in mortar.

All brickwork shall be plumb and square unless otherwise shown on drawing and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be levelled. The thickness of brick courses shall be kept uniform. For walls of thickness greater than 230 mm both faces shall be kept in vertical planes unless otherwise specified. All interconnected brickwork shall be carried out at nearly one level (so that there is uniform distribution of pressure on the supporting structure) and no portion of the work shall be left more than one course lower than the adjacent work. Where this is not possible, the work shall be raked back according to bond (and not saw toothed) at an angle not exceeding 45 degrees. But in no case the level difference between adjoining walls shall exceed 1.25 m. Workmanship shall conform to IS: 2212.

Brick shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum depth of 12 mm by raking tools daily during the progress of work when the mortar is still green, so as to provide a proper key for the plastering to be done. When plastering is not required to be done, the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top. If mortar in the lower courses has begun to set, the joints shall be raked out to a depth of 12 mm before another course is laid. No extra payment will be made for raking joints.

(vi) Cement Plaster

All joints in masonry shall be raked to a depth of 12 mm. with a hooked tool made for the purpose when the mortar is still green and in any case within 46 hours of its laying. The surface to be rendered shall be washed with fresh clean water free from all dirt, loose material, grease etc. and thoroughly wetted for 6 hours before plastering work is commenced. Concrete surfaces to be rendered will However, be kept dry. The wall should not be too wet but only damp at the time of plastering. The damping shall be uniform to get uniform bond between the plaster and the wall.

The proportion of the cement mortar shall be as specified on relevant drawings. Cement shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water, sand and cement shall be as per relevant I.S. The mortar thus mixed shall be used immediately and in no case shall the mortar be allowed to remain for more than 25 minutes after mixing with water.

Curing of plaster shall be started as soon as the applied plaster has hardened enough so as not to be damaged. The decision as to when the plaster has hardened will be given by the Engineer-in-charge. Curing shall be done by continuously applying water in fine spray and shall be carried out for at least 7 days.

Plastering shall be done on both faces of brick masonry, 20 mm thick inside and 12 mm thick outside.

The manholes shall be internally provided with **PVC/Poly Urea lining of thickness 1.5 mm** to protect the walls and top from corrosion developed due to sewer gases such as H2S etc.

(vii) Cement concrete channel

The channel for the manhole shall be constructed in cement concrete of M25 grade. Both sides of the channel shall be taken up to the level of the crown of the outgoing sewer. They shall be benched up in concrete extended vertically 50mm above and rendered in cement mortar (1:2) of 20 mm thickness and formed to a slope of 1 in 12 towards the channel.

The branch channels Also, be similarly constructed with respect to the benching but at their junctions with main channel, an appropriate fall, if required suitably rounded off, in the direction of flow in main channel shall be given.

The manholes shall be constructed at places shown on the drawings or wherever directed by the Engineer.

(viii) Pipe entering or leaving manhole

Whenever a pipe enters or leaves a manhole, bricks on edge must be cut to a proper form and laid around the upper end of the pipe so as to form an arch. All around the pipes, there shall be a joint of cement mortar (1:2) 13 mm thick between it and the bricks.

(ix) Rungs / foot steps

Rungs / footsteps shall be provided in all manholes and shall be Manufacture and conforms to the dimensions of IS 5455:1969(RA1977) are reinforcement encapsulated with PVC. The surface finish shall have 2mm tread on top by ribbing or chequering. These rungs may be 300 mm apart vertically and shall project a minimum of 100 mm beyond the finished surface of the manhole wall. The top rung shall be 450 mm below the manhole cover and the lowest not more than 300 mm above the benching. Rungs shall be tested as per IS and approved before usage.

(x) Frame and covers

Frame and covers for manholes shall be of required type and dimensions as per the relevant drawings.

Following information shall be clearly marked on each cover.

a. Year of manufacture
b. Identification mark of the purchaser
c. SEWER / SWD
d. Arrow showing direction of flow
e. Name of manufacturer / Trade mark

(xi) Steel Fibre Reinforced Concrete (SFRC) Frame and Cover

Steel Fibre Reinforced Concrete (SFRC) frame and cover shall be as manufactured as per IS 12592. (Latest edition). The contractor to submit the structural design and drawing of frame and cover and get it approved before manufacturing the same.

(xii) Drop Manhole

When a sewer connects a main sewer, and where the difference in level between water line (peak flow levels) of main line and the invert level of branch line is more than 600 mm or a drop of more than 600 mm is required to be given in the same sewer line and it is uneconomical or impractical to arrange the connection within 600 mm, a drop connection shall be provided for which a manhole shall be constructed as per relevant drawing, incorporating a vertical drop pipe from the higher sewer to the lower one. This pipe shall be provided outside the shaft and encased in concrete. A continuation of the branch sewer should be built through the shaft wall to form a rodding and inspection eye, which should be provided with a half blank flange. The diameter of the back drop should be at least as large as that of the incoming pipe. The drop pipe should terminate at its lower end with a plain or duck-foot bend turned so as to discharge its flow at 45 degrees or less to the direction of the flow in the main sewer

(xiii) RCC Manhole

In general, plain and reinforced concrete work for manholes shall be carried out in accordance with the specification and drawing.

(xiv) Measurement

Manholes

The depth of manhole shall be measure from the top of cover to the invert level of the deepest outgoing sewer from the manhole. The relevant items of manhole quoted in schedule of quantities and drawings. The measurement shall be per number basis and as per the actual depth of manhole constructed.

8.2 EXISTING CONNECTIONS

All existing connections which are removed during the uprooting of the existing sewer shall be replaced and reconnected with new sewer as per the directions of the Engineer. The replaced new sewer connections shall be properly laid, jointed and connected as per the directions of the Engineer. During the execution work of replacing sewer if the bedding of the connection has been disturbed it shall be replaced with new bedding as per specification contained in the tender document. After making the connection to the sewer, back filling shall be done in layers as directed by the Engineer.

8.3 VENTILATION SHAFTS

Ventilation shafts are to be provided for the manholes in SWD as shown in drawing. The connecting pipe from manhole to ventilating shaft should be DI K-9 150 mm diameter. A foundation block of 150mm thick PCC in M15 is provided surrounding the pipe. The vertical shaft should be made of ductile iron and it should be around 6 m high above the ground level and the internal diameter of the shaft should be 150 mm. All the dimensions are to be taken as per tender drawing. The joint of pipes forming the ventilating shaft should be made air tight. The location of the ventilating shaft should be such that it should not cause any nuisance to the vehicular traffic and the movement of pedestrians. The placing of ventilating shaft should be as per the directions of Engineer in charge. The details of fixing the ventilating shafts are provided in the drawing given in the tender document.

8.4 NEW HOUSE CONNECTIONS

The new house connections along the side of the storm water drain and the existing sewer connections connected at present to the storm water drain shall be disconnected to the storm water drain and be connected to the newly replaced sewer. While doing so the contractor has to

dismantle the storm water drain for the new connection. After properly connecting the above connections to the new replaced sewer, contractor shall reconstruct all the broken storm water drains and the rate for making the new connections shall Also, include the rectification of storm water drains. If the numbers of connections are more in a particular stretch contactor shall put a rider main along the side of storm water drain and connect it to the nearest D/S manhole. Separate payment will be made as per Bill of Quantities for the rider main. Therefore, the contractor shall inform the Engineer well in advance about the new connections or existing connections to the Engineer and the Engineer's decision for above two alternatives shall be final and binding on the contractor.

8.5 CONCRETE CRADLES, HAUNCHING, ETC.

The concrete cradles shall be constructed in situ by the contractor, indicated in the drawings, in places wherever required as decided by the Engineer.

Notes

If any damage is caused to the other services such as water supply pipeline, sewer, cable etc. during the construction of manholes Contractor shall be held responsible for the same and shall replace the damaged services at his own cost to the full satisfaction of the Engineer.

The interior of manholes shall be cleared of all debris after construction and before testing the same for water tightness by Contractor at his own cost.

Water for testing of manholes along with pipeline shall be arranged by Contractor at his own cost.

CHAPTER 9
SPECIFICATION FOR FRC MANHOLE COVERS

9.1 SCOPE

Contractor's scope includes the design, manufacture, supplying and fixing the FRC manhole frame and covers. The wet concrete mix is subjected to pressure applied through a hydraulic jack through a plunger kept at the top of the wet mix. The FRC manhole covers shall be able to resist 35 tonnes load bearing capacity. The thickness of the heavy duty manhole covers shall not be less than 10.5 cm. A 25x3 mm thick MS Flat all around the frame is welded to the main reinforcement of the frame so as to get a clear opening of 600 mm diameter. An 18 SWG MS strap all around the cover and lifting arrangement of 12 mm diameter MS bars welded to the main reinforcement are Also, to be provided for lifting the manhole covers. A coat of epoxy paint shall be applied to the underside and sides of the frame and cover.

GENERAL

a) The quality of materials, method of testing shall be approved by the Engineer in Charge.

b) The Engineer shall have the right to inspect the source/s of material/s, the layout and procurement, the equipment, quality control system, testing of material etc. If the Engineer desires the sample of the FRC cover or materials used for the manufacture of FRC covers, test certificate from approved laboratory. Then the contractor shall arrange the same without any extra cost.

MATERIAL

a) Cement

Unless otherwise specified in the specification or called for the engineer, cement shall be ordinary Portland cement as per the relevant IS code. More details are mentioned on the section of concrete under this tender document.

b) Fine aggregates

The details of this have been mentioned in the section concrete and allied works of this tender document.

c) Coarse aggregate

Coarse aggregate for concrete, shall conform to IS 383. This shall consist of crushed stone and shall be clean and free from elongated flaky or laminated pieces, adhering coating, clay lumps, coal residue, clinkers, slag, alkali, mica, organic matter or other deleterious matter, The maximum size of the aggregate shall be 12 mm .

d) Water

Water for use in concrete and curing shall conform to IS 456/1964 and its subsequent amendments.

e) Water/cement ratio

The water-cement ratio shall *be 0.40 to 0.45 to* yield a good workability. The workability can be increased by using appropriate admixtures.

f) Fiber Reinforcement

The fibres are cut from 0.40 mm Dia high tensile steel wires of about 12000 kg/cm2 ultimate stress. The fibre content for the manufacture of FRC covers is of the order 1 to 1.25% by volume of the concrete.

g) Design Mix

The vendor shall design the mix design of the concrete which is expected to give a concrete compressive strength of about 350 kg/cm^2 at 28 days.

h) Mixing

Concrete shall be mixed in a mechanical mixer. Mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency.

i) Placing and Compaction

The reinforcement shall be placed in proper position in steel moulds coated with a thin layer of mould oil. Concrete shall be filled to slightly overfill the moulds and compacted by vibration and struck off level with a trowel.

Use of needle vibrators for compacting the wet concrete mix containing fibres is not recommended since the holes left by the vibrator in the wet mix may not close after its removal owing to interlocking of the fibres with the mix. Compaction by means of shutter or form or table vibrators is recommended. In case of extra heavy duty and heavy duty cover frames, compaction by means of pressure cum-vibration technique may Also, be employed so as to achieve dense and strong concrete. Clear cover to reinforcement shall be not less than 15 mm. After de-moulding, cover frames shall be protected until they are sufficiently hardened to permit handling without damage.

j) Curing

The hardened concrete manhole cover frame shall be placed in a curing water tank or taken to the curing yard where they shall be kept continuously moist for at least 28 days. Frames

may be water cured by immersion in water, covering with water saturated material or by a system of perforated pipes. Mechanical sprinklers or any other approved method that will keep covering frames moist during the specified curing period. Steam curing of manhole cover frames may be adopted instead of method specified above provided the requirements of pressure or non-pressure steam curing are fulfilled and the manhole cover frames meet the requirements specified in this section.

k) Edge Protection and Finishing

The top and inside surface of cover frames shall be smooth. To prevent the top outer edge from possible damages, it shall be protected by 25 mm x 3 mm mild steel flat as part of the frame. Sufficient number of steel connectors shall be welded to the inner surface of the mild steel flat so as to connect it with the frame reinforcement and these shall be embedded in the

concrete during casting. Exposed surface of mild steel flat shall be given suitable treatment with anticorrosive paint or coating. Suitable arrangements may be made for fixing the manhole cover frames in position on the manholes by mutual agreement between the manufacturer and the purchaser.

l) Physical requirements
GENERAL

All the frames shall be sound and free from cracks and other defects which interferes with the proper placing of the units or impair the strength or performance of the units. Minor chippings resulting from the customary methods of handling and transportation shall not be deemed ground for rejection.

m) Dimensions

The inside dimensions at top shall match with the corresponding covers so that the maximum clearance at top between the frame and the cover is not more than 5 mm and the top surface of the frame and cover is in level within a tolerance of .± 5 mm.

h) Scale of Sampling
LOT

In a consignment 500 precast concrete manhole cover frames or a part thereof, of the same type and dimensions and belonging to the same batch of manufacturer, shall be grouped together to constitute a lot For ascertaining conformity to the materials in the lot to requirements of this specification, samples shall be tested from each lot separately. The number of cover frames to be selected from the lot shall depend on the size of lot and shall be according to the following table::

SCALE OF SAMPLING AND PERMISSIBLE NUMBER OF DEFECTIVES

No. of cover Frames in the Lot Dimensional Requirement

	Sample Size	Acceptance Number
Up to 100	10	1
101 to 200	15	1
201 to 300	20	2
301 to 500	30	3

CHAPTER 10

RCC SOCKET SPIGOT NON-PRESSURE PIPES

10.1 GENERAL

RCC NP3 and RCC NP4 class pipes shall be used as per the requirement. These pipes shall be in accordance with the specifications mentioned in IS:458-2003 and its Amendments.

MATERIALS

For pre-cast reinforced concrete pipes, materials complying with the requirements given in (i) to (v) shall be used.

i) Cement

Cement used for 1000mm and above size RCC NP3 pipes shall be manufactured with OPC grade 53 grade and conforms to 12269:1987 (RA2004).

Cement used for up to 900mm size RCC NP3 pipe should be manufactured with Sulphate resistant cement and conforms to IS12330:1988 (RA2005)

ii) Aggregates

Aggregates used for the manufacture of reinforced concrete pipes shall conform to IS:383;1970. The maximum size of aggregate should not exceed one third the thickness of the pipe or 20 mm, whichever is smaller.

iii) Reinforcement

Reinforcement used for the manufacture of the reinforced concrete pipes shall be mild steel Grade I or medium tensile steel bars conforming to IS: 432 (Part1):1982(RA2004)' or hard drawn steel wire conforming to IS 432 (Part 2) or structural steel (standard quality) bars conforming to IC 2062.

iv) Concrete or Mortar

The quality and design mix requirements of concrete (concrete mix, maximum water-cement ratio, minimum cement content, etc) used for the manufacture of reinforced cement concrete pipes and collars shall conform to IS: 456-2000 for at least very severe environment exposure condition and shall Also, be in accordance with Concrete and Allied works Section of Technical Specifications. In case of pipes cast by spinning process, higher cement contents, more fines and higher water-cement ratio may be the need of the process.

The concrete for non-pressure pipes shall have a minimum compressive strength of 35 N/mm2 at 28 days. If mortar is used, it shall have a minimum cement content of 450kg/m^3 and a compressive strength not less than 35 N/mm2 at 28 days.

Compressive strength tests shall be conducted on 15 cm cubes in accordance with the relevant requirements of IS:456-2000 and IS:516-1959.

The manufacturer shall give a certificate indicating the quantity of cement in the concrete mix.

v) Rubber Ring

Rubber ring chords used in pipe Joints shall conform to Type 2 of IS:5382-1985.Rubbers rings shall be tested
and approved before usage.

vi) The pipes shall be provided either with High Alumina Cement or Poly Urea internal lining to protect from
corrosion thus ensuring long life.

10.2 DESIGN

i) General

Reinforced concrete pipes either spun or vibrated cast shall be designed such that the maximum tensile stress in the circumferential steel due to specified hydrostatic test pressure does not exceed the limit of 125 N/mm^2 in the case of mild steel rods, 140 N/mm^2 in the case of hard-drawn steel wires and high strength deformed steel bars and wires.

The barrel thickness shall be such that under the specified hydrostatic test pressure, the maximum tensile stress in concrete, when considered as effective to take stress along with the tensile reinforcement shall not exceed 1.5 N/mm^2 for non-pressure pipes. The barrel wall thickness shall be as per IS:458-2003.

Longitudinal reinforcement shall be provided to ensure rigidity and correct location of cages (grids) longitudinally and to limit the effects of transverse cracking. Minimum longitudinal reinforcement shall be as given in respective tables of IS:458.

ii) Reinforcement

The reinforcement in the reinforced concrete pipe shall extend throughout the length of the pipe and shall be so designed that it may be readily placed and maintained to designed shape and in the proper position within the pipe mould during the manufacturing process. The circumferential and longitudinal reinforcement shall be adequate to satisfy the requirements specified under (i).

The pitch of circumferential reinforcement shall be not more than the following:

a) 200 mm for pipes of nominal internal diameter 80 to 150 mm,
b) 150 mm for pipes of nominal internal diameter 200 to 350 mm, and
c) 100 mm for pipes of nominal internal diameter 400 mm and above.

The pitch shall Also, be not less than the maximum size of aggregate plus the diameter of the reinforcement bar used.

The quantity and disposition of steel in pipes may be decided by mutual agreement between the KMC and the supplier; However, it shall be proved by calculations and tests that the quality of the pipes conforms to all the requirements specified in the standard. In the absence of calculations and tests, the reinforcement given in the respective tables of IS:458 shall be used as minimum reinforcement.

If so required by the KMC, the manufacturer shall give a certificate indicating the details relating to quality, quantity and dispersion of steel in the pipes as well as the clear cover to the steel provided in the pipe.

i) Ends of Pipes

Dimensions of spigot and socket for rubber ring roll on jointed pipes shall be as given in the respective tables of IS:458. Reinforcement in socket of rubber ring jointed pipes shall be as given in the respective tables of IS:458-2003.

10.3 MANUFACTURE

i) General

The methods of manufacture shall be such that the form and dimensions of the finished pipe are accurate within the limits specified in this standard. The surfaces and edges of the pipes shall be well defined and true, and their ends shall be square with the longitudinal axis.

ii) Concrete mixing

Concrete shall be mixed in a mechanical mixer. Mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour ad consistency, but in no case shall the mixing be done for less than two minutes. Water-cement ratio shall be less than 0.5.

The concrete shall be placed before setting has commenced. It should be ensured that the concrete is not dropped freely so as to cause segregation. The concrete shall be consolidated by spinning. Vibrating, spinning combined with vibrations, or other appropriate mechanical means.

iii) Reinforcement Cages

Reinforcement cages for pipes shall extend throughout the length of pipe barrel. The cages shall consist of spirals or rings and straight of hard-drawn steel wire or mild steel rod and may be circular. Circular cages and longitudinal reinforcement shall be placed symmetrically with respect to the thickness of the pipe wall. The spirals shall end in a complete ring at both the ends of a pipe.

Pipes having barrel thickness **above 100 mm** shall have double reinforcement cage and the amount of steel in the outer cage shall be 75% of the mass of the inner cage whilst the total shall conform to the requirements specified in the relevant tables of IS 458 : 2003. The total longitudinal steel per pipe shall be given in the relevant tables of the standard but the distribution shall be such that the round shape of the cage is not disturbed.

Diagonal reinforcement may be provided in pipes for which the cages are not welded so as to help in binding the cage securely. It shall, However, be ensured that the clear cover for any reinforcement is not below the limits specified in **6.4 of IS 458.** If diagonal reinforcement is provided, it shall be considered as part of process requirement and shall not be counted against the longitudinal reinforcement and spiral reinforcement. Single reinforcement cage shall be located near the inner surface of the pipe with adequate clear cover.

iv) Water Curing

Pipes manufactured in compliance with this standard shall be water cured for a period of not less than 2 weeks in case of pipes made from ordinary Portland Cement or Portland slag cement or Portland Pozzolana cement or hydrophobic Portland cement, and not less than 1 week in case of pipes made from rapid-hardening Portland cement or 53 grade ordinary Portland cement. Pipes may be water-saturated material or by a system of perforated pipes, mechanical sprinklers, porous hose, or by any other approved method that will keep the pipe moist during the specified curing period. In the case of large pipe projecting partly above the water level, the projected portion shall be kept wet by any suitable means.

10.4 DIMENSIONS

10.4.1 Pipes

The internal diameter, wall thickness, length of pipes, minimum reinforcements and strength test requirements for different classes of pipes shall be as specified in the respective tables of IS 458. The manufacturer shall inform the exact Rat .of the effective length of spigot and socket that he is able to supply.

10.4.2 Tolerances

The following tolerances shall be permitted:

Sr. No.	Dimensions	Tolerances
i)	Overall Length	: ± 1% of Standard Length.
ii)	Internal Diameters of Pipes	
a)	Up to end including 300mm: ± 3 mm	
b)	Over 300mm and up to and including 600mm : ± 5 mm	
c)	Over 600mm : ± 10mm	
iii)	Barrel Wall Thickness	
a)	Up to end including 30mm	: +2mm :-1mm
b)	Over 300mm and up to and including 50mm	: +3mm : -1.5mm
c)	Over 50mm and up to and including 65mm	: +4mm :-2mm
d)	Over 65mm and up to and including 80mm	: +5mm :-2.5mm
e)	Over 80mm and up to and including 95mm	: +6mm :-3mm
f)	Over 95mm	: +7mm :-3.5mm

Note :

In case of pipes with flexible rubber ring joints, the tolerance on thickness near the ends will have to be

reduced. Near the rubber ring joints, the tolerance on thickness shall be as given in Tables 13 to 19 of IS:458.

10.5 WORKMANSHIP AND FINISH

i) Finish

Pipes shall be straight and free from cracks except that craze cracks may be permitted The ends of the pipes shall be square with their longitudinal axis so that when placed in a straight line in the trench, no opening between ends in contact shall exceed 3 mm in pipes up to 600 mm diameter (inclusive), and 6 mm in pipes larger than 600 mm diameter

The outside and inside surfaces of pipes shall be dense and hard and shall not be coated with cement wash. The inside surface of pipe shall be smooth. For better bond the inner surface of the collar may be finished rough.

The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding.

Pipes shall be free from local dents or bulges greater than 3.0 mm in depth and dents and bulges shall not be extending over a length in any direction greater than twice the thickness of barrel.

Pipes may be repaired, if necessary, because of accidental injury during manufacture of handling and shall be accepted if in the opinion of the KMC, the repairs are sound and appropriately finished and cured, and the repaired pipe conforms to the requirements of this specification.

ii) Deviation from Straight

The deviation from straight in any pipe throughout its effective length, tested by means of a rigid straight edge as described in IS 3597 shall not exceed, for all diameters, 3 mm for every meter run.

10.6 TESTS, SAMPLING, INSPECTION and MARKING

All RCC S/S Non-pressure pipes are to be tested, for the numbers/scale of sampling and inspected and clearly marked as per the relevant clauses (10, 11 and 12) in IS:458-2003.

10.7 TRANSPORT AND HANDLING OF PIPES AND OTHER MATERIALS

The specification for transport and handling of pipes shall conform to IS:783-1985 unless otherwise specified.

a) The R.C.C. pipes, base plates, manhole frames and covers, bolts and nuts, clamps etc., shall be transported by the contractor for laying and construction work at the respective sites of work at his own cost.
b) It is essential to transport, handle and lay the pipes, materials, etc in such a manner as not to cause damage. In lorry/truck shipments, the pipe shall be supported in wide cradles of suitably padded timbers hollowed out on the supporting surface to fit the curvature of pipe, and all chains, calves, or other equipment used for fastening the load shall be carefully padded. For smaller diameter pipes, sand or saw-dust filled bags may be used instead of hollowed out timbers. Pipes shall not

be thrown down from the lorries/trucks nor shall that be dragged or rolled along hard surfaces. Slings of canvas or equally nonabrasive materials of suitable width or special attachment shaped to fit the pipe ends shall be used for lifting and lowering pipes so as to eliminate the risk of damage,

c) Great care shall be taken in handling the pipes right from the first operation until they are laid and jointed. The contractor shall be responsible for any loss or damage to the pipes and other materials.

10.8 PERMISSION TO LAY PIPE, CONCRETE

When any portion of the excavation shall have been carried down to the necessary depth, the contractor shall obtain permission from the Engineer before commencing the laying of pipes or concrete.

10.9 LAYING AND JOINTING OF SEWERS

a) The specification for laying and jointing of RCC pipes shall conform generally to I.S,783-1985 and amendments thereon.

b) These specifications cover the work of laying all RCC pipe lines, underground and above ground, including all civil works required for the same.

(a) The contractor shall manufacture the pipes for a length of maximum 500 m at a time. All these pipes should not be conveyed to the site at a stretch, Contractor shall carefully convey and stack the pipes along the side of the road at every two manhole lengths only. and this should not affect the traffic and pedestrians.

10.10 LAYING AND JOINTING OF R.C.C. PIPES

a) Before commencing the work of pipe laying the contractor shall study the longitudinal section and other relevant details of the pipe line for the section/reach concerned. Pedestals/ cradles to be provided for shall be constructed before commencing the pipe laying work in any section, If the pipes are required to be wholly encased in concrete encasement of the pipes shall be done as per the method decided by the Engineer.

b) The contractor should check all pipes, rubber rings and other materials beforehand and satisfy himself and intimate, the department if any defects are noticed or if the quality is found to be not to standard.

c) All pipes shall be carefully handled and lowered into the trench by means of proper methods of handling. The pipes shall be handled by flat rubber belts.

d) Socket should face the opposite to the direction of flow. Pipe shall be normally laid so that spigot end enters the socket face. The socket and spigot ends of the pipe shall be cleared of all extraneous matter specially of clay and grease. Rubber ring shall be clean and dry.

e) All the pipes shall be laid perfectly true both in line and grade specified in the drawings. the rubber rings shall be kept evenly positioned on the spigot groove and when satisfied that the pipe and rubber ring are correctly positioned, the pipe shall be forced/pushed well right home of the full depth of the joint by means of uniformly applied pressure with the aid of a jack or similar appliance. The rubber ring shall conform to 1S:53821985. Inside the joint, the two pipe ends shall be in close proximity. Properly fitted temporary wooden stoppers shall be provided and constantly used to close the ends of all in completed pipe lines.

f) Bailing or pumping out of water from trench including shoring, strutting and removing slush while laying, jointing and testing shall be done by the contractor. Caving, sliding, under pinning, floatation are some of the features to be kept in view by the contractor and he shall take all required/necessary special precautions during the course of execution. The contractor shall see that water will not be allowed to accumulate in open trenches, where work is in an incomplete stage. Precautionary works such as blank-flanging the open ends of the pipe line shall be taken up at the contractor's account and no separate payment will be made for the same. Should any section of the pipe line float during the contract period, the entire cost of laying it again to the correct line and level shall be to the account of the contractor.

g) Blank flanges

Blank flanges shall be provided at all ends left unattended for the temporary closure of work. At the end of a day's work, Also, suitable closures shall invariably be provided at the open end or ends to protect the pipe line from ingress of sub-soil water, mud, muck, debris, dust etc.

h) Wherever pipe laying work is done from two faces and/or has to be done in broken stretches due to any difficulty met with at site, to carry out final connection, the contractor should take all special precautions such as maintaining the levels, grades, alignment keeping in view the length of pipes. If any mistake or error occurs, the contractor shall relay the entire stretch at his cost. Any losses or damages either to pipes or other material thereupon shall be at the contractor's expense and necessary recoveries shall be made.

i) Precautions against floatation

When pipeline laid underground or above ground in a long narrow cutting gets submerged in water collected in the trench or cutting, it is subjected to an uplift pressure due to buoyancy and is likely to float, completely or partly empty. In the design of pipelines, provision is made to safeguard against floatation by providing sufficient overburden or by providing sufficient dead weight by means of anchor blocks.

In the case of the work extending into the monsoon season, However, special care and precautions are necessary during the progress of work on this account. The work of providing anchor blocks and refilling the trenches to the required level and compacting the same etc. shall always be done as soon as the pipeline has been laid.

The contractor shall see that water will not be allowed to accumulate in open trenches, where work is in an incomplete stage, precautionary work such as blank-flanging the open ends of the pipeline

and filling the pipeline with water etc. shall be taken as directed by the Engineer. Such works shall be to the contractor's account and no separate payment will be made for the same. Two metres over burden shall be maintained at all times. Where this overburden is not available, anchor blocks have to be provided.

Protection of pipeline against floatation during the contract period shall be the responsibility of contractor. Should any section of the pipe line float due to their negligence etc, the entire cost of laying it again to the correct line and level shall be to his account.

10.11 METHODS OF MEASUREMENT

1. For manufacture, supply and delivery of pipes, measurement shall be taken for actual number of pipes multiplied by the standard length.
2. Manholes shall be measured per manhole as provided in the Bill of Quantities.
3. Laying and jointing of pipes and specials and valves will be measured in linear meters along the centre line of the pipes actually laid, jointed and tested and will be limited to the number of pipes x standard length + part length of pipe if any. The rate shall include the cost of rubber ring.
4. Anti floatation blocks, pedestals and any other concrete structures shall be measured volumetric ally (cum.).

10.12 SPECIFICATION FOR SULPHATE RESISTANCE CEMENT PIPES AND HIGH ALUMINA CEMENT LINED PIPES

10.12.1 GENERAL

Pipes up to and including 900mm Dia should be manufactured with Sulphate Resistant (SR) Cement confirming to IS: 12330-1988.

Pipes up to and including 900mm Dia shall be lined with 12mm thick high alumina cement with SR cement. The main purpose of using High Alumina Cement for lining is to protect the pipe against sulphate attacks when it is used in sewer lines.

The normal proportion of the mix shall be as follows:

1. High Alumina cement one part- as per IS:6452.
2. Granite dust passing through I.S. sieve 150 micron-one part
3. Fine aggregate passing through I.S. sieve 1.18 mm as per I.S.383
4. Water cement ratio of the lining mix shall not be more than 0.35 and shall be sufficient to ensure maximum density.

10.12.2 PROCESS OF MANUFACTURE

The pipes shall be made by spinning process. The centrifugal force generated by spinning action will force the concrete against the mould, removing excess resulting in a dense concrete.

The mix for High Alumina cement lining shall be mixed in small separation mixer.

All the ingredients shall be weighed. As soon as the spinning of pipe is completed, the cement mortar shall be fed into the rotating mould uniformly and the pipe shall be spun until the cement mortar is set.

10.12.3 PRECAUTION TO BE TAKEN FOR HIGH ALUMINA LINING

1. It is not desirable to mix and do the lining in high constant temperature (temperatures more than 40 C). Hence, it is advisable to manufacture the pipe when temperature is lower than 40C.
2. Stream curing should not be used for curing pipes.
3. The high alumina lining shall be kept moist and cool for the first 24 hours. The curing of lining shall be started after 3 to 4 hours after operation.
4. The water cement ratio of the lining shall not be more than 0.35

10.13 RCC PIPES WITH PVC LINING / VITRIFIED CLAY TILES ELEMENTS / POLYMER/ POLYUREA LINING

10.13.1 Manhole/Chamber Protective Lining

(a) The Inside of manholes/chambers shall be lined with approved Polymer or Polyurea lining as indicated in the drawings. Where specified, the entire manholes and chambers shall be lined with Polymer or Polyurea lining.

(b) The Contractor shall take all necessary measures to protect the Polymer or Polyurea lining from being damaged during installation and shall make good any damage arising thereof The Engineers in charge may order a test be carried out to detect any holes in the PVC/Polyurea lining.

(c) Only pipes manufactured and lined to the satisfaction of the Engineers in charge are acceptable. Minor defects may be repaired with approval of the Engineers-In charge but each defect must be made good to the complete satisfaction of the Engineer in Charge who reserves the right to reject any pipe (or pipes) which in his opinion do not comply with this Specification and the required standard.

TABLE- A - PHYSICAL PROPERTIES

Property	Allowable Standard	Method
Tensile Strength	Longitudinal : 17.25 Mpa Transverse : 17.25 Mpa	ASTM D 638

Elongation at break	Longitudinal : 225% Transverse 225%	ASTM D 638
Hardness	54-62	Din 535.5
Permanence	0.4%	ASTM D 1203
Water Absorption	0.1%	ASTM D570
Water soluble matter	0.05%	ASTM D 570
Porosity	No pin holes	Spark Tester 7 KV

TABLE- B - CHEMICAL PROPERTIES

Chemical Agents		Test Method	Change in Weight Not more than
Sodium Hypo-Chloride	1%		0.20%
Ferric Chloride	1%		0.60%
Sodium Chloride	5%		0.15%
Sulphuric Acid	20%	ASTM	0.12%
Nitric Acid	1%	D 543	0.20%
Sodium Hydroxide	5%	(7 days at	0.10%
Ammonium Hydroxide	5%	20C)	0.40%
Soap & Detergent Solution	2%		0.40%

10.13.3 PVC Lining inside RCC pipes
NOT USED

10.13.4 Polymer/ Polyurea Linings

(a) Drawings and details indicating method of manufacture, lining, etc., together with test certificates of physical, chemical and biological properties of the Polymer/ Polyurea shall be submitted for Engineers in charge's approval prior to manufacturing of any pipe.

(b) The liner must be continuous and free of pinholes both across the joints and in the liner itself. All work for and in connection with the installation of the lining in concrete pipe and structure, and the field sealing and welding of joints, will be done in strict conformity with all applicable specifications, instructions, and recommendations of the lining manufacturer.

(c) Applicator Qualifications:

1) Submit the name and experience record of the coating applicator in similar application.

2) Include list of utility or industrial installations coated, responsible officials, architects, or engineers concerned with the project and the approximate contract price.
3) Submit application along with spray machine / equipment list of applicator.

(d) Inspect the surface and correct all deficiencies prior to the application of each coat.

(e) All coating products, liner material and all accessories as recommended by the manufacturer shall be supplied by the same Manufacturer at no additional cost to the Employer. The manufacturer shall submit experience record of product in similar application.

(f) Comply with all Government laws or ordinances, as well as all applicable codes, standards, regulations and/or regulatory agency requirements including:
1) ACI 515.1R, A guide to the use of Waterproofing, Damp proofing, Protective, and Decorative Barrier Systems for Concrete.

2) WPCF Manual of Practice No. 17, Paints and Protective Coatings for Wastewater Treatment Facilities. Guide and Paint Application Specifications.

(g) Only pipes manufactured and lined to the satisfaction of the Engineers in charge are acceptable. Minor defects may be repaired with approval of the Engineers-In charge but each defect must be made good to the complete satisfaction of the Engineer in Charge who reserves the right to reject any pipe (or pipes) which in his opinion do not comply with this Specification and the required standard.

(h) Approved Polyurea linings should not be less than 1.5mm thickness. Thickness shall be measured by using Ultrasonic thickness measuring instrument. Randomly destructive test shall be conducted for measuring thickness by the Engineer.

TABLE- A - PHYSICAL PROPERTIES

Sr. No.	Property	Allowable Standard	Method
1	Type	Pure Polyurea	
2	Mixing Ratio	1:1	
3.	Tensile Strength		
a)	New Material	> 18 Mpa	ASTM D-412
b)	After ageing for 40 years life	>18 Mpa	
3.	Elongation at break		
a)	New Material	>360%	ASTM D-412

b)	After ageing for 40 years life	>360%	
5.	Hardness	>45	ASTM D2240
6.	Abrasion resistance	<15mg loss	ASTM D 4060
7.	Tear Strength	70-75KN/M	ASTM D 624
8.	Chemical Resistance		
a)	HCl 10%	No Effect	ASTM D 543
b)	H2S04 10%	No Effect	ASTM D 543
c)	NaoH 30%	No Effect	ASTM D 543
9.	Adhesion: Concrete	>2.00Mpa (Concrete Failure)	ASTM D 4541
10.	Water Absorption	0.17%	ASTM D 570
11.	Porosity	No pin hole	
12	Dry to touch	20 to 30 Seconds	
13	Return to service	2 Hours	

10.13.5 Poly Urea Lining inside RCC pipes

a. Reinforced concrete pipes of diameter 1000mm and above (including 1000mm Dia) are to be lined with Poly urea lining of minimum thickness of 1.5 mm.

b. In the event of the Poly urea lining being damaged during the construction of the sewer, the whole pipe shall be replaced entirely at the Contractor's expense.

c. On completion of the laying, and jointing, the Contractor will be required to carry out a detailed inspection and test of the Poly urea lining in the presence and to the satisfaction of the Engineer in charge.

CHAPTER -11

PIPE JACKING

11.1 PIPE JACKING

General

(a) Where required, sections of the pipeline shall be laid by pipe jacking. The Contractor shall engage a professional having experience in Trenchless Technology to design and be responsible for the supervision of the construction of the jacking pits.

(b) Plans and details of the equipment, materials and the method of construction to perform and complete the work shall be submitted by the Contractor and must be approved by the Engineer in charge before commencing these operations. Approval of the Engineer in charge shall not relieve the Contractor of his sole responsibility for the efficacy, reliability, soundness of the method employed in completing the work in a satisfactory manner.

(c) It shall be the responsibility of the Contractor to satisfy himself as to the soil conditions along the pipe jacking route and if he judges it to be necessary, he shall carry out soil investigations at his own cost.

(d) It shall be the responsibility of the Contractor to maintain stable soil conditions at the jacking face to prevent loss of ground above the jacking operation and movement of the surrounding earth. The methods of maintaining face stability and preventing ground movement and subsidence shall be by means of compressed air or other plenum methods where fluid slurry or earth pressure is applied to the tunnel face. Alternatively, unstable ground ahead of the jacking face may be stabilised by the injection of suitable chemicals. Methods which require dewatering of the ground will not be accepted, nor will methods which may lead to significant ground loss. The Contractor's proposal must be submitted to the Engineers in charge for his approval.

(e) It is the Contractor's responsibility in ensuring that the pipe jacking machines are installed and removed at the designated launching and receiving pits. In the event that any additional pits need to be installed to either remove any obstruction at the face of the jacking machine, failure of jacking of machine or for any other reason, the Contractor shall bear all cost incurred in constructing the jacking pits and reinstating the ground to the original condition, subject to the approval of the relevant authority e.g. BMP, BDA, Police and the satisfaction of the Engineers in charge.

(f) Movement or settlement of structures, utilities and pavement shall be monitored by the Contractor during the jacking operation and reported to the Engineers in charge. If movement or settlement occurs which, in the opinion of the Engineer in charge may cause damage, the Contractor shall take immediate action to prevent further movement, settlement or damage. The Contractor shall repair at his own cost any damage and restore structures or pavements to the satisfaction of the Engineer in charge. Any damage to utilities during the execution shall be rectified by Contractor on his own cost.

(g) The Contractor shall be responsible for inspecting the location and familiarising himself with the conditions under which the work will be performed and with all necessary details as to the orderly execution of the work. The omission of any details shall not relieve the Contractor of full responsibility for the satisfactory installation of the work in its entirety. No monetary or other claims made by the Contractor on the grounds of want of knowledge will be entertained by the Board.

(h) The Contractor shall co-operate and shall have proper understanding about other contract packages of S2 components

(i) The Contractor shall have to work with a mutually agreeable Bench Mark under other contract packages of S2 components.

(j) The Contractor shall have to liaison with other utility agency like WRD, Railways, Police, PWD, CSPDCL, BSNL and other private users to get proper permissions for the required work.

(k) The Contractor shall be paid as per BOQ i.e. per running meter basis. This includes the cost of all the activities, material, items, investigation works, precautionary measures during execution including change in the approved methodology etc. There is no separate or addition payment.

Pipes for Jacking

(a) The pipes for jacking operation shall be MS pipe of 2500 mm Diaoras specified by the Clientor as directed by the Engineer in charge. The carrier pipe of RCC NP3 pipe of 1800mm Dia will be laid inside the MS pipe with proper joining & slopes as per specification & drawings.
(b) The supply of pipes shall be in accordance with the Specifications.

11.2 PRECAST REINFORCED CONCRETE PIPES (CARRIER PIPE)

(a) The precast reinforced concrete pipes shall be manufactured by a centrifugal or other equivalent process to be approved by the Engineer in charge. Design, manufacture and factory testing of the pipes and specials shall be to as per IS 458 (Latest Revision) and BS 5911-I (Latest Revision). The clear cover of concrete over steel reinforcement shall not be less than 50 mm.

(b) All pipes except for those less than 900 mm diameter shall be manufactured with two sets of grout holes. Each set shall consist of three grout holes spaced at 120 on centres circumferentially located at the quarter points from either end of the pipe. Two of these grout holes shall be at the soffit of the pipe.

(c) The strength of the pipes shall be tested by the three edge bearing test. When subjected to the design load in such a test, the maximum crack width developed on the pipe shall not exceed 0.25 mm. All such tests shall be carried out at the expense of the contractor.

(d) The contractor shall submit full details of his proposals for the pipes, giving detailed drawings showing sizes, reinforcement and type of joints, calculations, together with the name of the proposed manufacturer, the place of manufacture, and the manufacturing processes to the Engineers in charge

for approval. All workmanship and materials used in the manufacture shall be subject to the approval of the Engineers in charge who shall from time to time be permitted to inspect materials at source and the manufacturing processes in the factory.

(e) The pipes shall be sufficiently matured before they are used in the construction of the works. They shall be handled with extreme care to prevent the edges of the pipes from chipping. Repaired pipes shall not be allowed for use in the contract. The Engineers in charge may reject any pipes he considers not suitable for the works and these rejected pipes shall be removed from the site immediately. After factory testing and before despatch, every pipe and special shall be marked in accordance with the standard used. In addition, each pipe shall be marked with a number corresponding with the order of manufacture. Test certificates from the manufacturers or other relevant authority shall be submitted to the Engineers in charge.

(e) Where steel collars are used for pipe joints, it shall be made of weldable structural steel Grade 430 with minimum yield strength of 275 N/mm^2 as specified in Table 2 of BS 3601. The collars shall be of dimension and thickness to be approved by the Engineers in charge. Before fitted to the pipes, the collars shall be coated with approved anti-abrasive and anti-corrosive materials such as polymorphic resin or equivalent. Joint seals shall be manufactured from EPDM, complying with the requirement of BS 7874 (Latest Revision).

(f) Where steel shield is utilised during the jacking operation, this steel shield shall be bolted to or by other approved means joined to the first piece of pipe which is being jacked.

(g) All the loading conditions during installation state and operation state to be submitted for the design review. Contractor shall submit the design of pipes for Engineers approval. Pipe shall be designed in accordance with the following standards (Latest Revisions):

IS: 456	Plain and Reinforced Concrete - Code of Practice
IS: 458	Precast Concrete Pipes (with and without Reinforcement)– Specification
IS: 3370	Code of practice for concrete structures for the storage of liquids: (Part-
BS: 5911-I	Concrete pipes and ancillary concrete pipes, specification for unreinforced and reinforced pipes (including jacking pipes) and fitting with flexible joints
IS: 2062	Steel for general structural purposes
IS: 10748	Hot-rolled steel strips for welded tubes and pipes

Jacking Ring and Frame

(a) The Contractor shall be required to use a jacking ring. The jacking ring may be either of steel or concrete construction and shall be used at all times when a pipe is being jacked. This jacking ring will allow the jacking pressure to be distributed evenly around the wall of the pipe.

(b) The Contractor shall Also, be required to use a jacking frame during all operations. The jacking frame shall be designed to distribute the stresses from the jacks evenly to the jacking ring.

Jacking Operations

(a) The Contractor shall be fully responsible for the materials, equipment and facilities required in conjunction with jacking the concrete pipe.

(b) Before starting work, the Contractor shall submit to the Engineers in charge for approval, a detailed schedule of the entire jacking operation. Approval of such schedule shall not relieve the Contractor of his responsibility to provide a fully satisfactory installation. The Contractor shall be required to include with his submission evidence that he has successfully completed a jacking installation using procedures similar to those proposed.

(c) Where chemical stabilization of soil is used, a chemical grout shall be pressure injected into the soil over and ahead of the pipe jacking to stabilise the soil. The chemical grout used shall have a demonstrated history of success for stabilizing soils similar to that through which the pipe is to be jacked.

(d) Where a mechanical shield is used, the Contractor must provide proof that the particular model of shield has been used successfully in soils similar to that on the site. The crew for the operation of the shield must be specialist, with experience in the use of that particular type of machine.

(e) After the jacking operations has begun, the Contractor may have to work continuously (24 hours per day) if required and directed by the Engineers in charge until the complete length of jacked pipe is installed.

(f) The pipes shall be jacked into place, true to line and level. The maximum tolerance allowable in the displacement of the centreline of the laid pipe from the design centreline is 50 mm in the horizontal plane and 15 mm in the vertical plane but there shall be no back fall at any point. Any pipe which is not laid in its correct position must be removed and re-laid or adjusted to obtain its correct position.

(g) For precast reinforced concrete pipes, there shall be provision to prevent the relative movement between pipes at the joints by the use of steel gaiters or other approved methods during jacking operation. A packing piece of compressible material shall be provided at each joint and shall be securely held before the pipes are lowered into the thrust pit. Details of proposals shall be submitted to the Engineers in charge for approval.

(h) The Contractor shall be required to furnish and install and remove to the extent required, thrust blocks or whatever provisions that may be required for backing up the jacks employed in driving the pipe forward. The jacking pit shall Also, be equipped with steel rails or beams embedded in

concrete. These rails or beams will be used for placement and alignment of each pipe during the jacking operation.

(i) The Contractor shall be fully responsible for the design and construction of the jacking and receiving pits, thrusting wall, installation of jacking equipment, sheeting, bracing etc. and for the efficient execution of the jacking operation. Full details of the proposals, including plant, shield machine, equipment, operating procedures, jacking pit and intermediate jacking stations etc, shall be submitted to the Engineers in charge and shall be fully satisfactory to him before construction work begins. However, review of the plans shall not relieve the Contractor from his responsibility to provide a safe and satisfactory jacking pit.

(j) The Contractor shall be required to monitor closely the progress of the jacking operation. Daily site records of thrusting pressures and the line and level measurements shall be properly maintained and shall be available to the Engineers in charge at all times.

(k) It is the responsibility of the Contractor to ensure that the complete "tunnels" are watertight. If leakage occurs before completion or during the maintenance period, the Contractor shall carry out any remedial work that may be necessary to make the Works watertight all at his own expense. Contractor shall carry out the hydraulic testing as per IS 458 (Latest Revision).

(l) Contractor shall follow all safe working practices according to IS-4756 (Latest Revision) and BS-6164 (Latest Revision).

Cement Grouting

(a) The Contractor shall be fully responsible for preventing the occurrence of voids outside the pipe and if they occur he shall fill them with cement grout.

(b) Immediately following the jacking operation, the Contractor shall pressure grout the jacked section to fill all voids existing outside the pipe.

(c) Systems of standard pipe, fittings, hose, and special grouting outlets embedded in the pipe walls shall be provided by the Contractor. Care shall be taken to ensure that all parts of the system are maintained free from dirt. Grout composed of cement, sand and other approved compound and water shall be forced under pressure into the grouting connections at the invert and shall proceed until grout begins to flow from upper connections. Connections shall then be made to these holes and the operation continued to completion.

(d) Apparatus for mixing and placing grout shall be of a type approved by the Engineers in charge. It shall be capable of mixing effectively and stirring the grout and then forcing it into the grout connections in a continuous uninterrupted flow.

(e) After grouting is completed, pressure shall be maintained by means of stop cocks, or other suitable devices until the grout has set sufficiently. After the grout is set, grout holes shall be completely

filled with dense concrete and finished neatly without evidence of voids or projections.

11.3 Methods of Construction - Break-Outs from Shafts and Tunnels

(a) For the junctions of tunnels and shafts the Contractor shall submit, for the Engineer In charge's agreement a method statement describing the details of the work, with drawings and calculations.

(b) Tunnel and shaft linings shall not be broken out until all necessary temporary works, including ground treatment, where appropriate, have been completed to ensure the structural and geotechnical stability of the works.

(c) Temporary supports shall not be removed until so agreed by the Engineer in charge and the work for which they are required has been completed and the structure is capable of carrying the imposed loads. Once junction work is commenced it shall be completed as expeditiously as practicable.

(d) The break-out shall be of sufficient dimensions to accommodate the permanent structure to be built. Working space shall be kept to the minimum dimensions practicable.

(f) The break-up for a tunnel shall enable the construction of a stable initial length of an adequate tunnel lining, built within the specified construction tolerances.

(g) Ground improvement or other acceptable means shall be provided at shaft break-outs and break-ins as required to prevent instability of the ground as the sewer excavation exits or enters a shaft and elsewhere as required.

(h) The Contractor is deemed to have included in their price the cost of the interface with other contract including any ground improvement required to allow the access to the shaft or for the pipe jacking machine to be recovered as part of the works. The contract interface works are deemed to include shaft break-in or shaft breakout.

11.4 Limits of Surface Settlement

The method of jacking adopted by the Contractor shall be such that the initial surface settlement measured directly above the front face of the shield during the jacking operations do not exceed 25 mm and the maximum surface settlement after the tail voids are grouted shall not exceed 50 mm. Subsequently, the ground shall be reinstated to the original level notwithstanding, for the sections of pipeline near to sensitive structures, crossing under all roads along the route of the pipeline and paved area, the Contractor shall be required to incorporate in his jacking method measures to arrest the expected settlements so as to safeguard the integrity of the structures and road surfaces at all times. The Contractor shall ensure that the operational functions of these sensitive structures and traffic flows along all roads are not affected in any way by his work.

11.5 Shafts

Shafts - General

a) The working shaft shall be used for the construction of a manhole/chamber. The Contractor to construct the Jacking & Receiving pit as a permanent structural in RCC which would be served as a manhole during operation. The Jacking pit/Receiving pit would be converted into the manholes with necessary modifications including construction of the top slab, manhole cover frame, pipe benching, CI rungs etc. The Contractor to prepare the design & drawings as per the permanent structure requirements & shall be got it approved from the engineer.

(b) The Contractor shall submit for approval to the Engineers in charge dimensioned Drawings and calculations of the timbering or trench sheeting details for the working shafts. Each working shaft shall have a separate ladder bay for access, which shall be isolated from the part of the shaft used for hoisting materials.

(c) Prior to excavation, the shaft area shall be thoroughly checked for existing utilities and the appropriate measures taken in agreement with the Engineers in charge.

Shafts - Safety

(a) Shafts shall be provided with guard rails or rings at least 1.2 m above the surrounding ground level.

(b) Once sunk to final level, the shafts for regular personnel access shall be equipped with ladders and landings at intervals not exceeding 6 m. Protection shall be so provided that neither ladders, supporting structures, nor persons using them are subject to risk of accident, from the passage of skips, spoil or materials. All ladders are to be secured at the top and bottom.

(c) Should heavy plant and heavy loads have to be located in close proximity to any shaft, the Contractor shall take into account the effects of these loads as well as any ground loads when designing the shaft.

(d) The Contractor shall guard against distortion of shaft lining during construction and the possibility of shaft settlement or uplift at an intermediate stage of construction.

Temporary Shafts

(a) Full details of temporary shafts required by the Contractor's shafts working methods shall be submitted to the Engineers in charge for his agreement. Such shafts shall be adequately sized for all operations required for the execution of the works.

(b) Backfill for temporary working shafts shall comprise material agreed by the Engineers in charge.

(c) Where the Contractor wishes to recover temporary shaft linings the structure shall be removed in safe stages as backfilling proceeds, taking care to maintain the safety and structural integrity of the

remaining lining. No part of temporary works shall be left in the ground within 2 m of the designed final surface level.

Shafts - Construction

(a) Shaft sinking shall be carried out by a method suitable for all the particular circumstances of the site including ground parameters, groundwater, depth and final purpose.

(b) Where work is done by underpinning, only that ground which may be safely excavated for the installation of one ring or one unit of support shall be carried out. Until that depth is properly secured by permanent or temporary shaft lining, no further excavation shall take place. In the case of pre-formed rings securing shall include grouting.

(c) Where work is done by a caisson operation, a cutting edge shall be fitted to the leading ring. The cutting edge shall be maintained at an even level all round during shaft sinking. Jacking arrangements or kentledge shall be adequate for the work. The Contractor's arrangements shall ensure the stability of any kentledge. A lubrication space shall be maintained around the full shaft periphery during sinking.

(d) Concrete walls installed by slurry trench or secant piling techniques shall comply with best practice. The Contractor's proposals shall be submitted to the S.O. for his agreement.

(e) Where pressure compressed air low is used to assist shaft construction, air decks and locks shall be designed by the Contractor to give adequate margins of safety against the air pressures to be used in the shaft. The Contractor's proposals shall be submitted to the Engineers in charge for his agreement.

(f) Full details of temporary works required by the Contractor's method of working for the construction of tunnel or pipe jack eyes in the shaft lining, shall be submitted to the Engineers in charge for his agreement.

(g) Shaft bases shall be concreted. The Contractor shall submit his proposals for the shaft base structure taking account of ground and groundwater forces and sealing the shaft against water entry.

11.6 Mild Steel Pipe Work (Jacking Pipe)

Spiral welded pipes manufactured from HR coils conforming to IS 10748 Grade 3 steel. Plate welded pipes manufactured from plates conforming to IS 2062 Grade B steel.

I. Manufacture of Pipes

- **General**

Steel pipe shall be either plate welded or spiral welded pipe.

The pipes shall be truly cylindrical, and straight in axis. The ends shall be accurately cut and prepared for field welding. The external circumference of the pipe pieces which are to be fixed adjacent to flange adapter with fixed outer diameter shall not deviate from theoretical one by more than 2 mm.

Any pipe or part thereof which develops injurious defects in the opinion of Engineer shall be rejected and shall be replaced by new pipe at Contractor's expense.

II. Plate Welded Pipes

All pipes and specials shall be manufactured out of mild steel plates conforming to IS 2062 Grade B steel. The procedure of cutting plates to size, rolling of plates, post bending, tack welding, internal and external welding, facing should be such that it results in pipes of required diameter and thickness conforming to IS 3589, or equivalent or better international standards.

III. Spiral Welded Pipes

All spiral welded pipes shall be manufactured as per IS 5504. The requirements for weldable hot-rolled carbon steel strip in coils should conform to IS 10748 Grade 3. The process of manufacture should be such that it results in pipes conforming to IS 3589/IS 5504 or equivalent international standards.

Demonstration

Contractor shall make necessary arrangements to demonstrate at the pipe manufacturing mill individual items of work before commencement of works and during the works at intervals specified and as directed by the Engineer. No payment shall be made in this regard.

The works under demonstration shall include

(i) Manufacture of pipe and specials
(ii) Chemical and mechanical testing of pipes and specials
(iii) Machine and manual welding to qualify 'Welding Procedures'
(iv) External coating
(v) Cement mortar lining
(vi) Hydraulic testing after cement mortar lining at 12 bar pressure

Tolerances

Tolerances for pipes shall be in accordance with IS: 3589 except for the following.
Negative tolerance on pipe wall thickness is not permissible.
The permissible tolerances for specials for diameter, arm length and angular deviation shall be in

accordance with IS 7322/BS 534

Welding

Upon receipt of the order and prior to the start of works, the Contractor shall submit to the Engineer for his approval the 'Welding Procedure Method Statement' he intends to use for the field welding.

All components of pipe shell; either straight or bent etc. shall be welded by use of automatic arc welding machine by submerged arc process with alternating current. The strength of the joint shall be at least equal to that of the parent material. Manual welding shall be adopted only when machine welding is not possible. The Contractor shall use electrodes of approved make and size, the size depending on the thickness of plate and the type of joint. Standard current and arc voltage required for the machine shall be used with necessary modifications as may be found necessary after experimental welding. For this purpose, samples of welded joints shall be prepared and tested in the presence of the Engineer for qualifying the Welding Procedure Method Statement. Only approved welding procedures shall be used throughout the work and if any modifications are to be made, the written permission of the Engineer shall be obtained.
All the shop and field welding shall conform to IS 4353, IS 9595 and IS 816.
All longitudinal / spiral and circumferential joints shall be Single-V or Double-V butt joints with or without backing plates. After completing the welding joints of pipes or plates from one side, and before the welding on the other side, the joints shall be back chipped/ gouged and ground to remove irregular penetration till the even surface is exposed. Gouging shall be resorted to when the plate thickness is above 6 mm.

All circumferential welds involving plates of unequal thickness shall be so kept that the inside surface of plates match to provide stream lined joints without alteration in the internal diameter.

The welding shall be of the best workmanship free from weld defects. In order to maintain a good standard in welding, welders shall be tested by the Contractor before they are entrusted with the job. Qualification standard for welding procedures, welders and welding operators shall conform to IS: 7307 and IS: 7310 (latest). Only those who pass the test shall be allowed to work on the job. Periodical tests as regards their competence shall Also, be taken at suitable intervals and those found incompetent shall be removed from the job. If an incompetent welder has already welded some pipes, all welding done by him previously shall be fully checked by X-ray in addition to the regular X-ray inspections. The defects if any shall be rectified to the satisfaction of the Engineer. All such check tests and rectification of defects shall be entirely at the cost of the Contractor. No pipes or steel sections shall be erected unless the work of the welder concerned has been proved to be satisfactory and qualified. Site welds shall be done by welders qualified for the various welding positions as per applicable IS codes and standards.

A record shall be maintained showing the names of welders and operators who have worked in each individual joint. Manual arc welding shall preferably be carried out by a pair of welders so that, by observing proper sequence, distortion can be avoided. A joint entrusted to a particular individual or a pair shall be as far as possible, completed by them in all respects, including sealing run. No helper or other unauthorised person shall be permitted to do any welding whatsoever.

The weldment should not become brittle or sensitive to blows and there should be no loss of toughness due to welding or heat treatment. The material after welding and heat treatment shall match with the base metal

properties including original ductility. The weld should in no point be less than the nominal thickness of plate. A slight reinforcement as per IS codes shall be maintained on all weld joints. Final welding of closure gaps should be carried out within a temperature range of average air temperature 8^{o} C.

- **Radiograph of welded joints**

Soon after welding, each longitudinal / spiral and circumferential welded length, the minimum length of the weld at random for each pipe shall be radiographed to detect welding defects, as per the requirements of IS 4853 and as directed by Engineer. This sampling will be at random to ensure 100% coverage of junctions of longitudinal / spiral and circumferential joints. If the results of such radiography fail to conform to the requirements, the Contractor shall carry out at his expense 100 % radiography test for the pertinent pipe as directed and fully satisfying the Engineer.

The percentage breakdown of radiography is as follows:

Pipes and Specials manufactured at Mill / Factory - 10%
Field joints welded at site - 5%

The weld ripples or weld surface irregularities and slag etc., on both inside and outside shall be removed by any suitable mechanical process to a degree such that resulting radiographic contact due to any remaining irregularities cannot mark or be confused with that of objectionable defect. The radiograph shall be made in strict accordance with the latest requirements and as per the latest and most efficient technique either with X-ray or gamma ray equipment.

The radiographs are to be marked in such a way that the corresponding portion of the welded seam and the welder can be readily identified. All radiographs will be reviewed by the Engineer to identify the defects and determine those which requires rectification. Defects that are not acceptable shall be removed by chipping, grinding or flame gouging to sound metal and the resulting cavities shall be welded. After rectification, the joint is to be radiographed again to prove the quality of the repair. The radiographs will be judged as acceptable or unacceptable by the Engineer based on the latest standards prescribed by relevant Indian Standard specification.

All X-rays shall be taken with equipment and by personnel of the Contractor. Films shall be developed within 24 hours of exposure and be readily accessible at all times for inspection by the Engineer. The Contractor shall provide for the use of the Engineer suitable X-ray viewing equipment. X-ray films shall be properly maintained by the Contractor. A complete set of radiographs and records as described in IS: 2595, for each job shall be retained by the Contractor. All films shall be identified by the number and chart prepared indicating location of any work associated with the pipe erection and such inspection shall be performed by the Radiographer at the discretion of the Engineer.

Hydraulic Pressure Test at Pipe Manufacturing Mill

A hydraulic test shall be carried out at the mill for each pipe length fabricated. All pipes and specials shall be subjected to hydraulic test after fabrication, but before application of protective coatings and linings.

Prior to testing, the pipe shall be inspected thoroughly and all the apparent defects in welding such as slag,

porosity etc. shall be repaired by gouging and re-welding.

Each pipe shall be filled with water slowly and the pressure increased uniformly until the required test pressure is reached. The test pressure shall be as follows:
MS pipes and fittings – 12 bars.
The pipe to be tested shall be given a serial number which shall be painted with details such as pipe number, shell thickness, diameter, length etc. It shall be entered in the register to be maintained by the Contractor. The register shall be maintained in suitable format giving the following information for each shell tested:

a) Serial No.
b) Pipe No.
c) Date of test
d) Specification, diameter and wall thickness
e) Weight of pipe shell tested
f) Maximum test pressure
g) Details of test performance
h) Name of Engineer's representative witnessing tests

A copy of these details shall be furnished to the Engineer

For indicating the pressure inside the pipe an accurate pressure gauge of approved make duly tested and calibrated for the accuracy of readings shall be mounted on one of the closures which close the pipe ends.

The pressures shall be applied gradually by approved means and shall be maintained for at least 10 minutes or till the inspection of all welded joints is done during which time the pipe shall be hammered throughout its length with sharp blows, by means of a 1 kg. hand hammer.

The pipe shall withstand the test without showing any sign of weakness, leakage, oozing or sweating. If any leak or sweating is observed in the welded joints, the same shall be repaired by gouging and re-welding done after dewatering the pipe. The repaired pipe shall be re-tested to conform to the specified pressure.

If any leak or sweating is observed in pipe shell the pipe under test shall be rejected. The Engineer shall be supplied with two copies of the results of all the tests carried out.

No pipe shall be transported from the mill to the site and laid unless they have been hydraulically tested.

Tests and Inspection

The Contractor should submit results of inspection and testing covering the following in a suitable proforma, at the time of delivery of pipes in accordance with IS 3589/IS 5504. In case of discrepancy

between the requirements of the above standards the more stringent conditions shall apply. Each pipe shall

be subjected to mechanical and hydraulic tests as per IS 3589 and the corresponding test certificates shall be furnished along with. The test specimen shall exhibit mechanical and chemical properties not lower than those specified for IS 2062 Grade B/IS 10748 Grade 3 steel. The tests should Also, include determination of yield strength, tensile strength, elongation and bend tests. Tensile tests shall be carried out in accordance with IS 1894 on a test specimen provided from each lot of 100 lengths of pipe. Guided bend tests shall be carried out in accordance with IS 3589/IS 3600. One bend test shall be carried out from each lot of 50 lengths. The tests shall comply with the requirements specified in IS 3589/IS 3600.

The Contractor shall submit the following:

- pipe manufacturing process
- grade of pipe
- chemical composition – product analysis
- jointers
- tensile test report
- flattening test report
- weld test reports
- hydrostatic test report
- bend test report
- radiography report
- weld test report

The Contractor should notify the Engineer, in advance of the procurement of materials and fabrication in order that the Employer may arrange for mill and shop inspection (including third party inspection). The cost of tests including third party inspection shall be at Contractor's expense. The Engineer in his opinion may reject any or all materials or work that does not meet with any of the requirements of this specification. The Contractor shall rectify or replace such rejected material/performed work at his own cost to the satisfaction of the Engineer. The Engineer has the right to have the material tested independently to confirm the quality of the works.

The Contractor shall supply free of cost required specimen of materials for testing by the Engineer at any time during the progress of work and shall bear the cost of such tests or retests to the satisfaction of Engineer.

No separate payment will be made for any of the inspection and tests mentioned above and the rates for the items concerned shall be deemed to have been included in Contractor's item rates.

Mechanical Tests

The test plates shall be subjected to all mechanical tests as per the approved Method Statement, or as otherwise reasonably directed by the Engineer. Tests shall be carried out in accordance with relevant standards. The tests shall include determination of yield strength, tensile strength, elongation and bend tests. Tensile tests shall be carried out in accordance with IS 1894. One test plate shall be provided for from each lot of 100 lengths

If a test specimen shows defective machining or develops flaws not associated with welding, it may be discarded and another specimen submitted. The welded joint shall exhibit mechanical and chemical

properties not lower than those specified for IS 2062 Grade B.

Guided Bend test shall be in accordance with IS 3589 /IS 3600. One bend test shall be carried out from each lot of 50 lengths. The test shall comply with the requirements specified in IS 3589/IS 3600.

The field welded joints shall be tested in accordance with the procedure laid down in IS 3600. One test plate shall be taken for every 10 joints and shall be subjected to mechanical and chemical tests as specified above.

Re-tests

If the results of tests of any lot do not conform to the requirements specified, retests of two additional specimens from the same lot shall be made, each of which shall conform to the required specifications. In case of a failure of one or both, gouging and repairing shall be carried out to the particular lot of joints from which the samples have been taken as directed by the Engineer before the lot can be accepted. The rectification process Also, shall have adequate test plates and they shall be tested for compliance with the IS codes/standards.

In case both the samples yield satisfactory results in the re-test described above, gouging and repairing will be required to be carried out on the joint which has failed in the initial test only.

All charges in connection with re-testing of the welded samples including machining, testing etc. shall be borne by the Contractor.

Marking

All pipes and specials shall be carefully marked for identification in the field. The marking shall be on the side which will be the inside of the pipe after bending. The marking operation shall be conducted with full size rulers and templates with suitable paints.

The following information shall be clearly mentioned on each pipe and special.

Manufacturer's name with his registered trademark
Pipe / special with its serial number
Process of manufacturer and type of steel
Outside diameter (mm)
Pipe wall thickness (mm)
Length of pipe / angle of bend (in degrees)
Date of manufacture of pipe and special
Test pressure

After the hydraulic tests on the specials the direction of flow shall be stamped in a prominent manner.

Transportation, Handling, Stacking and Inspection

- **General**

All pipes and specials manufactured at the mill shall be transported to the site of laying after cleaning them

internally, etc. Vehicles on which pipes are transported shall have a body of such length that the pipes do not overhang. Pipes should be secure during transit. To ensure that laying of pipes is not held up at any time, the Contractor shall maintain an adequate stock of standard specials, flange rings, plug plates, manhole covers and short length of smaller diameter pipelines at site in his field stores in consultation with the Engineer. Whenever possible, the Contractor shall arrange one full month's requirement of pipes, specials, etc. stacked suitably along the alignment. All gaskets, nuts and bolts flange adaptors and other similar items shall be stored in dry conditions, raised off the ground in sheds or covered areas. Until required for incorporation each rubber ring or gasket shall be stored away from windows, electrical equipment and other materials like oil and chemicals and Also, from heat and cold. Where items require special storage requirements, the method of storage shall be to the approval of Engineer and in accordance with manufacturer's requirements. Storage areas shall be set out to facilitate unloading, loading and checking of materials. End covers and other protection shall not be removed until incorporation of the pipes or fittings into the Works. The Contractor shall provide 2 (two) sets of accurate 'Go" and 'No Go' ring gauges to measure the diameter of pipes, specials and fitting for the use of the Engineer at no extra cost.

- **Transportation and Handling**

The pipes and specials shall be handled in such a manner as not to distort their circularity or cause damage to their surface. Contractor shall provide temporary props in order to prevent any sagging of the pipes while they are stacked in their yard and while transporting to the site of laying. The props shall be retained until the pipes are laid. Details of proposed propping (strutting) system shall be submitted to Engineer for approval and if required by the Engineer, the method of propping (strutting) shall be demonstrated and tested at site. Valves shall not be lifted by the spindle

Pipe handling equipment shall be maintained in good condition and any equipment which in the opinion of the Engineer may cause damage to the pipes shall be discarded. Under no circumstances shall pipes be dropped, be allowed to strike one another, be rolled freely or dragged along the ground. No defective/damaged pipe shall be used in the works without rectification to the satisfaction of the Engineer. Any damage to the coating shall be repaired by the Contractor at his own cost to the satisfaction of the Engineer.

- **Stacking and Inspection**

The Contractor shall keep a responsible representative to take delivery of pipes, specials and appurtenances, etc., transported from the pipe manufacturing factory or a stock yard. Pipes and appurtenances should be handled, stored and stacked in a suitable manner as directed by Engineer. Padding shall be provided between coated pipes and timber skids to avoid damage to the coating. Gaps must be left between stacked pipes to permit access from one side to the other. The pipes, specials and appurtenances received at site shall be inspected and defects such as protrusions, grooves, dents, notches, damage to the protected coating, etc., shall be pointed out to the Engineer at site and in acknowledgement challans. Such defects shall be rectified or repaired by the Contractor at his expense, to the satisfaction of the Engineer. It will be the responsibility of the Contractor to protect the pipes, specials and other items stacked along the alignment against any possible damages or theft.

External Coating

Unless otherwise specified or stated on the drawings the pipeline of diameter more than 1000 mm to be laid underground and the exposed pipeline supported on saddles shall be cement mortar coated

- **External Geniting**

Cement mortar coating shall be in accordance with IS 1916.

(i) Cement shall be Portland Cement in accordance with IS 8112
(ii) The cement content shall be 600 kg/m^3 and water : cement ratio by mass shall not exceed 0.3:1
(iii) A length of 15 cm at each end of the pipe shall be left ungunited to facilitate site welding. The end faces shall be vertical.

- **Mix Proportion**

Cement mortar shall consist of 3 parts sand to 1 part cement by volume. The water in the mixture shall be carefully controlled so as to attain the required strength and so that the mortar will not run, sag or segregate.

- **Thickness of coating**

The minimum thickness of the coating shall be 25 mm with a positive tolerance of 3 mm and no negative tolerance. Checking of the coating thickness shall be by non-destructive means such as ultrasonic thickness gauge.

- **Surface Preparation**

The surface of all pipes to be coated with cement mortar shall be thoroughly cleaned by hand or by sand steel grit blasting if necessary. After cleaning the external surface of pipe shall be given a coat of cement wash.

All oil and greases on the surface of the metal shall be removed thoroughly by flushing and wiping using suitable solvents and clean rags. The use of dirty or oily rags will not be permitted. All other foreign materials shall be moved by buffing or by scrapping and wire brushing. After cleaning, the pipe shall be protected and maintained free of all oil, grease and dirt that might fall upon from whatever source until the pipe has received its cement mortar coating.

If blasting is necessary, all metal surfaces shall be thoroughly blasted to bright metal. Blasted surface which acquire a coat of rust shall be cleaned/reblasted as directed by the Engineer

- **Reinforcement**

Reinforcement for the coating shall comprise of 50 x 50 x 3 mm wire mesh conforming to IS 566 and 8 mm dia. bar to IS 1786. The mesh sheets shall overlap each other by a minimum of 100 mm and be tied with mild steel wire at 200 mm intervals. The reinforcement shall be held off the pipe wall by a series of 10 numbers equally spaced 8 mm Dia reinforcement bars which shall run the full length of the coating. Clear cover to the reinforcement shall be in accordance with IS 1916.

- **Application**

The pressure in the lower chamber of 'Cement Gun' shall be sufficient to produce a nozzle velocity of 115 to 150 m/sec when a tip with 19 mm opening is used. The compressor used shall be of an adequate capacity to maintain a pressure of at least 2.8 kg/cm^2 at the gun end. The nozzle shall be held at such a distance (65 to 100 cm) and position so that the stratum of flowing materials shall impinge as nearly as possible at right angles to the surface being gunited. All deposits of loose sand shall be removed prior to placing any layer of gunite. Gunite shall be shot in one coat to the specified thickness. Every precaution shall be taken to prevent the formation of sand pockets and if any develop, they shall be cut out and replaced with satisfactory machine placed material. No hand patching will be allowed. The Contractor shall apply the coating in such a manner that no sloughing shall occur at any time during or following its application.

Gunite shall be placed in the top and sides of the pipe, then screeded to a uniform thickness and the ground lines or blocks removed. All rebound and waste materials shall then be removed by air blowing and gunite placed in the bottom of the fittings and screeded. When completed, the coating shall be concentric with the barrel of an even thickness. The entire surface shall then receive a final flash coat of gunite and shall be steel towelled to a true surface equal in smoothness to the spun lining in such a manner not to impair the bond between mortar and steel plate. The guniting and surface finishing shall complete in set and shall be applied continuously without the use of construction joints. In case, for any reason whatsoever, the cement does not adhere to the walls of pipes and sloughs off, swabbing the pipe with cement slurry shall not be permitted.
If for any reason it is necessary to interrupt the placing of the gunite for a length of time that will result in the material taking a permanent set, a square shoulder shall be formed at the ends of the sections and/or elsewhere by shooting against a back or by working with a trowel or other suitable tools the irregular edges of the material last placed to a clean unbroken surface face perpendicular to the pipe that will provide a suitable connection or construction joint between such material and the material to be placed subsequently. When performing this work care shall be taken not to shatter or

disturb the material remaining in place or disturb the embedded wire mesh. Before placing fresh material against the surface of such joints, they shall be carefully cleaned and wetted to ensure a good bond between the fresh material and that previously applied.

The ungunited portion at the ends of the pipe lengths left for the purpose of field welding shall be coated with M15 concrete by hand after the field welding and hydraulic testing are completed.

- **Curing**

After the mortar has set, but not later than twelve (12) hours after application of the coating, curing shall be

commenced. Coating shall be kept continuously moist and in the shade for at least 14 days.

- **Inspection**

Pipe coatings shall be inspected prior to transports, to laying site and broken, defective or otherwise unsatisfactory areas may be rejected at any time during construction. All defective areas shall be made good to the satisfaction of the Engineer. Coating cracks over 0.25 mm wide or over 500 mm long shall be made good.

- **Tests**

Compressive strength test of concrete shall be conducted on 150 mm cubes in accordance with IS 516. The number of tests shall be at least 4 cubes for each age and each water cement ratio for each days work. The concrete mix shall have a minimum characteristic compressive strength of 25 N/mm^2 at 28 days.

- **Fiber Reinforced Coal Tar Enamel Coating**

Unless otherwise specified or stated on the drawings the pipeline of diameter 1000 mm and less to be laid underground and the exposed pipeline supported on saddles shall be externally coated with Fiber Reinforced Coal Tar Enamel at pipe manufacturing mill.

CHAPTER -12
RESTORATION OF ROADS

12.1 DEFINITIONS

The words like Contract, Contractor, Engineer (synonymous with Engineer-in-charge), Drawings, Employer, Government, Works and Work Site used in these Specifications shall be considered to have the meaning as understood from the definitions of these terms given in the General Conditions of Contract.

The following abbreviations shall have the meaning as set forth below:

MOSRTH	: Ministry of Shipping, Road Transportation and Highways
IRC	: Indian Roads Congress
IS	:Indian Standard published by the Bureau of Indian "Standards
GSB	: GRANULAR SUB BASE
WMM	: WET MIX MACADAM
BM	: BITUMINOUS MACADAM
BC	: BITUMINOUS CONCRETE
CBR	:California Bearing Ratio
AASHTO	: American Association of State Highway and Transportation Officials
ASTM	:American Society for Testing and Materials
BS	:British Standard published by the British Standards Institution

12.2 APPLICABLE CODES AND SPECIFICATIONS

The following specifications, standards and codes are referred to in this part.

IS : 460 (Parts 1 to 3) : Specification for Test sieves

IS : 1077 : Common burnt clay building bricks - Specification

IS : 1124 : Method of test for determination of water absorption, apparent specific gravity and porosity of Aggregates / stones

IS : 1195 : Specification for Bitumen Mastic for Flooring

IS : 1196 : Code of Practice for Laying Bitumen Mastic Flooring

IS : 1834 : Specification for Hot Applied Sealing Compounds for Joints in Concrete

IS : 2386 : Methods of test for aggregates for concrete (Parts 1 to 8)

IS : 2720 : Method of Test for Soils for determination of Liquid and plastic limit. (Part 5)

IS : 6241 : Method of test for determination of stripping value of road aggregates.

IRC : 16 : Specification for priming of Base Course with Bituminous Primers.

IRC : 17 : Tentative specification for Single Coat Bituminous Surface Dressing

IRC : 19 : Standard specifications and code of practice for water bound macadam

IRC : 29 : Specification for bituminous concrete (Asphaltic Concrete) for road pavement.

Table 12.1: Compaction requirement for Subgrade

MOSRTH

Specifications : Ministry of Shipping, Road transportation and Highways Specifications for Road and Bridge works

SECTION-101: GENERAL

SECTION-301 : EARTHWORK
SECTION-401 : GRANULAR SUB BASE
SECTION-502 : WET MIX MACADAM
SECTION-504 : BITUMINOUS MACADAM
SECTION-509 : BITUMINOUS CONCRETE

12.3 ROAD RESTORATION CONFIGURATION

On laying of water lines / sewer lines in the trenches, the roads shall be restored to it's original condition in layers as per Drawing(Refer Standard drawings Volume 4) over the back fill as per concerned sections of MOSRTH

Technical specification:

a). Backfill over the water lines / sewer lines to the desired level as per drawing and specification.

b). Approved soil compacted in layers as per drawing, using soil deposited at site from road cutting and excavation to achieve compaction level Table 300-2 and Section 301 of MOSRTH Technical specification.

c). Layer of sand / stone dust as per drawing to achieve 97% relative compaction of laboratory dry density to meet requirement of table 300-2 of MOSRTH specification.

d). Granular Sub base as per section 401 of MOSRTH specification.

e). Wet mix macadam (WMM) as per section 502 of MOSRTH specification.

f). Bituminous macadam (BM) as per section 504 of MOSRTH specification.

g). Bituminous concrete (BC) as per section 509 of MOSRTH specification.

12.4 MATERIALS

12.4.1 General

All materials shall be obtained from local sources and shall conform to technical specifications and be subject to Engineer's approval prior to use.

12.4.2 Approved soil for Subgrade / Embankment

The materials used in embankments, subgrades and miscellaneous backfills shall be soil, moorum, gravel, a mixture of these or any other material approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability

of the embankment/ subgrade.

The Contractor shall carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the backfill/restoration works without contamination by the unacceptable materials. The acceptable materials shall be stockpiled separately.

It shall be ensured that the subgrade material when compacted to the density requirements as in **Table 5.1** (As per Table 300-2 of MOSRTH specification) shall yield the design CBR value of the subgrade.

(As per Table 300-2 of MOSRTH Specification)

	Type of work/material	**Relative compaction as % of max. lab dry density as per IS: 2720 (Part 8)**
1	Subgrade and earthen shoulders	Not less than 97
2	Embankment	Not less than 95

The Contractor shall at least 7 working days before commencement of compaction submit the following to the Engineer for approval:

i) The values of maximum dry density and optimum moisture content obtained in accordance with IS: 2720 (Part 7) or (Part 8), as the case may be, appropriate for each of the fill materials he intends to use.

ii) A graph of density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum moisture content were determined.

iii) The Dry density-moisture content - CBR relationships for light, intermediate and heavy compactive efforts (light corresponding to IS: 2720 (Part 7), heavy corresponding to IS: 2720 (Part 8) and intermediate in-between the two) for each of the fill materials he intends to use in the subgrade.

Once the above information has been approved by the Engineer, it shall form the basis for compaction.

12.4.3 Granular Sub base

The material to be used for the work shall be natural sand, moorum, gravel, crushed stone, or combination thereof depending upon the grading required. Materials like crushed slag crushed concrete, brick metal and kankar may be allowed only with the specific approval of the Engineer. The material shall be free from organic or other deleterious constituents and conform to grading-iii given in **Table 5.2: Gradation for coarse graded granular Sub base.**

(As per Table 400-2 of MOSRTH Specifications).

The CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions, which shall be taken as being the density relating to a uniform air, voids

content of 5 per cent.

Table 12.2: Gradation for coarse graded granular Sub base.

(As per TABLE 400– 2 of MOSRTH Specification)

IS Sieve	**Percent by weight passing the IS Sieve**		
Designation	**Grading I**	**Grading II**	**Grading III**
75.0 mm	100	-	-
53.0 mm		100	
26.5 mm	55 – 75	50 - 80	100
9.50 mm			
4.75 mm	10-30	15-35	25-45
2.36 mm			
0.425 mm			
0.075 mm	<10	<10	<10
CBR Value(Minimum)	30	25	20

Note : The material passing 425 micron (0.425 mm) sieve for all the three gradings when tested according to IS : 2720 (Part 5) shall have liquid limit and plasticity index not more than 25 and 6 per cent respectively.

12.4.4 Coarse Aggregates

Coarse aggregate, stone chippings shall consist of natural or crushed stone, clean, hard, tough, durable and free from excess of flat, elongated, soft and disintegrated particles, dirt, salt, alkali, vegetable matter, adherent coatings, organic and other objectionable matter, and shall conform to the physical requirements given in **Table 5.3** and **Table 5.4** hereunder, as applicable. Aggregate for bituminous wearing courses shall in addition have good hydrophobic properties i.e. capacity of retaining the film of bituminous material applied to the stone in all weather conditions and especially in wet conditions. Basalt, dolerites are good in this respect; granite, quartzites are comparatively poor.

Table – 12.3 : Physical Requirements of Coarse Aggregate for Wet Mix Macadam (WMM)

Sl. No	Test	Requirements	Test Method
1.	Los Angeles Abrasion Value* Or	40 percent (max.)	IS:2386 (Part – IV)
	Aggregate Impact Value*	30 percent (max.)	IS:2386 (Part – IV) Or

			IS:5640***
2.	Flakiness Index **	15 percent (max.)	IS:2386 (Part I)

(*) Aggregate may satisfy requirements of either of two tests.

(**) Requirements of flakiness index shall be enforced only in case of crushed broken stone.

(***) Aggregates like brick, metal, kankar, laterite etc., which get softened in presence of water shall be tested for impact value under wet conditions in accordance with IS: 5640.

Table – 12.4: Physical Requirements of Aggregates for Bituminous macadam (BM)

Sl.No.	Test	Requirements	Test Method
1.	Los Angeles Abrasion Value* Or Aggregate Impact Value*	40 percent (max.) 30 percent (max.)	IS:2386 (Part – IV) IS:2386 (Part – IV)
2.	Flakiness Index **	35 percent (max.)	IS:2386 (Part I)
3.	Stripping Value	25 percent (max.)	IS:6241
4.	Water Absorption	2 percent (max.)	IS:2386 (Part-III)
5.	Soundness Loss with Sodium Sulphate – 5 cycles Loss with Magnesium Sulphate – 5 cycles	 12 percent (max.) 18 percent (max.)	 IS:2386 (Part-V)

(*) Aggregate may satisfy requirements of either of two tests

(**) Requirement of flakiness index shall be enforced only in case of crushed broken stone

12.4.5 Murum/Kankar/Gravel

Murum shall contain low plasticity binder material mixed with hard granular particles such as sand and/or gravel. Murum shall be sound and hard of a quality not affected by weather, to be screened at the quarry and free from all impurities. Large lumps shall all be broken at the quarry and murum delivered at site must pass in every direction through a 63 mm ring. Murum shall not contain more than 5% to 8% of fines passing a 75 micron sieve.

Gravel shall be composed of large, coarse, silicious grains, sharp and gritty to the touch, thoroughly free from dirt, organic and deleterious matter. It shall be hard, tough, dense and shall not contain particles bigger than 12 mm and more than 10 percent silt.

12.4.6 Sand / Stone Dust

The sand / Stone dust shall consist of clean, hard, strong and durable pieces of crushed stone, crushed gravel, or a suitable combination of natural sand, crushed stone or gravel. They shall not contain dust,

lumps, soft or flaky, materials, mica or other deleterious materials in such quantities as to reduce the strength and durability of the concrete, or to attack the embedded steel. Motorised sand washing machines should be used to remove impurities from sand. Fine aggregate having positive alkali-silica reaction shall not be used. All fine aggregates shall conform to IS: 383 and tests for conformity shall be carried out as per IS: 2386, (Parts I to VIII). The Contractor shall submit to the Engineer the entire information indicated in Appendix A of IS: 383. The fineness modulus of fine aggregate shall neither be less than 2.0 nor greater than 3.5. The Sand used shall be coarse, sharp, gritty, clean, granular material. Only material passing through 4.75 mm sieve and retained on 75 micron sieve shall be used. The sand / Stone dust / fine aggregates shall conform to grading requirement in Table 5.5

Table 12.5 : Gradation requirement of Sand / Fine aggregates
(As per Table 1000-2 of MSORTH Specifications)

IS Sieve Size	Per cent by Weight Passing the Sieve		
	Zone I	Zone II	Zone III
10 mm	100	100	100
4.75 mm	90-100	90-100	90-100
2.36 mm	60-95	75-100	85-100
1.18 mm	30-70	55-90	75-100
600 micron	15-34	35-59	60-79
300 micron	5-20	8-30	12-40
150 micron	0-10	0-10	0-10

12.4.7 Bituminous Materials

Bituminous materials shall conform to IS: 73, IS: 215, IS: 217 or IS: 454 as applicable and be of the grade specified.

Table 12.6: Physical requirements of coarse aggregates for Bituminous concrete (BC). (As per TABLE 500-17: MOSRTH specifications)

PROPERTY	TEST	SPECIFICATION
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve.
Particle shape	Flakiness and Elongation Index	Max 30% (Combined)2
Strength*	Los Angles Abrasion Value 3	Max 30%
	Aggregate Impact Value4	Max 24%
Polishing	Polished Stone Value5	Min 55
Durability	Soundness:6 Sodium Sulphate Magnesium Sulphate	 Max 12% Max 18%
Water Absorption	Water absorption7	Max 2%

Stripping	Coating and Stripping of Bitumen Aggregate Mixtures9	Minimum retained coating 95%.
Water Sensitivity**	Retained Tensile Strength8	Min 80%

12.5 EARTH WORK

12.5.1 Earthwork in Excavation

In general, the excavation shall be in accordance to Specifications specified elsewhere.
Profiles of road excavation shall be laid at 50 m intervals or as specified in Drawings to conform to the required alignment, sections, grades and side slopes and the lines of cuts shall be clearly marked. Contractor shall on no account excavate beyond the slopes or below the specified grade unless so approved by the Engineer in writing. If excavation is done below the specified level or outside the section the Contractor shall be required to fill up with approved materials, in layers of 150 to 200 mm, watered and compacted as specified for the subgrade.
The excavation shall be finished neatly, smoothly and evenly to the correct lines, grades, sections as shown in the drawings or approved by Engineer.

12.5.2 Earthwork in Subgrade

The Subgrade shall be formed of approved soil excavated from road trenches and stacked separately. Profiles of subgrade shall be set up with stout poles to mark the centre and edges of the formation with the top levels of formation clearly marked by paint or cut and the slopes with strings and pegs at every 10 metres on straight portions.

Subgrade material shall be placed in successive horizontal layers of 200 mm depth extending to the full width of the Subgrade / trench to allow compaction of the full specified section to 150 mm using mini rollers / tampers / plate vibrators till the soil is evenly compacted to 95% of Proctor density with 2% variation in optimum moisture content. Before placing the next layer of 200 mm the surface of the underlayer shall be moisture and scarified with pick axes or spades to provide a satisfactory bond with the next layer. The next layer shall also be compacted to 150 mm to the full width of the trench section till the soil is evenly compacted to 95% of Proctor density with 2% variation in optimum moisture content.

When boulders, broken stones and similar hard materials are mixed up with the embankment materials

care shall be taken to see that they are distributed uniformly into the bank and that no hollows are left near them. No stone or hard material shall project above the top of any layer. Each layer of embankment shall be watered, levelled, and compacted as specified before the succeeding layer is placed. The surface of the embankment shall at all times during construction be maintained at such a cross fall as will shed water and prevent ponding.

If the soil contains less than the optimum moisture, water shall be added to the loose layers of the subgrade to bring the moisture uniformly up to requirement. If the material contains more than the required moisture it shall be allowed to dry until the moisture is reduced to the required extent. The moisture/dried loose layers shall be compacted with a vibratory roller / mini roller / plate vibrator/ tampers to achieve the desired compaction level of 95% of Proctor density.

12.6 COMPACTION WITH SAND / STONE DUST

In order to achieve better compaction and a compacted surface before laying the GSB layer, two layers of sand / stone dust shall be laid and compacted to 150 mm each.

12.7 PREPARATION OF GRANULAR SUB-BASE (GSB)

Spreading and Compacting: The granular sub base material of **grade-iii** as specified in **Table 5.2: Gradation for coarse graded granular Sub base** (As per Table-2 of Section 401 – MOSRTH Specifications) shall be spread on the prepared sub grade maintaining the required slope and grade during the operation or other means as approved by the Engineer.

When the sub base material consists of combination of materials mentioned in clause 401.21, mixing shall be done mechanically by the mix in- place method.

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small – sized jobs. The equipment used for mix-in-place construction shall be rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work.

Moisture content of the loose material shall be checked in accordance with IS: 2720 (part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 percent above to 2 percent below the optimum moisture content corresponding to IS: 2720 (part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc harrows, rotavators until the layer is uniformly wet.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS: 2720 (part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction

equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re – compacted.

12.8 WET MIX MACADAM COURSE (WMM)

The GSB layer surface over which Wet mix Macadam (WMM) is to be laid 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. WMM. sub-base course of specified thickness shall be provided. The coarse aggregate for this shall conform to requirements in **Table-5.7: Grading Requirements of Coarse Aggregates for Wet Mix Macadam (WMM)** (As per Table 400-11 of MOSRTH Specifications).

Table – 12.7: Grading Requirements of Coarse Aggregates for Wet Mix Macadam (WMM) (As per Table 400-11 of MOSRTH Specifications)

IS Sieve Designation	Percent by weight passing the IS sieve
53.00 mm	100
45.00 mm	95 – 100
26.50 mm	-
22.40 mm	60-80
11.20 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600.00 micron	8-22
75.00 micron	0-8

12.8.1 Preparation of WMM layer

Preparation of mix: Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/positive mixing arrangement like pugmill or pan type mixer of concrete batching plant. For small quantity of wet mix work, the Engineer may permit the mixing to be done in concrete mixers.

Optimum moisture for mixing shall be determined in accordance with IS: 2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted.

Spreading of mix : Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared subgrade /sub- base/base in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.

The mix may be spread either by a paver finisher or motor grader. For portions where mechanical means cannot be used, manual means as approved by the Engineer shall be used so as to achieve

the specified slope and grade. The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. The layer may be tested by depth blocks during construction. No segregation of larger and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

Compaction: After the mix has been laid to the required thickness, grade and crossfall/camber the same shall be uniformly compacted, to the full depth with suitable vibratory roller. The speed of the roller shall not exceed 5 km/h.

12.9 PRIMER COAT

Primer: The choice of a bituminous primer shall depend upon the porosity characteristics of the surface to be primed as classified in IRC: 16. Surface of low porosity; such as wet mix macadam. The primer shall be bitumen emulsion.

Primer viscosity: The type and viscosity of the primer shall comply with the requirements of IS 8887, as sampled and tested for bituminous primer in accordance with these standards. Guidance on viscosity and rate of spray is given in **Table-5.8: Requirement of Viscosity and quantity of Liquid bituminous Primer** (As per Table 500-1 of MOSRTH Specifications).

Table-12.8: Requirement of Viscosity and quantity of Liquid bituminous Primer

(As per Table 500-1 of MOSRTH Specifications).

Type of surface	Kinematic Viscosity of Primer (Centistokes)	Quantity of Liquidat 60°CBituminous per 10 Sq.m(kg) Material
Low porosity	30-60	6 to 9
Medium porosity	70-140	9 to 12
High porosity	250-500	12 to 15

Preparation of road surface: The surface to be primed shall be prepared in accordance with Clauses 501.8 and 902 as appropriate. Immediately prior to applying the primer the surface shall be carefully swept clean of dust and loose particles, care being taken not to disturb the interlocked aggregate. This is best achieved when the surface layer is slightly moist (lightly sprayed with water and the surface allowed to dry) and the surface should be kept moist until the primer is applied.

Application of bituminous primer: The viscosity and rate of application of the primer shall be as specified in the Contract, or as determined by site trials carried out as directed by the Engineer. The bituminous primer shall be sprayed uniformly in accordance with Clause 501 of MOSRTH specifications. The method for application of the primer will depend on the type of equipment to

be used, size of nozzles, pressure at the spray bar and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified. Curing of primer and opening to traffic: A primed surface shall be allowed to cure for at least 24 hours or such other period as is found to be necessary to allow all the volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with an application of sand, using the minimum quantity possible.

12.10 TACK COAT

Over the primed surface, a tack coat should be applied in accordance with Clause 503 of MOSRTH Specifications.

The binder used for tack coat shall be bitumen emulsion complying with IS 8887 of a type and grade as specified in the Contract or as directed by the Engineer.

The tack coat distributor shall be a self-propelled or towed bitumen pressure sprayer, equipped for spraying the material uniformly at a specified rate. Hand spraying of small areas, inaccessible to the distributor, or in narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

The surface on which the tack coat is to be applied shall be clean and free from dust, dirt, and any extraneous material, and be otherwise prepared in accordance with the requirements of Clauses 501.8 and 902 as appropriate. Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

The application of tack coat shall be at the rate specified in the Contract, and shall be applied uniformly. If rate of application of Tack Coat is not specified in the contract then it shall be at the rate specified in **Table-12.9: Requirement of Viscosity and quantity of Liquid bituminous Tack Coat** (As per Table 500-2 of MOSRTH Specifications).

Table-12.9: Requirement of Viscosity and quantity of Liquid bituminous Tack Coat

(As per Table 500-2 of MOSRTH Specifications).

Type of Surface	Quantity of Liquid bituminous material in Kg per sq.m.area
i) Normal bituminous surfaces	0.20 to 0.25
i i) Dry and hungry bituminous surfaces	0.25 to 0.30
i i i) Granular surfaces treated with primer	0.25 to 0.30
i v) Non bituminous surfaces	
v) Granular base (not primed)	0.35 to 0.40
v i) Cement concrete pavement	0.30 to 0.35

The normal range of spraying temperature for a bituminous emulsion shall be 20°C to 70°C and

for a cutback, 50°C to 80°C.

12.11 BITUMINOUS MACADAM

The bitumen shall be paving bitumen of Penetration Grade complying with Indian Standard Specifications for "Paving Bitumen" IS:73.

Aggregate grading and binder content: When tested in accordance with IS: 2386 Part 1 (wet sieving method), the combined aggregate grading for the particular mixture shall fall within the limits shown in **Table-12.10: Composition of Bituminous macadam (BM)** (As per Table 500-4 of MOSRTH Specification) for the grading specified in the Contract. The type and quantity of bitumen, and appropriate thickness, are Also, indicated for each mixture type.

The aggregates shall be proportioned and blended to produce a uniform mixture complying with the requirements of Table 500-4.

Table-12.10: Composition of Bituminous macadam (BM) (As per Table 500-4 of MOSRTH Specification)

Mix designation	Grading 1	Grading 2
Nominal aggregate size	40mm	19 mm
Layer thickness	80 -100mm	50 - 75 mm
IS Sieve (mm)	Cumulative % by weight of total aggregate passing	
45	100	
37.5	90-100	
26.5	75-100	100
19	-	90-100
13.2	35-61	56-88
4.75	13-22	16-36
2.36	4-19	4-19
0.3	2-10	2-10
0.075	0-8	0-8
Bitumen content, % by weight of total mixture[1]	3.1 - 3.4	3.3 - 3.5
Bitumen grade	35 to 90	35 to 90

12.11.1 Preparation of the Base: The base on which bituminous macadam is to be laid shall be prepared, shaped and compacted to the required profile in accordance with Clause 501.8 and 902.3 as appropriate, or as directed by the Engineer.

12.11.2 Preparation and transportation of the Mixture: The provisions of Clauses 501.3 and 501.4 shall apply.

12.11.3 Spreading: The provisions of Clauses 501.5.3 shall apply.

12.11.4 Compaction : Compaction shall be carried out in accordance with the provisions of Clause501.6 and 501.7. The details of mixing, laying and rolling temperature of BM mix is as indicated in

Table-5.11:Manufactring& rolling Temperature of BM mix (As per Table 500-5 of MOSRTH

Specifications)

Rolling shall be continued until the specified density is achieved, or where no density is specified, until there is no further movement under the roller. The required frequency of testing is defined in Clause 903.

Table-12.11: Manufacturing& Rolling Temperature of BM mix

(As per Table 500-5 of MOSRTH Specifications)

Bitumen Penetratio	Bitumen Mixing (°C)	Aggregate Mixing (°	Mixed Material (°C)	Rolling (° C)	Laying (° C)
35	160 - 170	160-175	170 Maximum	100 Minimum	130 Minimum
65	150 - 165	150-170	165 Maximum	90 Minimum	125 Minimum
90	140 - 160	140- 165	155 Maximum	80 Minimum	115 Minimum

The bituminous macadam shall be covered with either the next pavement course or wearing course, as the case may be, within a maximum of forty-eight hours. If there is to be any delay, the course shall be covered by a seal coat to the requirement of Clause 513 before opening to any traffic. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

12.12 BITUMINOUS CONCRETE

This work shall consist of construction in a single layer of bituminous concrete on a previously prepared bituminous macadam (BM) surface.

Bitumen: The bitumen shall be paving bitumen of Penetration grade complying with Indian Standard Specification for Paving Bitumen, IS: 73 and of the penetration indicated in Table 500-18, for bituminous concrete.

The coarse aggregates shall be generally as specified in Clause 507.2.2, except that the aggregates shall satisfy the physical requirements of Table 500-17.

Requirements for the mixture: Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in **Table-12.12: Composition of Bituminous Concrete** (As per Table 500-18 of MOSRTH Specifications) and **Table-5.13: Requirement of Bituminous Concrete** (As per Table 50019: of MOSRTH Specifications).

Per cent air voids	3 - 6
Per cent voids in mineral aggregate (VMA)	See Table 500-12 below
Per cent voids filled with bitumen (VFB)	65 - 75
Loss of stability on immersion in water at 60°C (ASTM D 1075)	Min. 75 per cent retained strength

Table-12.12: Composition of Bituminous Concrete

Grading	**1**	**2**
Nominal aggregate size	**13 mm**	10 mm
Layer Thickness	**35-40 mm**	25-30 mm
IS Sieve[1] (mm)	**Cumulative % by weight of total aggregate passing**	
45		
37.5		
26.5	**100**	
19	**79-100**	100
13.2	**59-79**	79-100
9.5	**52-72**	70-88
4.75	**35-55**	53-71
2.36	**28-44**	42-58
1.18	**20-34**	34-48
0.6	**15-37**	26-38
0.3	**10-20**	18-28
0.15	**5-13**	12-20
0.075	**2-8**	4-10
Bitumen content % by mass of total mix[2]	**5.0 - 6.0**	5.0 - 7.0
Bitumen grade (pen)	**65**	65

Notes: 1. The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.

2. Determined by the Marshall method.
3. Job mix formula shall be generally as specified in Clause 507.3.3 and the results of

Table-12.13: Requirement of Bituminous Concrete

(As per Table 500-19: of MOSRTH Specifications)

12.12.1 Rolling

Immediately after the spreading of mix it shall be thoroughly compacted by rolling with vibratory rollers moving at a speed not more than 5 km per hour. Rolling shall be continued till the mix is thoroughly compacted to meet the general provisions of clauses 501.6 and 501.7.

12.12.2 Opening to Traffic

Traffic shall be allowed on the road after a lapse of minimum 24 hours, preferably 48 hours after laying as approved by the Employer's Representative.

12.13 QUALITY CONTROL OF ROAD RESTORATION WORKS

12.13.1 General

For ensuring the requisite quality of construction, the materials and works shall be subjected to quality control tests, as described hereinafter. The testing frequencies set forth are the desirable minimum and the Engineer shall have the full authority to increase the frequencies of tests as he may deem necessary to satisfy himself that the materials and works comply with the appropriate Specifications.

Test procedures for the various quality control tests are indicated in the respective Sections of these Specifications or for certain tests within this Section. Where no specific testing procedure is mentioned, the tests shall be carried out as per the prevalent accepted engineering practice to the approval of the Engineer.

12.13.2 Tests on Earthwork for Embankment and Subgrade Construction

(i) Sand content [IS:2720(Part IV)]
1-2 tests per 8000 cu. metres of soil

(ii) Plasticity Test [IS:2720(Part V)]
Each type to be tested , 1-2 tests per 8000 cu. metres of soil.

(iii) Density Test [[IS:2720(Part VII)].
Each soil type to be tested, 1-2 tests per 8000 cubic metres of soil.

(iv) Deleterious Content Test [IS:2720(PartXXVII)]

As and when required by the Engineer.

(v) Moisture Content Test [IS:2720(Part II)]
One test for every 250 cubic metres of soil.

(vi) CBR Test on materials to be incorporated in the subgrade on soaked/unsoaked samples [[IS:2720(part XVI)]

One test for every 3000 m^3 at least or closer as and when required by the Engineer.

12.13.3 Compaction control:

Control shall be exercised by taking at least one measurement of density for each 500 square metres of compacted area, or closer as required to yield the minimum number of test results for evaluation a day's work on statistical basis. The determination of density shall be in accordance with IS:2720 (part XXVIII). Test's locations shall be chosen only through random sampling techniques. Control shall not be based on the result of any one test but on the mean value of a set of 5-10 density determinations. The number of tests in one set of measurements shall be 5 as long as it is felt that sufficient control over borrow material and the method of compaction is being exercised. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increased to 10. The acceptance of work shall be subject to the condition that the mean dry density equals or exceeds the specified density and the standard deviation for any set of results is below 0.08 gm/cc.

However, for earthwork in subgrade and in top 500 mm portion of the embankment below the subgrade, at least one density measurement shall be taken for every 100 square metres of the compacted area provided further `that the number of tests in each set of measurements shall be at least 10. In other respects, the control shall be similar to that described earlier.

12.13.4 Tests on Granular Sub base(GSB) and Wet mix macadam (WMM) layers

The tests and their frequencies for the different types of bases and sub-base shall be as given in **Table 12.14**. The evaluation of density results for compaction control shall be on lines similar to those set out in clause 5.10.1.

Table –12.14: Control Tests and their frequencies for Granular Sub base(GSB) and Wet mix macadam (WMM) layer

Sl.No.	Types of Construction	Test	Frequency
1.	Granular sub-base	i) Gradation	One test per 200 m3
		ii) Atterbergs limit	One test per 200 m3
		iii) Moisture content prior to compaction	One test per 250 m2
		iv) Density of compacted layer	One test per 500 m2
			As required
2.	Lime/Cement Stabilised	i) Purity of lime (for lime-soil	One test for each

Sl.No.	Types of Construction	Test	Frequency

		stabilization ii) Lime/Cement content iii) Degree of pulverisation iv) CBR test on a set of 3 specimens v) Moisture content prior to	Consignment subject to a minimum of one test per 5 tonnes of lime. Regularly, through procedural checks. Periodically as considered necessary. As
3	Wet mix Macadam	i) Aggregate Impact Value ii) Grading iii) Flakiness Index iv) Atterberg limits of portion of	One test per 200m^3 of aggregate One test per 100 m^3 of aggregate One test per 200 m^3 of aggregate

Residual life of equipment at the time of handing over after 15 years of O&M period shall be as follows

1. Civil : Min 35 years
2. Mechanical : Min 15 years
3. Electrical : Min. 15 years
4. Diffuser membrane : Min. 7 years
5. Instruments : Min 15 years

12.13.5 Tests on Bituminous Constructions

The tests and their frequencies for the different types of bituminous works shall be as given in **Table-12.15** hereunder.

Table – 12.15: Control Tests and their Frequency for Bituminous Works

Sl. No.	Types of Construction	Test	Frequency
1.	Prime Coat/Tack Coat	i) Quality of binder ii) Binder temperature for a	As Required At regular close intervals

2	Bituminousmacadam (BM) /Bituminous Concrete (BC)	i) ii) iii) iv)	Quality of binder Aggregate impact value, flakiness index and stripping value of aggregates Mix-grading Control of temperature of binder in boiler, aggregate in the dryer and mix at the	As required One test per 50-100m^3 of aggregate One set of test on individual constituents and mixed aggregates from the dryer for each 100 tonnes of mix subject to a maximum of two sets per plant per day.
		vi) vii) viii)	Binder content and gradation in the mix (Binder content test vide ASTM:D-2172) Rate of spread of mixed material	density, and void content, subject to a minimum of two sets being tested per plant per day. One test for each 100 tonnes of mix subject to a

CHAPTER-13
ACCEPTANCE TESTS

13.1 CHECK FOR OBSTRUCTION

a. As soon as a stretch of pipes whether of stoneware or cast iron or RC Pipes has been laid Complete from manhole to manhole, the Contractor shall run through the pipes both backwards and forwards a double disc or solid or closed cylinder 75 mm less in diameter than the internal diameter of the pipes. The open end of an incomplete stretch of pipe line shall be securely closed as may be directed by the Engineer to prevent entry of mud or silt etc.

b. If as a result of the removal of any obstruction the Engineer considers that damages may have been caused to the pipe lines, he shall be entitled to order the length to be retested at the expense of the Contractor. Should such retest prove unsatisfactory the Contractor shall at his own expense amend the work and carry out such further tests as are required by the Engineer.

c. It shall Also, be ascertained by the Contractors that each stretch from manhole to manhole is absolutely clear and without any obstruction by means of visual examination of the interior of the pipe line.

13.2 HYDRAULIC TESTING OF SEWERS

Immediately after the test with the double disc or cylinder as mentioned above has been completed and any defects thereby disclosed have been made good, the Contractor shall prove the joints of the stretch of under-ground pipes whether of stoneware, cast iron or RC Pipes, to be water tight.

Each section of sewer shall be tested for water tightness preferably between manholes. To prevent change in alignment and disturbance after the pipes have been laid, it is desirable to backfill the pipes up to the top keeping at least 90 cm length of the pipe open at the joints. However, this may not be feasible In the case of pipes of shorter length, such as stoneware and RCC pipes. With concrete encasement or concrete cradle, partial covering of the pipe is not necessary.

In case of lowered stoneware pipes with cement mortar joints, pipes shall be tested three days after the cement mortar joints have been made. If it is necessary that the pipelines are filled with water for 7 days before commissioning the application of pressure to allow for the absorption by pipe wall. Where there is obstruction to traffic the period of 7 days allowed for absorption by pipe wall can be reduced by the engineer at his decision.

The. sewers are tested by plugging the upper end with a provision for an air outlet pipe with stop cock. The water is filled through a funnel connected at the lower end provided with a plug. After the air has been expelled through tile air outlet, the stop cock is closed and water level in the funnel is raised to 1.5 m above the invert at the upper end. Water level in the funnel is noted after 30 minutes and the quantity of water required is measured at an interval of 10 minutes to restore the original water level in the funnel. The pipe line under pressure is then inspected while tile funnel is still in position. There shall not be any leaks in the pipe or the joints (small sweating on

tile pipe surface is permitted), any sewer or part there of that does not meet the test shall be emptied and repaired or re-laid as required and tested again. The leakage or quantity of water to be supplied to maintain the test pressure during the period of 10 minutes shall not exceed 0.2 litres/mm dia, of pipes per kilometre length per day.

Water and other accessories required for testing shall be to the account of the contractor.

13.3 AIR TESTING OF SEWER

The air test is to be conducted for sewers before back filling. It should not be used for testing after back filling or if the trench is water logged as under those conditions it is possible for a faulty line to be satisfactory.

The requirements of the codes of practice for the air test are that the length of pipe under test should be effectively plugged and air pumped in by suitable means until a pressure of 100 mm of water is indicated in a glass U-tube connected to the system. The air pressure should then not fall to less than 75 mm I during a period of 5 minutes without further pumping, after allowing a suitable time for stabilization of the air temperature. In case the drop is more than 25 mm the leaking joints shall be traced and suitably treated to ensure water tightness. The exact point of leakage can be detected by applying soap solution to all the joints in the line and looking for air bubbles.

13.4 TESTING OF MANHOLES

The entire height of the manhole shall be tested for water tightness by closing both the incoming and outgoing ends of the sewer and filling the manhole with water. A drop in water level not more than 50 mm per 24 hours shall be permitted. In case of high sub-soil water, it should be ensured that there is no leakage of ground water into the manhole by observing the manhole for 24 hours after emptying it.

Water and other accessories required for testing shall be arranged by the contractor at his own cost

CHAPTER-14

ELECTRICAL & INSTRUMANTATION WORKS

(For all sub-works wherever applicable)

14.1 TRANSFORMERS

14.1.1 General

a) Transformers rated, which are designed to receive power at high voltage shall be of oil immersed type and shall not employ forced cooling of oil. Radiator banks shall be of the detachable type. Transformer shall be suitable for indoor duty and shall be installed inside closed room.

b) Transformers shall be complete with all fittings / accessories / devices etc. which are required for their satisfactory operation along with 6" wdg. temp indicator, 6" oil temp indicator trip alarm contacts for winding temp, and oil temp. It shall have HV cable box. For Transformer of 1000 KVA and above, bus duct shall be used in LT side whereas for transformer below 1000 KVA, cable box shall be provided in the LT side. Radiators shall Also, be detachable type along with HT cable boxes and disconnecting chamber on HT side. Transformer shall be complete with all accessories like conservator, breather, air vent, lifting hooks, bi-directional roller etc.

c) Transformers shall employ copper conductor windings.

d) Transformers in clause (b) above shall have a separate bushing brought out on the transformer tank for earthing of neutral. Transformers designed for HV cable connections shall incorporate disconnecting chambers.

e) Transformers in clause (a) above shall have off load tap changing gears with auto / manual operating features. The tap changer range shall be –10% to + 5% in steps of 2.5%. The voltage profile of the transformer shall confirm to the voltage profile of power distribution agency. Transformers in clause (b) above shall have off load tap changers.

f) The Transformer KVA rating shall be designed considering full load with a power factor of 0.8. No. Of transformers shall be 2 nos each of 100% of total plant load.

14.2 REQUIREMENT FOR OTHER ELECTRICAL ITMES:

14.2.1 Painting:

a) Rust in the sheet steel, structural steel used for fabrication shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly hot water and drying. A lightweight zinc coating to class C as per relevant IS shall be applied. After phosphating thorough rinsing shall be carried out with clean water, followed by final rinsing with dilute dichromate solution and drying.

After pretreatment, powder coats of thickness not less than 50 microns shall be applied.

b) Paint shade for all electrical equipment shall be 692 (smoke grey shade) and 631 (admiralty grey) for indoor and outdoor equipment respectively. Unless specifically instructed interior portions of all housings

shall be painted with while colour. Paint shade references are as per relevant IS.

14.2.2. Sheet Metal Work:

Sheet steel used for fabrication of these or similar items shall be cold rolled sheet of 2 mm or hot rolled sheet of 2.5 mm.

All cubicles, panels, cabinets, kiosks and boards shall comprise rigid welded structural frames made of pressed and formed sheet steel thickness of not less than 2 mm cold rolled or 2.5 mm hot rolled. The frames shall be enclosed by steel sheets thickness of at least 2 mm cold rolled or 2.5 mm hot rolled, smoothly finished and free from flaws. Stiffeners shall be provided wherever necessary.

All doors, panels, removable covers, gland plates, etc. shall be gasketed all-round the perimeter. Locking arrangement for doors / removable covers/ panels shall be hand operated type requiring no tools for locking or unlocking. Padlocking facilities where required shall be provided in addition to above along with padlocks and duplicate keys.

All doors shall be removable and supported by strong hinges of the disappearing or internal type and braced in such a manner as to ensure freedom from sagging, bending and general discretion of panel of hinged parts. The hinges should be in such a fashion that door once hooked in upper hinge automatically slides in the bottom hinge. Suitable compartment shall be made for mounting switchgear and compartment shall be fully isolated from other compartment.

14.2.3. Switchgears:

14.2.3.1. LV Switchgears:

415 V switchgear shall comprise separate, segregated modules for each circuit in compartmentalized fashion for PCC and MCC with starters capacity > 50 HP. More than one module may not be arranged in the same compartmentalized section. Medium voltage switchgear circuits controlled by circuit breakers shall be of draw out type. It shall not be possible to obtain access to an adjacent cubicle when any door is opened. Each door shall be interlocked and all line terminals, bus bar chambers & back covers must be shrouded between each vertical riser and there should be proper barriers. Not more than one air circuit breaker shall be mounted in one vertical bay

Bus bars and cableways in 415 V switchgear shall run in separate segregated compartments and again these should be isolated from equipment chamber making minimum form 3B construction.

Instruments, relays and control devices shall be mounted flush on hinged door of the metering compartment located in the front portion of the cubicles.

14.2.3.2. Circuit Breakers:

a. General:

The circuit breaker shall be air brake type with draw out design confirming to the relevant Indian standards. All the circuit breakers of the panel will be mounted in separate cubicles and will be of same make to maintain the uniformity.

The breakers will be draw out type and will be mounted on a rigid steel frame moving on horizontal ball, telescopic slides offering minimum of friction. The system will have horizontal, self-aligning, isolating pairs of moving and stationary power and control contacts. The unit will have three horizontal positions corresponding to:

b. Plugged In Position:

Here both the Power and control contacts are in make position and the breaker gets mechanically locked in this position. The breaker can go in ON position only after being locked in this position.

Test Position:

Here the power contacts get isolated whereas the control contacts can be kept in make status. The breaker can be mechanically locked in this position and make ON and OFF for testing purposes.

d. Withdrawn Position:

In this position the power and control connections are in isolated status and the moving portion of the breaker can be dismantled from the panel. An isolating shutter or set of shutters is to be provided for the automatic coverage of live power and control fixed isolating contacts in the withdrawn position.

All the breakers with remote closing arrangement will have a spring charging motor of single phase 230 V and a closing coil. In case of power failure, the spring charging can be done manually with the help of button or lever. The circuit breaker should switch on only when the spring is charged fully which should be able to store energy for one closing and one tripping operation. The spring will Also, get fully charged when the breaker is in closed position. In this case the spring should store enough energy to make first tripping, one re-closing and the second tripping.

The breaker will have quick making trip free closing mechanism. The operation of the mechanism will be independent of the speed of the closing lever or the duration of the closing signal.

The breaker will have following indications distinctly notable from outside.

- Electrical indication of breaker ON status.
- Electrical indication of breaker OFF status.
- Electrical indication of trip circuit healthy.

All breakers will have switching ON and OFF time of less than 4 cycles and will have the following interlocks for the safe operation of the equipment:

- Breaker to ON only when mechanically locked in any of the three horizontal isolation position.
- When the Breaker is in "Plugged in" position it will go to ON position only with the front door closed.

The breakers will be provided with 6 Nos each of type NO and NC auxiliary contacts rated for 10 Amps AC at 415 V and 6 Amps DC at 48 V. These contacts are in addition to the ones already in use for the operation of the breaker and will be required for subsequent interlocks incorporated in near future.

Whenever requested mechanical positive interlocks will be provided between the operation of different breakers with the help of individually unique and suitable Castle Key Locks.

14.2.3.3. Isolators Switches, Fuse Units & Fuses:

These items shall conform to the latest IS13947 and following specifications:

a. The isolators and switch fuse units (SFU) will be three pole or four pole air brake double isolating type capable of making and breaking the current as detailed below without any abnormal deterioration in the life of equipment and without endangering the safety of the operators. Wherever isolable neutral is specified, neutral is terminated / isolated separately. Wherever switched neutral is specified, four pole switches will be used. All switches will be fully shrouded and a proper barrier plate will be used between phases.

b. In case of isolator/SFU supplying heater, lighting loads etc., the current is of 125% of full load current connected.

c. In case where the switch is supplying current to a group of motors this capacity of the isolator/SFU will be equal to full load current of all motors plus the locked rotor stator current of the largest motor of the group.

d. In case of the load being capacitors this capacity of the isolator/SFU is equal to 225% of the capacitor current.

e. In case of the DB's, SFU panel etc. the isolator/SFU will be mounted on the component plate of the module and the operating handle will be brought out for front access to enable the operation. The operation of the isolator/SFU will be interlocked with the isolator/ SFU in ON and OFF positions will be provided. Clear indications of ON and OFF positions of the handle will be shown on the front door for confusion free evaluation of the status of the isolator/SFU.

f. The operating mechanism of the isolator/SFU will be quick make, quick break type and its speed of operations will be independent of the speed of the operating handle.

g. The isolator/SFU will be able to carry short-circuit current 1for 10 cycles before the fault is cleared by the local/ remote fuses/breaker.

h. The SFU will have three fuses one in each phase to provide safety against high currents. The fuses will be only High rupturing capacity (HRC) type. The fuses should be capable of clearing the fault current on short circuited without damaging the isolator/ switch and without endangering the safety of the operator and the adjacent equipment.

i. All the control fuses and the power fuses will be HRC type with current rupturing capacity of more than 41 KA at 440 V AC. No wire fuses or any other kind of fuses shall be used in the supply of electrical equipments for this project.

j. Shall have very high mechanical life e.g. 10000 operations for 800A.

k. Manufacturer to confirm that equipments have been tested as per IS13947.

14.2.3.4. Contactor Type Motor Starters:

Motor starter / contactor shall be of the electromagnetic type rated for uninterrupted duty. Contactors of DOL and star / delta starters shall be suitable for class AC 3 utilization category and contactor for reversing starters shall be of AC 4 category. Contactors used for star / delta and forward / reverse shall be electrically interlocked. Main contacts of the contactors shall be silver faced. Operating coils shall be suitable for operation on 230V, 1 Phase, 50 Hz supply. Each contactor shall have minimum 2 Nos + 2 NC auxiliary contacts for interlocking and control circuits. Contactors shall have very high electrical & mechanical life and size shall confirm to only type II coordination. At least one spare 1 NO + 1 NC shall be provided for future use after using all control contacts for interlocking, control circuit in PLC/ DDC logics, indication and controls.

14.2.3.5. Overload Relay:

All the Over load relays used for the protection of three phase induction / synchronous motors will be three elements, ambient temperature compensated, positive acting, manual reset, as well as auto reset from panel front, heavy duty, separately mounted, bimetallic thermal type relays with one change over contact rated for 6 amps at 415 V AC. The resetting of the relay will be done by a push button located on the front door with the help of movement transfer by a flexible shaft in flexible cable outer between the push actuator and the relay reset point. The relay shall have single phasing prevention feature and shall be as per latest amended relevant IS. If due to PLC logic, more changeover NO/NC contacts are required then either relay shall have more changeover contacts or basic changeover (along with the relay) shall be multiplied to obtain extra contacts. The rating of these contacts should be rated for at least 2 times the current requirement.

For the equipment having higher inertia special arrangements will be made to short circuit the relay with or without resistance, with the help of a contactor and a timer. The shorting contactor will open after laps of a preset time (Set on the timer) after the starting.

The adjustment range of the over load relay shall cover 70% and 110% of the full load currents of the motor it is protecting.

All motors of 100 H.P. and above shall have additional protection of earth leakage through core balance current transformers and winding temperatures shall be displayed. For these motors of 100 H.P. and above, the numeric type micro-processor based relays shall be used in place of conventional thermostatic overload relays.

14.2.3.6. Moulded Case Circuit Breaker

Moulded Case Circuit Breakers shall comply with IS-13947 and have a category of duty P2. They shall be of the low energy let through type incorporating positive ion quenching in order to ensure rapid arc quenching i.e. shall be of extra current limiting feature. It shall have provision of adding either one-shunt trip or under voltage along with two changeover contacts at any stage.

The operating faceplate shall have three positive positions 'ON', 'OFF' and 'TRIPPED' and this shall be used with front extended rotary handle. All contacts shall have phase barrier and extended links for aluminium suitability.

Tripping characteristic shall be of ambient temperature compensated and selected according to application, i.e. distribution, generation or motor duty. The size of MCCB shall be selected after taking necessary de-rating into account inside panel compartment. It shall have variable over current setting and variable short circuit setting.

14.2.3.7. Miniature Circuit Breaker:

Miniature circuit breaker (MCB) shall have 10 KA breaking capacity. If fault withstand capacity of MCB is less than that of the switchboard, backup HRC fuse or motor protection circuit breaker shall be fitted. MCB shall confirm to latest IS 8828 : 1996 and shall have lower watt losses and shall be rated for 10 KA and type 'C' Curve shall be used.

14.2.3.8. Residual Current Circuit Breaker

Residual current circuit breaker shall be current operated and comply with IS 12640 or BS 4293. The tripping current shall be selected dependent on location within the supply network and the calculated loop impedances. It shall operate to trip all phases including the neutral. Unless otherwise specified the following sensitivities shall be applied:

- Individual ring mains, ring main group or socket outlets 30mA
- Small consumer boards incorporating no other RCCB protection 30mA
- Small consumer boards incorporating RCCB protection on outgoing way100mA
- Large consumer board incoming RCCB shall be at least 300 mA

The residual current circuit breaker shall be capable of withstanding the likely fault current at the point of installation.

14.2.4 Bus Bars:

Switchgears shall be provided with three phase or three phase and neutral bus bars. Bus bars shall be of aluminium and shall be insulated with close fitting fibre reinforced plastic sleeve. PVC sleeve shall be acceptable for LV switchgear. Insulating sleeves shall have R, Y, B, colour bands at suitable intervals for identification of phases and shall withstand 90 o C temperature. Bus bar used shall be Al 91E with minimum 55% conductivity. Bus bar will be designed for 500V with neutral bus bar size shall be half of phase. Bus bar sizes will be uniform throughout horizontal run and again uniform on the vertical run. No reduction of bus bar size is permissible either in horizontal or vertical run and uniform life of busbar shall be adopted.

All bus bar joints and bus tap joints shall be plated. Bus bar joints shall be of the bolted type and shall be insulated with moulded caps. To provide a tight seal between adjacent cubicles, bus bars shall be taken through seal off bushings or insulating blocks.

Bus bars shall be adequately supported on insulators capable of withstanding dynamic stresses due

to short circuit. The short circuit rating of bus bars shall not be less than that of the associated switchgear and bus bar ratings shall be worked out after taking deratings of ambient temperature and enclosure. Bus bar temperature shall not rise beyond 850 C. Bus bar temperature rise calculations, short circuit calculations along with the KMC support distance shall be submitted at detailed engineering stage for approval along with temperature rise and minimum size of busbar selected. Similar calculations must be submitted for earth bus.

14.2.5 Interlocks:

Interlocks for LV circuit breakers shall comply with the following requirements:

a) It shall not be possible to plug in or isolate a closed circuit breaker. Attempted isolation of a closed circuit breaker from switchgear cubicle / module shall trip the circuit breaker.

b) It shall not be possible to close a circuit breaker unless it is in “service”, “test”, or “isolated” position.

c) Isolating devices, if provided shall be interlocked with breakers to prevent their making or breaking current.

d). It shall not be possible to close the circuit breaker in service position, without completing the auxiliary circuits between fixed and moving portions.

e) Where key interlocking is employed tripping of a closed circuit breaker shall occur if any attempt is made to remove the trapped key from the mechanism.

14**.2.6 Test Operation Facilities:**

A separate test position of the breaker shall be provided in the cubicle / module. It shall be possible to test the breaker in this position with all interlocks in the circuit.

14.2.7 Safety Shutters:

Switchgear cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage to cover the stationary isolated contacts when the breaker is withdrawn.

14.2.8. Switchgear Control Components, Devices and Other Features:

All individual components of control equipment associated with any item of pumping station shall be contained in a single control cubicle or panel.

All instruments, relays, switches, lamps, push buttons and the like shall be arranged on the cubical in a neat, functional and logical manner. The arrangement shall be subject to the KMC approval.

Similar items shall be of the same type, style pattern or appearance throughout. Control and changeover selection switches for various functions shall be of the same type but with a handle of different shape for each specific function.

Instruments, control devices and relays mounted on different panel sections but having similar functions shall be located in a physically similar position. Such equipment shall be mounted at an operating height not exceeding 1800 mm and not less than 300 mm operating height above floor level.

14.2.8.1. Indicating Meters:

All indicating meters shall be digital type complete with inter-facing devices.

a)	Display	:	4-1/2 Digits, 7 segments red coloured LED
b)	Accuracy	:	+ 1%
c)	Inputs	:	From current transformer /voltage transformer as required.
d)	Dimension of digits	:	12.5 mm (Minimum)
e)	Sampling rate	:	4 samples / sec

14.2.8.2. Indicating Lights:

Indicator lights shall be not less than 20mm diameter and shall be panel mounted types with metal bodies adequately fastened so that the lamps shall be capable of replacement from the apparatus without disturbance to the lamp holder or panel wiring. Lamp holders shall be keyed into panels to prevent rotation. Lens colours shall comply with BS EN 60037 as follows:

Power on	White*
Running	Green
Tripped/ alarm	Red
Status (open, closed, etc)	Blue
Ready to start	Blue
Warning (no imminent danger)	Amber

Note: *white may be used where doubt as to which other colour to use.

The Lights shall be under-run to give long life either by use of a resistor to limit voltage to 90% normal value or by using higher voltage lamps. The indicating lamps on control panel shall be cluster of LED's.

14.2.8.3. Push buttons:

Colours of push buttons shall generally comply with IS 6875, BSEN 60947, 60037 or IEC 60073 and in particular shall be as follows:

Stop, emergency stop	Red
Start	Green
Jogging/ inching	Black
Reset (when not Also, acting as a stop)	Blue
Lamp test	Blue
Override/ alarm accept	Yellow

14.2.8.4. Control Transformers:

Unless otherwise specified all control circuit supplies for contractor starters shall be obtained from a 230V, 50 Hz integral control transformer contained in the breaker or starter cubicle. In the case of motor control centres and composite boards comprising circuit breakers and starters one or more master control circuit transformers shall be provided for each section of busbars in the switchgear to feed a group of outgoing

starters and / or outgoing breakers via bus wires in the board. Each control transformer shall be busbar connected and be provided with isolation facilities, and primary and secondary HRC fuses. Transformers shall be of the double wound pattern and be provided with earth screen between primary and secondary windings. One end of the secondary winding shall be earthed through a link. Each control transformer will have 100% standby and a manual change over arrangement between two control transformers.

14.2.8.5. L.T Current Transformers (CTs):

The current transformers to be used in the L.T. Electrical panels shall be low tension, ring/ rectangular type resin cast current transformer with the requisite currents ratio having secondary of the current transformers. For guidance the protective current transformers shall have an accuracy class 5P and an accuracy limit factor greater than 10. Low reactance current transformer shall be used for protection. Selection will be based on the following information:

a) For energy measuring : 1.0 class of accuracy.
b) For other metering : 1.5 class of accuracy.
c) For protection : 5P10 class of accuracy.

The current transformers to be selected for this panel will have at least 20% extra VA capacity available over the normal conventional meter capacity based on the following details:

- For ammeters conventional : 3 VA.
- For current coils of KW & KWH : 5 VA
- For current coils of PF.KVAR meters : 5 VA
- For all recorders conventional : 5 VA
- For normal wiring : 2 VA
- For current coil of protection relays : 10 VA.

The VA rating shall be calculated keeping 30% spare capacity and under no circumstances the VA rating of the CT's will be less than 15 VA. In case of low currents, a primary wound CT will be chosen or a higher size ring type CT with 2 or 3 or 4 or 5 turns of primary conductor may be used to get the VA rating at required current ratio.

14.2.8.6. Terminal Blocks:

Terminal boards or block shall be of barrier pattern, stud type having covers of transparent insulating material.

All terminals shall bear a permanent identification number of letter. Terminal blocks shall be of 650 V grades, 10A rated.

Dropping type shorting links shall be provided on terminal block for CT secondary shorting. Terminals used in conjunction with current transformer shall have facilities for shorting out of the output to enable removal of instrumentation.

Terminal blocks shall be of the screw clamp, rail mounted type to IS: 13947, VDE 0611 : Part 1 for connection of copper conductors up to 1000V.
The terminals used shall be suitable for the type of wire to be terminated and current carrying capacity.

Each terminal rail and each individual terminal shall be indelibly marked with a unique number corresponding to the schematic numbering system.

No more than two cables shall be terminated per clamp. Cross connections shall be used to link adjacent terminals where multiple wire connections are required.

Earth terminals shall be coloured green/yellow and shall clamp to the fixing rail in order to provide earth continuity.

Terminals of different sizes and for different voltage terminations shall be partitioned.

Where un-isolated external voltages may be present, terminals shall be screened and a warning label fitted.

Terminals used in conjunction with current transformers shall have facilities for shorting out of the output to enable removal of instrumentation.

In any terminal arrangement adequate space shall be provided for the neat and logical termination of the incoming wiring. Terminal rails shall have provision for the installation of at least 10% additional terminals.

Terminals within cubicles and enclosures shall not be obscured and shall be easily accessed for installation and testing purposes, without removal of equipment.

14.2.8.7. Anti Condensation Heaters/ Panel Internal Illumination:

Each vertical section of MV switchgear shall incorporate wiring for supplies to anti condensation heaters. The wires will be energized from a single phase supply obtained from a separate distribution board. The heater circuit shall be controlled by a rotary type ON/ OFF switch, HRC fuse or MCB mounted inside the panel and adjustable type thermostat. Multitier cubicles shall have cubicle heater and thermostat for reach vertical panel section.

The heaters shall be located in cable alleys where such alleys are available or shall be located in the bottom portion.

Panels / panel sections shall be provided with fluorescent lamp lighting fixtures of 20W rating protected by HRC fuse and a switch or a MCB located inside the panel.

14.2.8.8. Safety Arrangements:

All terminals, connections, relays and other components which may be “Live” when front access doors are open shall be adequately screened / shrouded.

14.2.8.9. Auxiliary Switches:

Auxiliary switches/ devices shall be supplied as required for indication, protection, metering, controls, interlocking and supervisory purposes. They shall be readily accessible and enclosed in transparent dust proof cover.

14.2.8.10.Panel Internal Wiring:

Inside switchgears, motor control centres, annunciation panels, etc the wiring for control, signalling, protection and instruments shall be done with PVC insulated copper conductors of minimum 1.5 sq. mm size. Wiring for CT circuits shall be with 2.5 sq.mm copper conductor. The insulation grade for these control wires shall be 1100 V. Inter panel wiring shall be enclosed in PVC wire ducts.

Wiring for three phase circuits shall be colour coded red, yellow and blue for identification of relevant phases. For single phase AC circuits white coloured wires shall be used for phase conductor and black coloured for neutral conductor. Grey coloured wires shall be used for DC circuits and green coloured wires for earth connections.

Circuits in which the operating voltage exceeds 110V shall be physically segregated from all other wiring. All wiring shall be neatly and securely fixed by insulated cleats or run in insulated wiring troughs. Wiring shall be so arranged that access to any apparatus or connection point is not impeded.

Wiring carrying low-level DC signals shall be segregated from AC circuits and screened if recommended by the manufacture of associated equipment/ instruments. Spare contacts available on relays / devices etc shall be wired up to terminal blocks.

Wires shall be joined or tied between terminal points.

Each wire shall be identified at both ends by yellow colour PVC ferrules marked with black letters/ numbers. The letters/ numbers used for marking on ferrules shall correspond with the appropriate wiring diagram. Trip circuit wires shall be distinguished by an additional red colour. Ferrules of other colours, if used, shall be subject to the KMC approval.

Wiring termination shall be made with solder less crimping type tinned copper lugs. Insulated sleeves shall be provided at all termination.

14.2.9 Main and Auxiliary Bus Bars:

Bus bars shall be of uniform cross section throughout the length and made of high conductivity hard drawn conforming to IS 613.

14.2.9.1. Safety

Access to any enclosure shall be possible only when the circuit isolator is open and unless connections within the enclosure are isolated or fully shrouded against accidental contact.

Where a test facility exists for use with the enclosure door open all live contacts shall be shrouded to prevent accidental contact.

Isolators shall be pad lockable in the 'OFF' position. It shall not be possible to open the assembly door when the isolator is in the 'ON' position.

14.2.9.2. Short Circuit

The short circuit rating of the assemblies shall be suitable for the point of installation in the system. Where possible short circuit protective devices shall be coordinated to ensure that a fault in any outgoing branch does not operate the assembly incoming protection device.

14.2.9.3. Earthing

Assemblies shall be provided with earthing facilities as follows.

For small single compartment assemblies an earth stud shall be provided.

For large single compartment or multi-compartment assemblies a clearly marked continuous Alum./ GI earth bar of minimum 40mm x 5mm shall run the entire length of the assembly and shall be provided with terminals for connections to the metal cladding or armouring of all incoming and outgoing cables. The earth bus size shall be generally 10% of phase size subjected to meeting short circuit conditions and minimum size for any panel shall be 40x5mm.

The temperature rise of the busbar and connections under fault conditions shall not cause damage to the connections of any equipment to which they may be connected. The earth fault calculations shall be submitted along with detailed engineering.

No earth terminal bolts or studs shall be less than 8mm diameter.

An earth bond of minimum size 4 sq.mm. shall be made to all enclosure doors.

14**.2.9.4. Labels**

The assembly as a whole and each compartment shall be clearly and unambiguously identified.

The labels shall be engraved letters and numbers filled black on a white background.

Warning labels shall be engraved and filled black on a yellow background.

Labels shall be affixed with non-corrodible rivets or screws.

Internal labels shall be used to identify all components and terminal strips. They shall be of plastic in constructions and shall be affixed adjacent to the component to which they appertain.

14.2.10 Internal Wiring Arrangement:

14.2.10.1. Internal Power Distribution

The internal power distribution arrangement for each assembly shall comprise an MCB distribution board arrangement for each voltage present. Separate switches on this board shall be dedicated to individual circuits in order to ease fault finding and to localize faults.
Separate MCB's shall typically be provided for supplies to :

For 240 V AC :
: Power supplies
: CPU and input modules
: PLC output modules
: Transformers
: Rectifiers
: Each instrumentation loop
: Panel Lighting
: Panel cooling
: Anti-condensation heating
: Internal socket outlets

For 24V DC : DDC input/ Output circuit and modules

Where specified auxiliary contacts shall be fitted to each MCB to indicate a trip.

The power supply for PLC & PC to be tapped from true Online UPS providing immunity from mains voltage disturbances.
The 24V DC power shall be derived from a regulated reliable voltage power supply.

14.2.10.2. Arrangement of Internal Components

Internal components shall be laid out in a logical manner in order to provide freedom of access to terminations and to allow removal of any component without interference to adjacent components.

Particular attention shall be paid to the location of heat dissipating equipment such as power supplies etc. in order that they do not have a detrimental effect on adjacent cabling or components.

Where necessary forced ventilation shall be provided by extraction fans mounted in the sides or access doors of the assembly as appropriate. Unless otherwise specified disposable filters shall be provided at the inlet grills. These shall be externally serviceable without affecting the operation of the assembly.

An over-temperature alarm signal shall be provided by the volt free contacts.

14.2.10.3. Terminal Arrangements

Cable entering and leaving an assembly shall do so via suitably positioned terminals.

Terminals shall be arranged in function groups as follows:

Supply outputs to field devices
Signal inputs from field devices
Control output to starter section
Signal inputs from starter sections
Signal inputs to telemetry
Signal outputs form telemetry

Within each group terminal shall be arranged in subgroups as follows:

Voltage
Energized with panel door open
De-energized with panel door open
Digital signal
Analogue signal

Terminals for circuits at voltages greater than 24V that are not de-energized when the assembly door is open shall be screened and labelled accordingly. Wiring for different voltage like A.C. And D.C. shall be carried out by different colour and in case any components/voltage is live even if incomer of the panel is off then it should be labelled along with warning sign and orange colour wire should be used for this type of wiring.

Incoming and outgoing cables to intrinsically safe barriers shall connect to the barriers via knife terminals.

14.2.10.4 Lighting:

Each cubicle of an assembly shall be provided with an internal switched fluorescent luminaire. It shall be positioned to illuminate all internal areas of the assembly cubicle.

14.2.11 Motor Control Gear and Control Panel Assembly Control Facilities

Unless otherwise specified assemblies shall contain dedicated sections for motor drive, starters, common control, instrumentation, lamp test.

14.2.11.1 Motor Drive Starters

All starter modules shall be self-contained. The drives shall have manual and automatic control features selectable by manually positioning a starter mounted automatic/ off/ manual selector switch.

Facilities may Also, be provided for manual control to be carried out locally or remotely. If this facility is provided a remote/ local selector switch shall be provided on the starter. In this instance a remote start/ stop station is located adjacent to the drive. This station is only active when the starter is selected ‘manual’ and ‘remote’.

Control in manual mode shall comprise safety controls only.

Control in automatic mode shall comprise safety controls and process controls.

Safety controls shall comprise controls necessary for the safe operation and protection of the drive

in order to protect the drive itself and/ or personnel. Typically, these shall comprise flow check switches, run dry protection, overrun devices, torque switches, overload, over temperature, high pressure, emergency stop devices etc. These devices shall be hard wired direct to the starter and shall be independent of any PLC/ DDC controls that may exist.

Process controls typically interact with the drive via a PLC/ DDC or hard wired logic. Typically, these shall comprise controls for duty rotation, auto standby, level and flow control, sequencing, startup/ shut down procedures, scheduling etc.

Section of manual control shall enable local drive start/ stop controls at the starter itself or remote manual controls if fitted. In this mode the starter shall operate independent of process controls. All safety controls shall be operative.

Selection of automatic control shall deactivate local and remote manual controls. In this mode the starter shall respond to the dictates of process and safety controls.

For starters module of motors rated for 100 H.P. and above, they shall have (besides above protection) numeric type microprocessor relay along with temperature scanner for windings. There should be minimum two thermocouples /PT 100 devices for each winding. These should be wired from motor to starter.

14.2.11.2Common Control Section

This section shall house:

Safety controls which are related to drive groups rather than specific drives. Typically, these shall comprise run dry protection (when used in a common sump), group emergency stop control, etc.

Process controls facilities. These facilities shall typically be provided by a PLC. However, unless otherwise specified, hard wired logic will be acceptable for simple control schemes comprising less than twenty control relays.

Lightning protection barriers, if fitted, shall be installed at the base of the section adequately segregated from all other unrelated devices.
The common controls section may Also, provide facilities for the marshalling of starter module status, alarm and remote control signals in order to facilitate the use of multi core cable connections to remote locations.

The interior of the common control section shall be accessible without isolation of any drive or circuit. Therefore, all voltages in excess of 24V shall be screened to prevent access.

Each circuit shall be individually protected by an MCB such that maintenance work can be carried out with the minimum of interference to running pumping station.

The front face of the common control section shall typically be fitted with pumping station controls, status indication and alarm annunciation facilities.

Alarm annunciation facilities shall show drive group faults, non-drive related faults and drive common fault alarms, Specific drive related faults shall be indicated at the drive module itself i.e. the common control's fault annunciator may indicate a fault on drive A but starter module A shall indicate precisely what the fault is.

14.2.11.3 Instrumentation

This section shall house equipment associated with field and panel mounted instrumentation. Lighting protection barriers, if fitted, shall be installed at the base of the section adequately, segregated from all other unrelated devices.

Each circuit shall be protected by an MCB such that maintenance work can be carried out with the minimum of interference to running pumping station.

14.2.11.4 Lamp Test

Facilities shall be provided to test all lamps on an assembly. This shall comprise a common lamp test section. Operation of the lamp test circuit shall energize a relay in each section of the assembly in order to light each lamp and annunciator. The lamp test circuit shall pass through auxiliary contacts on section isolators if fitted. A short time delay shall ensure that the lamp test supply is retained to allow visual checking of all lamps.

On small assemblies, less than ten starters, individual lamp test buttons on each section shall be acceptable unless otherwise specified.

14.2.11.5 Emergency Stop Circuitry

Each drive or group of drives shall provide with an emergency stop facility which shall comprise a red coloured, mushroom headed, stay-put-twist to release push button.

The emergency stop device shall be located adjacent to the drive or drive group to which it relates and shall be clearly labelled.

Individual drive emergency stop devices shall be wired directly into the drive starter contactor circuit.

14.2.11.6 Local Control Station

These shall be of heavy duty construction and with the smaller sizes designed for mounting on or near the pumping station to be controlled.

The bottom face shall be arranged to accept with adequate space for the use of spanners, gland terminations for the number of cables required. Cables shall enter from the top generally.

Terminals provided for interconnections shall be easily accessible and marked with identification numbers/ letters corresponding with the associated diagrams.

Indicator lamps shall be not less than 20mm diameter and have projecting lenses with a wide angle of vision.

Pushbuttons and selector switches shall be of heavy duty, oil tight type of matching design. Legend plates shall be provided to identify equipment to be controlled and the purpose of each operating or indicating device.

Pendant type control for cranes, hoists, etc. shall be of moulded neoprene or equivalent heavy flexible, high impact strength materials, with a long moulded-in cable strengthening sleeve, to minimize the possibility of cable fracture at the bending point. The enclosure shall be coloured in safety yellow.

14.2.12 HV Switchgear Components:

14.2.12.1. Circuit Breakers:

Circuit breakers shall be vacuum / SF 6 type and of the draw out pattern. SF 6 circuit breakers shall be puffer type or self-extinguishing type with rotating arc of dead tank and single pressure design. SF 6 pressure/ destiny monitoring switch/ contacts shall be provided.

The short circuit fault level of HT Panel shall be obtained from nearest power distribution agency grid station and shall be taken as minimum 350 MVA.

Vacuum breakers shall have completely sealed interrupting units for interruption of arc inside the vacuum. All breakers shall be provided with contact wear gauge and we should be able to measure snatch gap below the interruptible vacuum bottle. It shall be possible to isolate easily the vacuum interrupted unit from the breaker operating mechanism for testing of the interrupter.

Circuit breakers shall be complete with surge arrestors (if the breaker design necessities the same) to provide protection to the equipment controlled by the breaker, against switching surges. However, for motor starting application surge suppressors shall be provided.

Circuit breakers shall be fully rated for the specified ambient conditions.

14.2.12.2 Operating Mechanism for Circuit breakers:

The circuit breakers shall be operated by a motor operator spring charging type mechanism. The motor operated spring charges mechanism shall be completed 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 spring to enable the mechanism to be ready for the next closing stroke. 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 spring. Failure of any spring, vibration or mechanical shock shall not cause tripping or closing of the circuit breaker. The operating mechanism shall be designed to release the spring to close the circuit breaker only by a deliberate action.

Only one closing operation of the circuit breaker mechanism shall result from each closing impulse (manual / electrical), even though the breaker trips while the control device (manual / electrical) is being held

in the 'close' position.

The circuit breaker mechanism shall make one complete closing operation, once the control switch has been operated and the first device in the control circuit has responded, even though the control switch is released before the closing operation is complete, subject to the condition that there is no counter- impulse for tripping.

Spring of motor operated spring charged mechanisms should not discharge until they are fully charged, and the charging means are disconnected. All switch gear compartment like circuit breaker compartment busbar chamber, CT& cable box compartment should be provided with pressure relief flap. Metallic safety shutters should be provided for busbar spouts and circuit spouts be interlinked with movement of circuit breakers.

All operating mechanisms shall be provided with ON/OFF mechanical indicators.

A local manual trip device shall be provided on the operating indicators.

14.2.12.3. Isolators & earth switches:

Unless otherwise specified isolators and earth switches shall be off-loaded and fixed type. For vertical isolation type switch gear integral earthing facility for busbar side (for incomer breaker) or circuit side (for outgoing breaker) shall be provided by breaker transfer position principle. For horizontal isolation type switch gear earthing should be provided by integral earthing switch or earthing truck for busbar and circuit side.

Mechanical and electrical interlocks shall be provided where applicable to ensure that the isolators cannot be operated unless the associated breakers are open.

14.2.12.4. Circuit Earthing Facility:

It shall be possible to connect each circuit of the switchgear to earth, either through earthing switches or though trunk mounted earthing devices.

Earthing switches shall be mechanically interlocked with the associated breaker/isolator to prevent earthing of live circuit.

Necessary NO and NC auxiliary contacts shall be provided on each earth switch for interlocking with the respective circuit breaker.

14.2.12.5. Relays:

All relays shall be numeric type microprocessor type. Relays shall be equipped with operation indicator LEDs for visual indication. On three phase relays with separate phase elements, each phase element shall have separate indicator with phase identification clearly marked. Output elements of over current, earth fault & other relays shall operate through master tripping electro-mechanical relay.

All relays shall be suitable for flush mounting, with only the dust tight covers projecting from the front of the panel. All relays shall be accessible for setting and resetting from the front. Access to setting devices shall be possible only after the front covers of the relays are removed. Resetting facilities shall However, be accessible external to the relay case.

All protective relays except auxiliary relays shall be of the draw out type. Where it is not possible to provide protective relays of the draw out pattern due to non-manufacturing range, fixed type relays with facilities for plugging in a portable test plug shall be provided. Necessary test plugs shall be furnished along with the relays.

All relays shall be provided with positive action flag indicators visible from the front.

No control relay except under voltage relays, which would trip a circuit breaker when de-energized, shall be used.

Auxiliary relays shall be rated to operate satisfactorily between 80% and 110% of the rated voltage. Tripping relays shall be rated to operate satisfactorily between 50% and 110% of the rated voltage. The successful bidder shall prepare coordination chart of all relays with the help of graphic chart and shall submit it for approval. The successful bidder has to ensure that only immediate relay trips first.

14.2.12.6. Current Transformers (CTs)

All current transformers shall have a short time current rating of not less than that of the switchgear in which they are incorporated. CTs shall be resin cast type and shall have class 1.0. Rating of CT's shall be worked out in such a way that 30% spare VA capacity is available.

Duplicate rating labels shall be fitted on the exterior of the mounting chambers suitably located to enable reading without the removal of cover or metal sheeting forming part of the structure of the switchboards.

14.2.12.7. Voltage Transformers (VTs):

Voltage transformers shall be supplied where required. They shall have a winding ratio to give voltage between lines of 110V on the secondary. They shall have a rated burden, at the stated accuracy, in accordance with the requirements of all connected instruments, meters and relays and of any instruments or meter to which they may be connected via test blocks.

The primary circuit shall be protected by HRC fuses having a short circuit rating of not less than that of the Switchgear. The connection between the fuses and the switchgear primary conductors shall be capable of withstanding the short time current of the switchgear.

The secondary circuit shall be protected by HRC fuses mounted as closely as possible to the secondary terminals. The fuses shall have safe access for replacement without the necessity for complete isolation of the switchgear.

Windings for metering circuit shall have accuracy class 1.0 and those for protective circuits shall have accuracy class 5 P10.

VT shall shave continuous over voltage factor of 1.2 and short time over voltage factor 1.5 for 30 seconds for effectively earthed system and in case of resistively earthed system or non- effectively earthed system, the short time over voltage factor shall be 1.9 for 30 secs.

14.2.13.Switch Tripping Unit (Batteries, Battery Chargers and DC Distribution Boards)

14.2.13.1. General

Switch tripping unit shall comprise battery, charger and DC distribution board housed in a common sheet steel enclosure. The enclosure shall be of cold rolled cold annealed (CRCA) and thickness shall not be less than 2mm. Enclosure shall be of indoor, floor standing, totally enclosed, dust, damp and vermin proof of adequate strength and rigidity. Degree of protection shall be IP-42.

The equipment shall be so housed in the cabinet as to facilitate easy inspection and maintenance. To prevent accident all live parts inside the cabinet shall as far as possible be adequately insulated to avoid contact during maintenance.

All external fasteners shall be cadmium plated/ zinc passivated to withstand the atmosphere conditions. The cabinet shall be complete with all necessary wiring, cable glands and sockets for incoming and outgoing circuits and suitable circuit label/inscriptions made of non-rusting metal, 3 ply limacoid or engraved PVC. Two earthing terminals shall be provided to earth the cabinet.

All the steel works of the cabinet shall be painted after suitable pretreatment with anti-rust paint and special finishing paint. The internal surface shall be painted in white and the external surface in dark admiralty grey colour.

14.2.13.2. Battery

Batteries shall be of high performance 30V DC lead acid SMF conforming to relevant IS. The battery calculations shall be attached with the bid.

Batteries shall be suitably sized to supply the control requirements of HT and LT breakers and Annunciations wherever required.

Batteries shall have cells housed in translucent, high impact plastic containers. The containers shall be fitted with vented filler pumps. High and low electrolyte levels shall be permanently marked on the container.

Cell terminals shall be of bolted type. The terminal polarity shall be permanently marked.

Battery cells shall be arranged so that each is accessible for test and inspection. Cells shall be arranged in single steps, double tier rack formation and shall be not less than 300mm above floor level.

Batteries shall be supplied complete with all necessary connections. The connections between tiers and cells and disconnection links and fuses shall be of the multi-stranded plastic insulated type.
The battery rack shall be made of mild steel painted with alkali resistant paints and shall be supplied in

knocked down condition which could be bolted and assembled at site. The batteries shall rest on treated wooden planks inside battery racks.

14.2.13.3. Battery Charger

Battery Charger shall conform to relevant and IS code. The charger shall be a float cum boost charger suitable for rating lead acid cells up to 1.85V per cell and Also, capable of quick charging the battery up to 2.2V / cell. The charger should be able to supply continuous DC load during boost charging with 10% margin.

14.2.13.4. Terminal Arrangement

The Battery and Battery Charger shall have terminals suitable for connecting PVC insulated, armoured aluminium cables. Approved type of terminal lugs and screwed type glands for the entry of cables in the panels shall be provided.

1**.2.13.5. Accessories**

Each battery shall be complete with all accessories and devices including but not limited to the following:

Battery stands
Set of inter-cell, inter-row and inter-bank connectors and number plates as required for the complete installation.

One number each of the following accessories shall be supplied with each battery unit.

I-centre zero cell testing voltmeter to IS: 1248 scaled 3-0-3 volts/
Plastic filling bottle
Insulated box spanner
Insulated tommy bar
End lugs
Bellavee washers
Lugged inter row cable
Vent caps

Battery Charger and DCDB shall be provided with the following Components.

Double pole rotary switch for AC input
HRC fuses with fittings for the above
Pilot lamp to indicate the equipment ON condition
Variance to give step less control of DC output voltage from 0-48V.
Double wound, impregnated, naturally air cooled single phase mains transformer with taps.
Single phase, full wave bridge connected, silicon controlled rectifiers. Stack with RC network for each SCR for surge suppression.
Filter circuit to reduce the ripple content to 3% RMS
Moving coil ammeter of suitable range and size to measure the DC output current

Moving coil voltmeter of suitable range and size to measure the DC output voltage.
HRC fuses with fittings for DC output
Voltage dropping diode with selector switch and contactor
Cable connection from battery to charger
Cubicle internal light operated form a 240V, single phase, AC system with on-off switch.
Battery earth leakage relay comprising of solid state sensing/ triggering circuit with electromagnetic relay with centre zero millimetres isolating switch and fuse.
Space heater suitable for operation on 240V, 1 phase, 50 hz, A.C system with ON-OFF switch.
Local auto/visual annunciations for the following faulty conditions shall be provided for:
Mains fuse failure
Rectifier fuse failure
Capacitor fuse failure
D.C output overload
Rectifier control supply failure

14.2.13.6. DC Power Supply:

The Power supplies will operate from 240V AC, and produce a 24V and 48V DC output voltage at full load current

Voltage regulation	:	0.02% for ± 10% mains voltage variation
Load regulation	:	0.3% from zero to full load conditions
Triple at full load	:	<1 mV rms

The power supply shall incorporate an over voltage protection circuit, the components of which shall be independent of the voltage regulating circuit.

The protection circuit shall operate within 50ms of an over voltage occurring and shall cause rupturing of the mains input or output fuses.
Automatic reset of the over voltage protection circuit is not permitted.

14.2.14.Harmonic Filter

Harmonics generated in electrical systems shall be limited to 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.

14.2.15 Motors

The bidder shall strictly adhere to following condition while selection of motor:

i. Motors of 3000 rpm are not acceptable. In turn the bidder shall not consider pumps/ drives of 3000 rpm/ 2900 rpm. 2 pole motor shall not be considered anywhere in the project.

ii. Bidder shall take in general 15% additional safety factor while selecting the motor's KW. Bidder while selecting motor size shall take 25% safety margin for motors up to 5 KW and 15% safety margin for motors rated above 5 KW. Safety margin is defined as safety on top of EKW required by pump plus

efficiency of motor.

iii. All the motor shall be provided with class F insulation and with temperature rise limit of B class above ambient temperature when operating at full load.

iv. All the motors shall have overloading capacity as per latest revision of IS.

v. The noise level during the operation of the pump sets/ drive shall not exceed 85 dBA at a distance of 1.86 m from the pump/drive.

vi. The mechanical vibration limits shall be as required by BS 4675: Part 1 to class III, subclass B or better. Vibration measurements on the drive and non-drive end of motor bearing, pump bearing housing and base plates shall not exceed 2.8 mm/sec. RMS within ± 10% rated head, while the limit is 4.5 mm/sec RMS for balanced portion from shut off to maximum flow. The above indicated vibrations shall be measured at the manufacturer's works during testing. For the purpose of guarantees the site tests shall govern.

vii. All motor shall be on LT system. However, the motors above 75 KW shall be of slip ring type.

14.2.16.Lighting Fixtures:

14.2.16.1. Luminaries

a. Luminaries shall be designed for continuous trouble-free operation without reduction in lamp life or without deterioration of materials and internal wiring. Outdoor fitting shall be weather-proof and rain proof type confirming to minimum IP-54 protection.

b. The luminaries shall be designed so as to facilitate easy maintenance. Including cleaning, replacement of lamps/ starters etc.

c. Connections between different components shall be made in such a way that they will not work loose by small vibration.

d. All luminaries shall be supplied complete with lamps suitable for operation on a supply voltage and the variation in supply voltage and frequency indicated in the KMC's Requirement.

e. Fluorescent type, metal halide and sodium vapour type luminaries shall be complete with accessories like lamps, ballasts, power factor improvement capacitors, starters, re-wireable fuse and fuse base. These shall be mounted as for as possible in the luminaire housing only. If these cannot be accommodated integral with the Luminaires then a separate metal enclosed control gear box shall be included to accommodate the control accessories together with a terminal block suitable for loop-in, loop-out connections. Outdoor type fixtures shall be provided with outdoor type weather-proof box. No mercury vapour lamps shall be used indoor & outdoor. Mainly sodium vapour lamps shall be used outdoor.

f. Fluorescent type Luminaires with single or double lamp shall be provided with electronic ballasts and these luminaire shall be used up to maximum height of five meters..

g. Each luminaire shall have a terminal block suitable for loop-in loop-out and T-off connection by 250/ 400V, 1 core, PVC insulated copper/ aluminium conductor wires up to 4 sq.mm. in size. In outdoor areas the termination at the luminaire shall be suitable for 1100V, PVC insulated, copper/ aluminium conductor, armoured cables of sizes up to 6 sq.mm. alum. conductor or suitably sizes cable as per design. Terminals shall be of stud of clamp type. The internal wiring shall be by means of insulated copper wire of

minimum 1.5 sq.mm. size and terminated on the terminal block. Terminal blocks shall be mounted with minimum two fixing screws.

h. Mounted facility and conduit knock-outs for the luminaries shall be provided.

i. Earthing

Each Luminaire and control gear box shall be provided with an earthing terminal.

All metal or metal enclosed parts of the luminaire/ control gear box shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing continuity

j. Painting/ Finish

All surfaces of the luminaire control gear housing accessories shall be thoroughly cleared and degreased. It shall be free from scale, rust, sharp, edges and burrs.

The luminaire housing shall be stove-enamelled/ epoxy stove-enamelled - vitreous enamelled or anodized as indicated under various types of fittings.

14.2.16.2. Decorative Luminaire

Fluorescent Luminaires shall be provided as per following guide lines :

a. These luminaries shall be generally indoor type provided with cold rolled cold annealed (CRCA) sheet steel channel/ rail cum reflector housing complete with all electrical control accessories mounted on it. The finish shall be stove enamelled.

b. Decorative fluorescent type luminaries shall be provided with aluminium louvers providing minimum glare at work station.

c. Luminaires shall be suitable for the number of lamps of specified wattage, direct mounting on ceiling/ wall/ column pendant mounting or for recess mounting in false ceiling.

d. Decorative luminaries with mirror optic reflectors shall be of the wide angle dispersion type. Where these luminaries are mounted in control rooms and computer rooms, clip-on type adjustable reflectors which can be attached onto the tube shall be provided to direct the light output in the desired direction. This is mainly to reduce reflection of the light source form TV/ monitor screens.

e. Luminaires mounted recessed in false ceiling shall be with reflector housing and spring loaded fixing arrangement for the diffuser/ louver frame. It shall be possible to have access to the lamp and other accessories from below.

14.2.16.3 Industrial Luminaires

Fluorescent Luminaires shall be provided as per following guidelines :

a. The luminaire shall be provided with CRCA sheet steel mounting rail with reflector of minimum 22 SWG thickness and complete with all control accessories mounted on it. The finish shall be vitreous enamelled.

b. Luminaires shall be suitable for the number of lamps of specified wattage, direct mounting on ceiling/ wall/ column/ pendent mounting.

c. The distribution of light shall be such that at least 80% of the total luminous flux from the luminaire shall be in the lower hemisphere.

d. The luminous output of the luminaire with reflector shall hot be less than 75% irrespective of type of reflector used.

e. Luminaires for use in areas where chlorine is stored or dosed shall be fully enclosed to IP-65 and

have a luminaire body constructed of GRP or some other non-metallic material resistant to attack by chlorine.

14.2.16.4. Incandescent/ Metal Halide / Sodium Vapour Luminaires

14.2.16.4.1. Bulk head Luminaire

The Luminaire shall be robust construction, with cast aluminium/ vitreous enamelled housing, heat and shock resistant prismatic or clear glass cover fixed with neoprene gaskets for sealing. For mechanical protection to the glass cover, round steel wire guard with vitreous enamelled finish shall be provided.

The Luminaire shall be suitable for incandescent lamp up to 150 watts, for direct mounting to ceiling/ walls/ column and used for general purpose indoor lighting.

14.2.16.4.2. High and Medium Bay Luminaires

High medium bay luminaries shall be with cast aluminium housing, anodized aluminium mirror polished reflector canopy with eye bolt for suspension, cooling fins and glass cover.

The luminaire shall be suitable for metal halide up to 1000W and sodium vapour lamps up to 400 watts. The control gear accessories shall be mounted integral with the luminaire.

High bay luminaries shall be used when the mounting height is above 8 meters while medium bay luminaries shall be used when the mounting height is around 5 to 8 meters.

14.2.16.4.3. Flood Light Luminaries

a. General purpose flood Light Luminaries

Flood Light luminaries shall be of weather proof construction with cast aluminium housing, anodized aluminium mirror polished reflector, heat resistant, toughened glass cover and necessary neoprene gaskets to prevent ingress of dust.

The housing shall be supported on a cast iron base and capable of being swiveled in both horizontal and vertical directions and locked in any desired position.

For focusing purposes, knobs, shall be provided along with sector plate indicating the angle in degrees between 0-90 degrees, in vertical direction.

The Luminaries shall be suitable for single and dual metal halide or sodium vapour lamps up to 400 watts. When metal halide or sodium vapour lamp specified, the same shall be mounted in a separate sheet metal enclosed/ cast aluminium weather proof control gear box.

The luminaries shall be provided with cable gland on the canopy in down ward direction for cable connection.

It shall be possible to adjust the lamp position to achieve wide beam, medium beam or marrow beam.

It shall be possible to replace the lamp from the canopy without opening the front glass.

b. Outdoor Lantern Luminaires Post top Lantern

Post top lantern Luminaires shall be generally outdoor weather proof type of illumination of

walkways, gate posts, gardens or in front of office area only.

The luminaire shall have cast aluminium spigot of 50/60 diameter finished with corrosion proof paint for mounting, opal acrylic or high density polyethylene (HDP) diffuser bowl, complete with integral mounted control gear, neoprene gaskets, earthing terminal etc

.

14.2.16.4.4. Street Lighting Luminaires

a. Fluorescent Luminaries:

Street lighting fluorescent luminaire shall be outdoor weather proof type for illumination of secondary roads, walkways, peripheral lighting of buildings etc.

The luminaire shall be of semi-cut off or non-cut off type, CRCA sheet steel housing, vitreous enamelled, plain or corrugated clear acrylic cover, complete with integral mounted control gear, neoprene gaskets, side pipe entry or top suspension type.

The outdoor luminaire shall have IP 55 enclosure.

b. Sodium vapour luminaries

Street light sodium vapour luminaries shall be outdoor weather proof type for illumination of main roads, traffic islands etc.

The Luminaire shall be of semi-cut off with cast aluminium housing, acrylic or prismatic cover, polished aluminium reflectors, complete with integral mounted control gear, neoprene gaskets and with near pipe entry.

The luminaire shall be suitable for 1 x 150W/ 1 x 250W/ 2 x 150W / 2 x 250W sodium vapour lamp and for mounting heights up to 9 meters from natural ground level.

c. Emergency Light Luminaires

Emergency light of installed luminaire shall be indoor type for providing emergency light during failure of normal AC supply.

The luminaire shall be with CRCA sheet steel enclosure, complete with metallised mirror reflector, leak proof re-chargeable battery rated for two hour discharge, battery charger, charger-on lamp, push button switches, automatic changeover switch/ relay, two meter length cord with plug, mounting pads and other accessories required for satisfactory operation of the luminaire.

The luminaire shall be suitable for connection to 240V, 50 Hz single phase supply. On failure of normal A.C supply the luminaire shall pick-up automatically and on restoration of A.C supply the luminaire shall switch off automatically. The luminaire shall be suitable for incandescent lamp up to 40W or fluorescent lamp up to 20 watts.

14.2.16.4.5. Accessories for Luminaires

a. Reflector

The reflectors shall be made of CRCA sheet/ aluminium/ silvered glass/ chromium plated sheet copper as indicated for above mentioned luminaries.

The thickness of steel/ aluminium shall comply with relevant standards. Reflectors made of steel shall have vitreous enamelled finished. Aluminium used for reflector shall be anodized/ epoxy stove enamelled/ mirror polished. The finish for the reflector shall be as indicated for above mentioned fittings.

Reflectors shall be free from scratches or blisters and shall have smooth and glossy surface.

Reflectors shall be readily removable from the housing for cleaning and maintenance without disturbing the lamps and without the use of tools. They shall be securely fixed to the housing by means of positive fastening device of captive type.

b. Lamp/ Starter Holders

Lamp holders shall have low contact resistance, shall be resistant to wear and shall be suitable for operation at the specified temperature without deterioration in insulation value. They shall hold the lamps in position under normal condition of shock and vibration met with under normal installation and use.

Lamp holders for the fluorescent lamps shall be of the spring loaded bi-pin rotor type. Live parts of the lamp's holder shall not be exposed during insertion or removal of lamp or after the lamp has been taken out. The lamp holder contacts shall provide adequate pressure on the lamp cap pins when the lamp is in working position.

Lamp holders for incandescent, mercury vapour and sodium vapour lamps shall be of Edison Screw (E.S.) type.

The starter holder shall be so designed that they are mechanically robust and free from any operational difficulties. They shall be capable of withstanding the shocks met within normal transit, installation and use.

c. Ballasts (Electronic)

The ballasts shall be designed to have a long service life, low power loss &high power factor.

Ballasts shall be mounted using self-locking, anti-vibration fixings and shall be easy to remove without demounting the fittings. They shall be in dust tight, non-combustible enclosures.

Separate electronic ballast for each lamp shall be provided in case of multi lamp luminaries, except in the case of 2 x 20W luminaries.

Electronic ballast shall have very high power factor (more than 0.95) and harmonic distortion shall be less than 10%.

Voltage variation of ballast shall be between 140-320V.

d. Lamps

Incandescent lamp

General Lighting Service (GLS shall be tungsten filament incandescent type. The filament shall be coiled coil type rated for 230/250V, single phase A.C.

Lamps shall be with Edison Screw type metal lamp caps.

Lamps shall milky white for diffused, soft, glare free lighting and rated up to 100 watts.

Fluorescent Lamps

Fluorescent lamps shall be low pressure metal halide type with low wattage consumption and high efficiency and longer burning life (above 2500 hours).

Lamps shall be of white light type suitable for operation on 240V, single phase A.C in standard lengths of 2, 4 and 5 feet and ratings up to 65 watts.

Lamps shall be provided with features to avoid blackening of lamp ends.

High intensity discharge lamp

These lamps include high pressure metal halide lamps and high pressure sodium vapour lamps.

High pressure metal halide lamp shall be with quartz discharge tube, internal coated shall, quick restrike time (of within 8 minutes) and with burning life (above 10000 hours) in standard ratings up to 400 watts.

High pressure sodium vapour lamp shall be with polycrystalline translucent, coated discharge tube, coated shell, quick restrike time (of within 5 minutes) and with burning life (above 10,000 hours) in standard rating up to 400 watts.

14.2.16.5. Lighting System Equipment - Main Lighting Distribution Boards and Lighting Panels (AC & DC)

Construction Features

Boards and panels shall be sheet steel enclosed and shall be fully dust and vermin proof, providing a degree of protection of IP-52. Outdoor panels shall in addition be completely weather-proof with a sloping canopy for protection against rain and providing a degree of protection of IP-55. The sheet steel used for frame shall be cold rolled of 2.0mm thick or 2.5 mm hot rolled and all frame enclosures, doors, covers along with partitions will be of same thickness.

All boards and panels shall be provided with hinged doors for access to equipment. Doors shall be gasketed all round with neoprene gaskets. For the main floor mounted distribution boards with the switch fuse units arranged in tier formation, the hinged door of each unit shall be interlocked so as to prevent opening of the door when the switch is ON and to prevent closing of the switch with door not fully closed. However, a device for by-passing the door interlock shall be provided to enable the operation of the switch with the door open, when necessary, for examination/ maintenance. For wall mounting 1- phase ways lighting panels wherever provided with MCBs, arranged latched front door shall be provided with key-locking facility and slotted bakelite sheet shall be provided inside. Only the MCBs operating knobs or the fuse cap covers shall project out of the bakelite sheet slots for safe operation and neat appearance. Incomer to lighting panels shall be provided with TPN MCB with RCCB. Lighting panels shall be manufactured with 1.6 mm cold rolled sheet.

All accessible live connections/ metals shall be shrouded and it shall be possible to change individual fuses, switches, MCBs from the front of the board panels without danger contact with live metal.

For floor mounting type distribution boards, adequately sized mounting channel shall be supplied and for wall/ column/ structure mounting type panels suitable mounting straps shall be provided.

Adequate interior cabling space and suitable removable cable entry plates shall be provided for top/ bottom entry of cables through glands and or conduits as required. Necessary number of glands to suit the specified cable sizes shall be provided. Cable glands shall be screwed on type and made of brass.

Two earthing terminals shall be provided.

All sheet steel parts shall be undergo rust-proofing process which should include degrading de-scaling and a recognized phosphating process. The steel works shall be then painted with two coats of Zinc-chromate primer and two coats of final stove-enamelled finish paint of specified colours.

14.2.16.6. 415V, 3 Phase Switch Socket Outlets (Receptacles):

Switch socket outlets shall be suitable for operation on 3 phase, 4 wire, 50 Hz supply system. The switches and sockets shall conform to relevant standards. These units shall be housed in epoxy painted sheet steel boxes and shall be suitable for outdoor installation. The units shall be fed from power distribution boards / switchgear etc. located in relevant areas.

14.2.16.7. Receptacles (Lighting and Small Power) :

Decorative and industrial type receptacle (receptacle means a combination of a socket and a switch) units of approved make with switches shall be supplied. The units shall be suitable for mounting flush or within painted sheet steel boxes. Decorative receptacles shall be 5A / 15A rated with 5 pin sockets and 15A switches. Industrial receptacles shall be of 20A rating along with MCB.

14.2.17.Ceiling Fans & Exhaust Fans:

Ceiling fans shall be provided in areas such as offices, stores etc. Adequate ventilation arrangements shall be made for enclosed areas where ceilings fans are not proposed to be installed or cannot be provided.

Power supply for the ceiling fans shall be derived from lighting circuits. Ceiling fans shall be complete with all accessories. Regulators shall be electronic type. Heavy duty exhaust fans shall be installed in plant rooms as to achieve a 20 air changes per hour.

14.2.18.Diesel Generator:

The Scope of Work covers the design, Manufacturer; testing supply of suitable capacity D.G. set which including the following:

a) Alternator along with its excitation system auxiliaries, circuits, control panel, metering and protection circuits.

b) Diesel engine along with its accessories and starting system.

c) Flexible / semi flexible couplings.

d) Common heavy-duty channel for base frame supported by anti-vibration damper at bottom.

e) Cooling arrangements etc.

f) Exhaust piping with heavy-duty residential type silencer, insulation of exhaust piping and etc height of piping as per pollution control regulation.

g) Starting lead Acid batteries with battery charger having trickle and boost charging arrangements complete with Ammeter with switch and voltmeter with fuse and switch to read battery voltage, starting motor, fuel oil, service tank, fuel oil piping etc.

h) All control and power wiring between D.G. set, control panel batteries, safety controls, pumps and AMF panel etc.

i) First fill of fuel oil, lubricating oil; etc including cleaning and flushing out of the system after the test at manufacture facility.

j) Fuel and oil for testing, trials runs and up to commissioning

k) Obtaining all licenses, approval from local authorities including but not limited to any or all of the following:

1) Electric Supply Utility.
2) Electrical Inspector of Govt. of Uttar Pradesh.
3) Pollution Control Board.
4) Fire Department of the local Fire Brigade.
5) Traffic Advisory Committee.
6) Municipal Corporation.

All requirement offered shall be provide design and reliable in operation. Diesel Generator set capacity specified is at site condition.

The Tenderer shall specify in detail all equipment offered including auxiliaries, associated piping, cabling based on typical layout

DG set with individual Auto Transfer starting facilities is required to provide electric power to the essential loads in the events of failure of normal power supply or when normal supply is switched off under abnormal conditions like fire. When normal power fails or is tripped manually, the D.G. set should start automatically and restore electrical supply for essential loads. It should have provision to start all the equipments one by one so as to reduce higher starting current. The DG set shall Also, run continuously to supply power to the loads till restoration of normal power supply.

The starting time of the DG set should be as less as possible, but not exceeding 15 sec. to come on load. In case the first starting operation is not successful, two more attempts with preset time intervals should be attempts; the particular set should be locked out. When an engine speeds up and alternator develops desired voltage in frequency, generator circuit breakers will be switched on.
Both the engine and Generator shall be rated for continuous duty at full load and have an overload capacity of 10% for an hour in 12 hours operation. The excitation system shall be designed to maintain the rated voltage constant even if a load of 150% of rated load is imposed on to the Generator for duration of 15 secs. Tenderer shall indicate power consumed by auxiliaries along with the Tender document.

The diesel engine shall be indoors type, multi cylinder, totally enclosed, continuous duty, direct fuel injection, series Turbo charged compression ignition, complete with its self-contained lubricating system. The lube oil system shall be provided with Engine Driven Lube Oil Pump only.

The Contractor shall carry out the installation of the DG sets including but not limited to the following:

a) Installation of the DG Set, testing, commissioning, alignment, mounting along with AVM pads on ready floor, foundation to be made by the Contractor and the cost shall be included in the rate for supply and installation of the D.G. set.
b) Installation of fuel oil system complete with day tank and Lube oil system with necessary piping, valves, fittings, supports, etc.
c) Installation of air intake system, exhaust gas system complete with residential type silencer, expansion bellows, etc. and necessary piping, valve, fitting. Supports etc.
d) Installation of Auto Transfer Switch and any other electrical panel.

e) The Contractor to supply and install the required 8" Dia MS exhaust pipe up to the required height (as stipulated by Pollution Control Board Authorities) above the building in which the D.G. set are housed. The scope Also, includes providing insulation.
f) Installation and charging of battery along with leads, battery stand, etc.

The fuel used for the DG set shall be High-speed diesel (HSD) only. The day tank shall be filled manually by operating Hand pump. In order to transfer fuel from day tank to engine has to be done through fuel transfer pump which should be engine driven only. The fuel oil day tank shall be provided with gauge glass, filling, drainage and vent connections with valves.
Radiator shall be offered by the Contractor to cool the water received from the engine or any other cooling system as specified by Engineer-in-charge.

Manual Electrical starting arrangements of the engine in case of power failure shall be provided. The system will consist of DC starter motor mounted on turning gear will receive power from the set of 24V DC Batteries.

The generator shall Also, conform to 15 4722 or equivalent.

Tests
1. Equipment shall be tested to conform to the appropriate standard and the following tests shall be conducted in the presence of purchasers.
2. Functional tests, continuity tests and high voltage test on control panel to establish the performance called for in the specification.
3. Power frequency voltage test on switchgear and mechanical / electrical operation check.
4. Routine test for alternator as per IS 4722.
5. Over speed test (1.2 times the rated speed for 2 minutes)
6. Transient response tests for sudden application and rejection of loads of 25°/0/ 50%, 75%, and 100% of rated capacity.
7. Wave from test (type test result are acceptable).
8. Please sequence test.
9. Vibration test.
10. Noise level test
11. Dimensional and alignment.

14.2.19.Samples:

Contractor shall be required to obtain the KMC approval for samples of items such as lighting fixtures of each type, ceiling fans, switch socket outlets of each type and rating, light/fan control switch of each type and rating, push buttons, conduits of various sizes, junction boxes, cable trays, wires and earthing conductor to be used for lighting system etc. before commencement of installation work.

14.3. DRAWINGS:

Following minimum data / information shall be made available on contractors drawing:
a). Single line diagrams for AC and DC system.

i). All equipment with rating.
ii). Cable details for all circuits.
iii). Details of relays and major components related associated with each circuit.
iv). Bus bar details makes of equipment/ components.
v). Relevant reference drawings.

b). General arrangement drawings (equipment, cabling, earthing, lighting, lightning protection etc.).
i). Dimensional layout drawing composite layout of these items.
ii). Plans and sections as required to show access space/ clearances etc.
iii). Civil foundation details, details of cutouts, openings, supporting/ mounting details etc.
iv). Bill of material, identification of components / rooms / area etc.

14.4. INSPECTION OF EQUIPMENT:

a) Bidder shall note that, all equipment manufactured within India shall be inspected from reputed third party inspection agency such as SGS / Bureau VERITAS / . All costs towards inspection of this material shall be borne by the bidder. In case, the equipment are manufactured outside India then inspection shall be carried out by third party inspection agency such as SGS / Bureau VERITAS / .

.

b). Items of equipment/system not covered by standards shall be tested in accordance with the details and programmed agreed between the KMC and contractor.

c). If during or after testing any item of equipment/systems fails to achieve its intended duty or otherwise prove defective it shall be modified or altered as necessary, retested and reinspected as required by the KMC.

d). No equipment / system is to be delivered to site without inspection having been carried out or officially waived in writing by KMC representative.

14.5. INSTALLATION WORK:

Equipment shall be installed in a neat, workman like manner so that it is level, plumb, square and properly aligned and oriented. Tolerance shall be as established in the manufactures drawing or as stipulated by KMC. No equipment shall be permanently bolted down to foundation of structure until the alignment has been checked and found acceptable by KMC.

Manufacturer's drawings, instructions and recommendation shall be correctly followed in handling, setting, testing and commissioning of equipment.

Contractor shall be required to obtain approval of KMC in respect of sample installations at commencement of any installation activity, these may include but be not limited to activities such as mounting of lighting fixtures/switch socket/switches/junction boxes etc., cable terminations, fixing of supports for cables/conduits etc., alignment/routes of cable/conduits/cable trays etc. More details in this regard shall be finalized with the contractor at site.

14.6. INSTRUMENTATION

14.6.1 Flow Measuring System

Flow measuring system shall consist of flow sensor/ transducers, flow computer and flow transmitter.

Flow transducers shall be rugged in construction and shall be suitable for continuous operation. Flow transducers shall have waterproof construction and shall be suitable for installation in underground/ above ground pipeline.

To avoid the effects of disturbances in the velocity profile, a straight and uninterrupted run, upstream as well as downstream from the location of the flow sensor shall be provided in accordance with the requirements of the flow meter manufacturer.

The flow transmitter shall be suitable for field or panel mounting and shall accept an input from the flow sensor. It shall process the input signal and provide 4-20 mA dc output proportional to flow rate. The flow range shall be adjustable.

A zero span adjustment facility shall be provided for flow transmitter and indicator.

Flow measurement shall not be affected by physical properties of sewage viz., temperature, pressure, viscosity, density etc., within given limits. Contractor shall provide compensating electronic circuits if required. The overall accuracy of flow measuring systems shall be at least ±1.0% of the measured value unless otherwise stated.

14.6.1.1. Electromagnetic Flow meter

Full bore electromagnetic flow meter shall consist of flow sensors (i.e. flow tube), transmitter and remote flow indicator cum integrator.

The flow meter shall have flanged connection and shall be inserted in the sludge line.
The flow computer/ transmitter shall be microprocessor based and shall have diagnosis facility.

Remote flow indicator cum integrator shall be provided on the control panel.

To ensure full electromagnetic compatibility the flow tube flanges and transmitter housing shall be connected earth.

14.6.1.2. Open Channel Flow Meter

Open channel flow measuring system shall consist of level transducer, flow computer and flow transmitter. The level of the fluid in the flume shall be measured by the ultrasonic level transducer. The level measured shall be used along with the physical characteristics of the flume to compute the flow rate.

The level transducer shall be suitable for flange or bracket mounting as required and shall be environmentally protected as per IP65. it shall have ambient temperature compensation and adjustable datum setting facilities.

The design and application of ultrasonic level meter shall take into account the channel construction, the

material size, shape, environment, process fluid or material, the presence of foam granules, size etc.

The installation shall avoid any degradation of performance from spurious reflections, absorption, sound velocity variations, sensor detection area, temperature fluctuation, specific gravity changes and condensation. For application where spurious reflections are unavoidable the control unit shall be provided with facilities for spurious reflection rejection.

The structure required for supporting the level sensor, platform, railings etc. shall be in the Contractor's scope.

14.6.2 Level Measuring System

14.6.2.1. Ultrasonic Level Meters

Ultrasonic level measuring devices applied for liquid level measurement shall comprise a transducer, control unit and remote indicator.

The transducer shall be suitable for flange or bracket mounting as required and shall be environmentally protected to IP65.

The design and application of ultrasonic level meters shall take into account the vessel or channel construction, the material, size, shape, environment, process fluid or material, the presence of foam granules, size etc.

The installation shall avoid any degradation of performance from spurious reflections, absorption, sound velocity variations, sensor detection area, temperature fluctuations, specific gravity changes and condensation. For applications where spurious reflections are unavoidable the control unit shall be provided with facilities for spurious reflection rejection.

If turbulence exists, shielding, stilling tubes or other measures shall be provided to avoid effects on the measurement.

14.6.2.2. Conductivity Level Switches

The electrodes used for conductivity level switches shall be stainless steel. Single electrode systems (one electrode per holder) shall be used (except where their use is impractical) with insulated electrodes such that only the tip of each electrode is exposed to the liquid at the operating level.

Relay or control units operating with level electrodes shall have adjustable sensitivity. Electrodes for use in fluids of low or variable conductivity shall be fitted with conductivity discs.

Where relay or control units are not mounted in control panel, they shall be provided with surface mounting enclosures with a degree of protection to IP-54 for indoor locations or IP 65 for outdoor location.

14.6.2.3. Ultrasonic Differential Level Measuring System

The ultrasonic type differential level measuring system shall consist of ultrasonic type level sensors on upstream and downstream of screens, differential level computer / transmitter and indicator.

The flow computer / transmitter shall be microprocessor based and shall have facility for programming (i.e. adjustment of set points).

The ultrasonic transducer shall be suitable for flange or bracket mounting as required and shall be environmentally protected as per IP-65. It shall have ambient temperature compensation and adjustable datum setting facilities.

1.6.3. Pressure Gauges

Pressure gauges shall comply with BS 1780. Snubber shall be provided where the gauge is subjected to pressure pulsations and / or vibrations. The internal parts of pressure gauge shall be of stainless steel material. In chlorine applications the diaphragm shall be silver or tantalum for other fluids an appropriate diaphragm material shall be used. The pressure gauges shall be provided with diaphragm seal arrangement.

The minimum diameter for round pressure gauges shall be 150mm unless specified otherwise or where the gauge forms part of a standard item of equipment.

The accuracy of pressure gauges shall be ±1% over the operating range.

The zero and span of pressure gauges shall not change by more than ±0.1% of the span per __OC changes in ambient temperature.

14.6.4. Surge Protection Devices

Surge protection devices (SPDs) shall be suitable for withstanding the surge arising out of high energy static discharge / lighting strikes and protect the instrument to which it is connected against damage. SPDs shall provide protection through the use of quick acting semi-conductors like Tranzorb, zener diodes, varistors and an automatic disconnect and reset circuit. SPDs shall be passive and shall require negligible power for operation. During the occurrence of a surge, it shall clamp on the allowable voltage and pass the excess voltage to the ground. The SPD shall be self-resetting to minimize the down time of the measurement loop.

SPDs shall be provided to protect devices transmitting and receiving analogue and digital signals derived from field devices located outdoors.

The surge protection device shall be rated for surge rating of 10kA.

14.6.5. Cabinets for Field Instruments

Wall mounted cabinets shall be provided for enclosing transducer unit and associated accessories which are mounted outside the main control panel. The cabinet shall be of die-cast aluminium, field provided not less than IP-55 protection and shall be lockable. The cabinet shall have facilities for earthing. A steel plate shall be provided inside the cabinet for mounting instrument and accessories.

14.6.6. Alarm System

Alarms shall be initiated by the opening or closing of volt-free contacts which shall remain unchanged throughout the periods in which the alarm conditions exit. Alarm Circuits shall be cable of conversion from open-healthy to open-alarm or vice versa by a simple modification after installation requiring no additional parts or special equipment.

Each alarm shall initiate the operation of both visual and audible devices.

Audible devices in the same room or area shall have distinguishable sounds and adjustable sound levels.

14.6.7. Matrix Type alarm Annunciators

The alarm annunciator shall be microprocessor based, modular, split type unit with alarm windows mounted on the front door and electronic modules inside the panel. The weather protection class for alarm annunciator shall be IP-54 of IS 13947, Part-I.

Each alarm shall initiate a visible and audible indication of the specified condition. Unless otherwise specified, alarm indicators shall be grouped together in annunciator units each having at least 20% spare ways. Alarm indicator lamps (Cluster LED type) and shall have transparent screens engraved with legends approved by the KMC's Representative. The legend area of each indication shall not exceed 40mm high and 75mm wide.

When any alarm condition occurs, a condition device common to an alarm annunciator system shall sound and the appropriate indicator shall flash on an off. The flashing rate shall not be less than 2 Hz and shall not exceed 5 Hz. On pressing an accept pushbutton, the audible device shall be silenced and the flashing light shall become steady. The alarm indicator shall remain illuminated until the alarm condition ceases and a reset pushbutton has been operated.

The operation or acceptance of one alarm shall not inhibit the operation of the audible device or the flashing of the appropriate alarm indicator if a further alarm condition occurs. At unmanned locations alarms operated on two or more annunciators shall require acceptance at each annunciator.

Alarms shall be accepted automatically and the appropriate audible device silenced after an adjustable period of 1 to 5 minutes.

An integral 'test' pushbutton shall be provided to illuminate each lamp in the appropriate group and to operate the audible device but shall not cause a spurious alarm condition on any other annunciator.

Alarm circuitry shall be arranged so that spurious or transient alarm states persisting for less than 0.5 seconds do not initiate any action.

Alarm annunciator / indicator legends or labels shall be arranged with three lines of text as follows:

Topline Location
Middle Line Parameter

Bottom Line Status

e.g. reservoir 1
level high & level low

14.6.8 Uninterruptible Power Supply (UPS)

The UPS shall be floor mounted; self-contained and metal clad and shall be suitable for operating on a non-linear load.

It shall be front door accessible.
The UPS system shall be true On-Line.

The ON LINE UPS shall be incorporating a six-pulse rectifier and pulse width modulation inverter technology with 100% microprocessor control with built in static and manual bypass switch.

The UPS shall incorporate a DC under voltage trip circuit to electrically trip the UPS in order to protect the battery.
The noise level of the unit shall not exceed 60dB (A) at 1m from the UPS cabinet.

The output of the inverter shall be a sine wave having less than 5% THD for linear loads and less than 4% to 50% non-linear load. It shall be suitable for load power factor 0.8 lag.

The unit shall have dynamic response such that a 100% step load causes an output voltage transient of less than ±4% with a recovery time of less than 4 ms.

For three phase output units the output voltage shall not very by more than ±1% for an unbalance for 10%.
The load crest factor shall not be less than 3:1.
The efficiency at full load and 0.8 power factor shall be greater than 88%.

Indicators to indicate
UPS status
UPS alarm conditions

The UPS shall provide a volt free contact output to indicate:
Warning. i.e. low battery capacity
Fault
Static bypass in use.

The UPS shall have an overload capacity of 150% for 30 seconds and shall be protected in the event of a short circuit of the output.

The batteries shall be housed, either within the UPS enclosure or within a separate matching battery cubicle suitable for location adjacent to the UPS.

The batteries shall be maintenance free lead acid type sealed for life.

Terminals shall be shrouded to prevent accidental contact. The battery enclosure shall be corrosion resistant and ventilated to prevent the buildup of gases.

Warning notices shall be provided for wall mounting to warn of the presence of charge gases.

The battery supply of the UPS shall be via a fused load break switch dis-connecter circuit breaker.

The battery recharge time to 90% of full charge shall be approximately ten times the discharge time at full load.

The UPS battery shall have a backup of 120 minutes at full load and supported with inverter of suitable capacity.

14.6.9 Air Conditioning / Air Handling / Cooling and Ventilation / Exhaust:

The bidder shall design and provide AC / Air cooling / Ventilation and exhaust system as per the norms, regulations, statutory and process design requirement. The control room shall be provided with air conditioning of required capacity. All plant rooms shall be provided with push pull ventilation with air intake through a fan filter unit and exhaust with propeller fans. The design of supply air capacity should be based on 20 air changes per hour or heat load with inside temperature limited to a maximum of 5o C above ambient temperature. The equipment shall comprise of air intake louver, panel type filter, centrifugal air supply fan, GI ducting, Grills, propeller fans and their gravity louvers.

14.6.10 Testing / Inspection:

1.6.10.1.Tests on cables

Check details are in accordance with the specifications

Check for physical damage

Continuity Check, meggar test for insulation

Connections

No dark visible marks of armouring onto external surface

14.6.10.2. Tests on electrical installation

Check all closing, tripping, supervision and interlocking of control devices.

Check operation of all alarm circuits.

Check CT polarities, give primary & secondary injection.

Carry out relay calibration

14.6.10.3. Test on complete control system

On completion, the functioning of the complete system shall be tested to demonstrate its correct operation in accordance with the Specification.

For control system testing, the contractor may provide temporary means to simulate operating conditions, but the system will not be finally accepted until correct operation has been demonstrated to the satisfaction of the Engineer when all the pumps are operating.

The system shall be shown to operate correctly whatever the selection of duty and standby equipment may be.

Conditions to be tested shall include:
Normal automatic operation.
Normal manual operation
Emergency manual operation

14.6.10.4. Commissioning Tests

Correct operation of controllers shall be verified by observing that the final control element moves in the proper direction to correct the process variable as compared to the set point. All logic sequences shall be verified to operate in accordance with the specifications.

All defects and malfunctions disclosed by test shall be corrected immediately. New parts and materials shall be used as required and approved and tests shall be repeated.

A report certifying completion of validation of each instrument system indicating calibration values, verification that the system performs as per requirements and any provisional settings made to devices shall be provided. A format for commissioning checklist to be provided for approval before performing the commissioning tests.

14.6.10.5. Final Operational Testing and Acceptance

Upon completion of instrument calibration and system validation, all systems shall be tested under process conditions.

The testing shall include, but not limited to all specified operational modes, taking process variables to their limits (simulated or process) to verify all alarms, failures, interlocks and operational interlocks between systems and/ or mechanical equipment.

Any defects or malfunctions shall be immediately corrected using approved methods and materials and the tests shall then be repeated.

Upon completion of final operational testing, a report shall be submitted, indicating that the total control system provided meets all the functional requirements specified herein. This report shall be made in the format approved by the Engineer. The Engineer shall certify this report and it shall constitute final acceptance of the control system.

14.7. COMMISSIONING:

After completion of installation works the contractor shall arrange to carry out following checks/tests in the presence of KMC representative / Engineer – in – charge.

1.7.1 Tests on Transformers:

a). Mechanical Completion Checks:

Compare name plate details with the specification.
Check for any physical damage, in particular of bushings and cleanliness of bushing.
Check for tightness of all bolts, clamps and connecting terminals.
Check for oil leakage and oil level.
Breather condition, check whether breathing line is free, silica gel is reactivated, oil is available at the bottom.
Check for clearances.
Water tightness of terminal boxes.
Earthing of transformer tank and neutral.
Ensure that all cooler and header valves are open
Check that the transformer is correctly installed with reference to it phasing.

b). Commissioning Test:

Test oil for dielectric strength as per IS.
Insulation resistance test of windings.
Test the transformer for the following.
Voltage/ turns ratio at all the taps.
Winding resistance at all the taps.
Short circuit impedance (at low voltage)
Magnetic balance
Core loss at normal tap at low voltage.
IR and PI.
Vector group test.
Phase sequence test.
Test the current transformers for following.
Continuity test.
Polarity test.
Insulation resistance test.
Magnetization characteristics.
Rough ratio test (if bushing CTs provided prior to mounting of busing)
Measurement of secondary winding resistance.
Line connection as per phasing diagram.
Winding resistance.
Insulation resistance of control wiring.
Buchholz relay operation (for alarm and trip)
OLTC control indicating and alarm circuit. (if used)
Operation test of all protective devices (electrical and mechanical) and interlocks.

Calibration of temperature indications (oil and winding) and temperature relays.

14.7.2 Tests of Motors:

a). Mechanical Completion Checks:

i). Compare name plate details with the specification.

ii). Check for tightness of all bolts, clamps and connecting terminals.

iii). Check ground connection.

iv). Bearing lubrication.

v). Check clearance inside terminal box.

vi). Megger testing of motor winding and cables.

vii). Motor winding, control and power cables continuity checks.

viii). Resistance of motor winding.

ix). Check / calibration if RTDs, BTDs for bigger motors, flow switches (in case of water cooled motors) and if any other instrument mounted.

b). Commissioning Test:

i). Controls and interlocks.

ii). Ready test and settings.

iii). Phase sequence and rotation.

iv). Starting and no load currents.

v). No load operation (observe variation, noise level, temperature of bearing and windings of motor , check speed of motor).

vi). On load operation, starting and running currents operation (observe variations, noise level, temperature of bearing and windings of motor, check speed of motors), vibrations.

vii). In case of closed loop arrangement for cooling the windings of motor, inlet and outlet temperature of the cooling air / water.

14.7.3 Test on Control Panels and Switchboards:

a). Mechanical Completion Checks:

i). Check name plate details of every associated equipment according to specification.

ii). Check for physical damage.

Iii). Check for tightness of all bolts, clamps and connecting terminals.

iv). Check earthing.

v). Switch developments.

vi). Each wire shall be traced by continuity tests and it should be made sure that the wiring is as per relevant drawings. All interconnections between panels/equipment shall be similarly checked.

vii). All the wires should be maggered to earth.

b). Commissioning Test:

i). Checks on relays, functioning of relays, simulation of fault for testing.

ii). Checks on motors.

Iii). Setting of relays, other alarm, tripping devices and interlocks as per scheme.

iv). Phase angle checks, measurement of magnitude and phase angle of current transformer secondary currents and potential transformer secondary voltage.
v). Functional checking of all power and control circuits e.g. closing, tripping, control, interlock, supervision and arm circuits including proper functioning of the components equipment. If inter locks are provided with other equipment, it shall be thoroughly tested.

14.7.4 Test of Relays:
a). Mechanical Completion Checks:
i). Check name plate details according to specification.
ii). Check for any physical damage.
iii). Check internal wiring.
iv). Megger all terminals to body.
v). Megger AC to DC terminals.

b). Commissioning Test:
i). Check operating characteristics over the entire range by secondary injection.
ii). Check minimum pick up voltage.
iii). Check operation of electrical /. Mechanical targets.
iv). Relay settings to be checked by injecting different values of current.
v). Setting of relays as per discrimination chart

14.7.5 Test for Meters:
a). Mechanical Completion Checks:
i). Check name plate details according to specification.
ii). Check for any physical damage.

b). Commissioning Checks:
i). Check calibration.
ii). Megger all insulated portions.
iii). Check CT and VT connection with particular reference to their polarities for relevant meters.

14.7.6 Tests for Circuit Breakers:
a). Mechanical Completion Checks:
i). Check name plate details according to specification.
ii). Check for any physical damage.
iii). Check for tightness of all bolts, clamps and connecting terminals.
iv). Check oil level, air pressure and leakage (wherever applicable).
v). Check earth connection
vi). Check cleanliness of insulators and bushings.
vii). Check all moving parts are properly lubricated.
viii). Check heaters provided.
Check alignment of breaker trucks for free movement, check operation of shutters.

b). Commissioning Checks:
i). Check control wiring for correctness of connections, continuity and IR values.
ii). Manual operation of breaker.
iii). Power closing / operating manually and electrically.
iv). Breaker tripping and closing time.
v). Trip free and anti pumping operation.
vi). IR values, resistance and minimum pick up voltage.
vii). Contact resistance.
viii). Simultaneous closing and mechanical interlocks provided.
ix). Check electrical and mechanical interlocks provided.
x). Checks on spring charging motor, correct operation of limit switch and time of charging.
xi). Checks on CTs.
xii). All functional tests.

14.7.7 Tests for Voltage Transformers:
a). Mechanical Completion Checks:
i). Check name plate details.
ii). Check for any physical damage.
iii). Check cleanliness of insulators.
iv). Check for tightness of all bolts, clamps and connecting terminals.
v). Check earthing connections.

b). Commissioning Checks:
i). Insulation resistance test.
ii). Polarity test.
iii). Ratio test on all cores.
iv). Line connections are per connection diagram.
v). Open delta test with low voltage, wherever required.
vi). Measure core loss from LT side.

14.7.8. Tests for Current Transformers:
a). Mechanical Completion Checks:
i). Check name plate details according to specification.
ii). Check for any physical damage.
iii). Check cleanliness of insulators and bushings.
iv). Check for tightness of al bolts, clamps and connecting terminals.
v). Check for oil level and leakage.
vi). Check connections.

b). Commissioning Checks:
i). Megger between windings, winding terminals and body.
ii). Polarity test.
iii). Ratio identification checking of all ratios on all cores by primary injection of current.

iv). Magnetisation characteristics, secondary winding resistance.
v). Capacitance and tan delta test.
vi). Dielectric test of oil (wherever applicable).

14.7.9 Tests for Isolators:

a). Mechanical Completion Checks:
i). Check name plate details according to specification.
ii). Check for any physical damage.
iii). Check cleanliness of insulators.
iv). Check for tightness of all bolts, clamps and connecting terminal.
v). Insulation resistance of each pole.

b). Commissioning Checks:
i). Manual and electric operation and interlocks.
ii). Correctness of connections, continuity and insulation resistance values of control circuits.
iii). Contact resistance of each pole / gap between male and female contacts.
iv). Earth connections of structures and operating handle.
v). Clearance in open and closed position.
vi). Simultaneous closing of all phases.

14.7.10 Tests for Cables:

a). Mechanical Completion Checks:
i). Check name plate details according to specification, check internal /outer dia. of cores, cross sectional area of conductor.
ii). Check for any physical damage.
iii). Megger test between each core and armour/sheet.
iv). Continuity check.
v). Connections.

14.7.11 Test for Battery:

a). Mechanical Completion Checks:
i). Check name plate details according to specification.
ii). Check for any physical damage.
iii). Dimensional check of plates (before assembly)

b). Commissioning Checks:
i). Specific gravity test.
ii). Cell voltage test.
iii). Capacity test.
iv). Initial charging cycle.

14.7.12 Tests for Battery Charger:

a). Mechanical Completion Checks:

i). Check name plate details according to specification.
ii). Check for any physical damage.
iii). Check Connections.

b). Commissioning Checks:
i). Functional check of auxiliary devices, such as alarms, indicating lamp etc.
ii). Insulation test of all circuits.
iii). Measurement of voltage regulation.
iv). No load current and voltage (AC) and voltage and current both AC and DC) at different points.
v). Voltage at tap cell (While boost charging).

14.7.13 Test for Electrical Installation:

a). Mechanical Completion Checks:
i). Check all closing, tripping, supervision and interlock of control devices.
ii). Check operation of all alarm circuits.
iii). Earthing:
Measure resistance of each earth electrode by isolating the same from station grid as well as from other earth electrodes.
- Check continuity of grid conductors and wires.

b). Commissioning Checks:
i). Cable Testing.
All 3.3 kV, 6.6 KV, 11 KV cables to be high voltage tested.
ii). In addition to above, any other tests specified by manufacturer shall be carried out as per manufacturer's instruction.
iii). Measure voltage across bearing pedestal insulation and between rotor shaft and bearing.

14.7.14 Miscellaneous:
Mechanical completion checks and commissioning tests on items not covered above, shall be carried out by the contractor as per the instructions of KMCrepresentative./ Engineer - in – charge.

14.8 Diesel Generator Set 1500 KVA at two locations

14.8.1 GENERAL

1. It will be complete responsibility of successful agency to carry out following Work without any extra cost. If any minor Work other than the considered items in required being carried out without any extra cost, which may please be noted.
2. The successful agency will be responsible to operate the D.G. Set after testing and commissioning for the period of two year including defects liability period of one years from the date of completion of Work. The agency is to deploy one operator and one helper with required minor materials and tools round the clock and should take care of the required operation and maintenance of D.G. set during power failures in coordination with regular maintenance and repair agency or as specified by Engineer-in-charge.

3. The agency is required to provide Diesel for the D.G. Set as per the requirements. The diesel tank should be full/90% capacity at all times. No laps on any accounts shall be tolerated. The payment of the same will be paid as per actual after producing required documents such as diesel consumption/cash memo etc.
4. The manual operation required for the D.G. Set is Also, included in this scope. The successful agency will have to operate the D.G. Set in coordination with the KMC's other Electrical departments and existing electrical M&R agency Uttar Pradesh Electricity Department supply is to be used as a standby supply during that period.
5. The agency is to bring adequate diesel required for the DG Set. They should operate the D.G. Set at least 10 minutes in a day and keep the D.G. set in full working condition at all times.
6. The D.G. Set provided is fully automatically operative condition. However, in case of any emergency, if the D.G. Set is not operating in its automatic mode, then the operator should be in a position to operate the D.G. Set in manual mode.
7. The agency should provide the manpower during the three shifts or as specified by Engineer-in-charge from time to time.
8. It will be the responsibility of the successful agency to obtain the necessary approval/sanctions from concerned authorities like Uttar Pradesh Electricity Department, Electrical Inspector, PWD, Pollution Control Board etc. before commissioning of the D.G. Set and same shall be submitted to Engineer-in-charge within the stipulated Contract period.
9. Successful agency will Also, be responsibility for carrying out comprehensive maintenance of total installation under Contract in addition to operation for a period of Five year including defect liability period of three year. This Also, included the replacement/ repairs of any defective parts and fuel and oil required, so as to ensure the required operation schedule.
10. In case if any breakdown/ power failure is notice due to negligence in operating the D.G. set during the emergency/during the required period, 2% of the total deposited amount against operation of D.G. set for the period of one year will be deducted as penalty for every incident.
11. Before quoting the Tenderer should inspect the present location where the D.G. set is to be kept and also, visit the site to collect the data for Work.
12. The successfully agency will have to design the scheme matching with existing system and Work will be started only after due approval to the scheme from Engineer-in- change.

14.8.2 SPECIAL REQUIREMENT

1.0 GENERAL

1.1 The entire electrical Work shall be carried out in accordance with specification without any extra cost. The Work shall conform to relevant Indian standard, Indian Electrical Acts and requirements of local electricity board.

1.2 For supervision, Contractor must depute qualified electrical engineer with sufficient experience for similar type of Work.

1.3 The Contractor shall employ only experience and licensed electrical / wiremen for the Work. Only licensed electrical Contractor are allowed to Work.

1.4 When the electrical installation is complete, the same shall be tested as per I.S. code, i.e. Regulations in front of Engineer-in-Charge and result are to be submitted in four sets.

1.5 The Contractor shall carry out all minor civil works connected with electrical Work. The Contractor shall repair and make good damage caused to the civil structure while carrying out the electrical works.
1.6 The foundation for panel board grouting of frames in wall etc is required to be carried out by the agency.

2.0 SCOPE
2.1 Supply, installation, testing and commissioning of D.G. set of desired rating, Auto transfer panel and power and control cabling Work and sound proof Enclosure (Acoustic canopy). DG set shall be provided for critical process requirement only i.e. to for load requirement of SBR air blowers, plant lighting & raw sewage transfer pumps.
2.2 The scope of Work Also, including the operation and maintenance of the D.G. set for the period of two year including the defect liability period of three year. It Also, including and breakdown maintenance / replacement of defective parts and providing require manpower for daily operation of same round the clock or completely as per the requirement of Engineer-in-charge.
2.3 DRAWING & SPECIFICATION
Drawing and specification shall be followed and if any deviation from the same is necessary to make the Work conform to the requirement, the same shall be called to the attention of the Engineer. If any discrepancy between specification, Drawing and BOQ is noticed the same shall be informed to the Engineer-in-charge before execution of the Work and higher standard amount the three will take precedence.

3.0 SHOP DRAWINGS
3.1 The Contractor prepares detailed shop drawing and submits for the approval of the Engineer before commencing the Work. The shop drawings showing all setting out details and physical dimensions of all complements in the system like conduits and cable, routes, location if HT & LT pane's, D.G. sets AMF panels, sound proof canopy and fixing details. Works shall not be comments without the approval from the Engineer for each working drawings. The drawing should include circuit diagram of the AMF panel.

4.0 BROCHURE AND DATA
4.1 The Contractor shall submit to the Engineer four copies of all brochures, Manufacturer description data and similar literature. One copy will be returned to the Contractor after approval.
5.0 SCALE
5.1 Electrical layout plans shall be drawn to scale as established on drawings and shall indicate the size and location of all equipment and accessories herein. The Contractor shall obtain all dimensions preferably at the building and check those plans for interference with the building structure and other plans for interference with the building structure and other equipment.

6.0 APPROVAL
6.1 The engineer’s approval of such drawings, schedule, brochures, etc. will be an approval of general details and arrangements only and shall not relive the Contractor from responsibility for deviation from drawings or specifications unless he had, in writing, called the Engineer attention to such deviations at the time of submission, nor shall it relieve the Contractor from responsibility for errors or commissions of any kind in the shop drawings when approved.

7.0 STORAGE

7.1 All materials and requirements shall be stored properly to the satisfaction of the Engineer so that physical handling and climatic conditions do not affect the equipment.

8.0 CUTTING & PATCHING

8.1 Cutting, patching and reading shall be kept to the minimum. Whenever this is required, advance approval of the Engineer shall be obtained before cutting and patching Work is taken up during the installation of Work. Those shall be subsequently finished properly to the satisfaction of the Engineer. Care shall be taken to prevent spreading of dust and debris and for protection of equipment and finishes.

9.0 PROTECTION

9.1 All Work equipment and material shall be protected at all times to prevent obstruction, damage or breakage. All equipment shall be covered and protected against water, dust and sand as well as chemical and/or mechanical damage. At the completion of the Work, all equipment shall be thoroughly cleaned and delivered in a perfect unblemished and working condition.

10.0 TESTING & COMMISSIONING

Testing and commissioning of complete electrical, accessories/equipment/ installations shall be carried out in the presence of Engineer-in-charge/ Uttar Pradesh Electricity Department officials as per the required norms/ directives at Manufacturers place and at site.

11.0 The Contractor shall furnish all labour and materials called for in this specification and accompanying drawings and shall install the system complete in every respect. Only license approved electrical Contractor/Sub Contractor are permitted to execute the Work.

12.0 GUARANTEE

The Contractor shall furnish one-year guarantee on all equipment and appliances. This shall include guarantee against defects in workmanship or material in any part or accessory. If any higher period is implied elsewhere in this Contract, the same shall hold a Govern. If any defects are found during the guarantee period, the Contractor at no additional cost shall replace the defective part or Work.

13.0 HANDING OVER OF INSTALLATION:\

13.1 The Contractor shall handover the complete installations to the Corporation in a clean, brand new and perfect working condition. Any area in which the Contractor has worked, shall be thoroughly cleaned of all debris and unwanted materials cleaned and handed over in a perfectly finished, ready to use condition.

14.0 DEVIATION & ORDERING MATERIAL

14.1 The Contractor must quote exactly as per specification bill of quantities and drawing.

14.2 The bill of quantities shall not be used as a basis for ordering materials and the Contractor shall be responsible for assessing the quantities of material to be ordered.

15.0 AS BUILT DRAWINGS

15.1 On completion of Work, the Contractor shall submit to the Engineer, a reproducible and five copies of "As Built" drawing showing:

1) LT Cable layout wherever required.
2) Single line diagram and complete electrical layout.

15.2 Contractor shall prepare operation and maintenance manual for the complete electric system under this Contract and submit the same in four sets.

16.0 MANUFACTURE TEST

The Contractor shall specifically perform all test such as routine test, type test on all equipment in the presence of KMC& Uttar Pradesh Electricity Department officials. All cost incidental to such test shall be deemed to have been included in the specific items of that equipment and no extra charge will be payable.

1.8.3 GENERAL SPECIFICATION

1. INTENT OF SPECIFICATION

This specification is intended to cover the design engineering manufacturing, fabrication. Assembly, testing at Manufacturer Work/delivery properly packed for transport, transportation up to site, erection, testing and commissioning at site suitable design capacity of D.G. Set. The D.G. Set shall run with HSD oil and shall be supplied complete with all the accessories described below for safe and trouble free commercial operation, in manner accepted to KMC Ltd.

2. CODES & STANDARD

The design, manufacture, shop testing, erection and commissioning of compression ignition diesel Engines and accessories shall conform to the following particular standard and codes, with latest revisions in addition to the relevant standards and manufactures own standards.

3. SCOPE OF WORK

The scope of Work includes design, manufacture, supply, transport to project site, handing erection testing and commissioning of Diesel Engine driven Generating sets in conformity with the specification given herein and the schedule of quantities.

The scope of Work covers the design, Manufacturer; testing supply of suitable capacity D.G. set which including the following:

a) Alternator along with its excitation system auxiliaries, circuits, control panel, metering and protection circuits.
b) Diesel engine along with its accessories and starting system.
c) Flexible / semi flexible couplings.
d) Common heavy-duty channel for base frame supported by anti-vibration damper at bottom.
e) Cooling arrangements etc.
f) Exhaust piping with heavy-duty residential type silencer, insulation of exhaust piping and etc height of piping as per pollution control regulation.

g) Starting lead Acid batteries with battery charger having trickle and boost charging arrangements complete with Ammeter with switch and voltmeter with fuse and switch to read battery voltage, starting motor, fuel oil, service tank, fuel oil piping etc.
h) All control and power wiring between D.G. set, control panel batteries, safety controls, pumps an AMF panel etc.
i) First fill of fuel oil, lubricating oil; etc including cleaning and flushing out of the system after the test at manufacture facility.
j) Fuel and oil for testing, trials runs and up to commissioning
k) Obtaining all licenses, approval from local authorities including but not limited to any or all of the following:
1) Electric Supply Utility.
2) Electrical Inspector of Govt. of Uttar Pradesh.
3) Pollution Control Board.
4) Fire Department of the local Fire Brigade.
5) Traffic Advisory Committee.
6) Municipal Corporation.

Installation and commissioning of the above D.G. Set is Also, including in the scope.

All requirement offered shall be provide design and reliable in operation. Diesel Generator set capacity specified is at site condition.

Generator shall be rated for critical process requirement only. The excitation system shall be designed to maintain the rated voltage constant even if a load of 150% of rated load is imposed on the Generator for duration of 15 Sec. Tendered to indicate power consumed by auxiliaries along with quotation.

The Tenderer shall specify in detail all equipment offered including auxiliaries, associated piping, cabling based on typical layout

PAINTING, PACKING AND TRANSPORT
All metal surfaces shall be thoroughly cleaned of scale, rust and grease, etc. prior to painting. Cleaned Surface shall be given two coats of primer and prepared for final painting. Final finish shall be free from all sorts of blemishes.

The equipment shall be shipped to site suitably packed to present any damage. Each package shall have labels to show purchaser name, purchase order and equipment number, suitable lifting lugs, etc. shall be provided and lifting points shall be clearly marked on the package. Packing shall be suitable for storage at site for a minimum period.

TEST AND INSPECTION
The owner or his authorized representative may visit the works during manufacture or equipment to assess the progress of Work as well as to ascertain that only quality raw materials are used for the same. He shall be given all assistance to carry out the inspection.

Detailed test procedure along with the facilities available at Contractor works shall be furnished as and when called for. Owner representative shall be given minimum four-week advance notice for witnessing the final testing. The Contractor shall furnish test certificate including test records and performances curves, etc.
The Contractor shall prepare and submit detailed shop drawing depicting the general arrangement of D.G. Sets, connected accessories, fuel tank, fuel oil piping, pumps, control panels, single line electrical diagrams for power and controls, exhaust piping, chimney, foundation details, etc. within 10 days of award of Work.

LOCAL REGULATION, BYELAWS, I.E.R. ETC
The D.G. Set installation will be generally governed by the following Regulations:

i) Indian Electricity Rules (1956 and latest revisions).
ii) Local regulations.
iii) Pollution Control Rules (State/Union Govt. Rules)
iv) Electrical Utility Co.
v) Fire Brigade.
vi) Electrical Inspector Approval.
vii) Tariff Advisory Committee.

OPERATION & MAINTENANCE MANUALS SPARE PARTS, TOOLS ETC.
The Contractor shall furnish operation and maintenance manuals in triplicate after installation of the D.G. Set. One set of special tools required shall be supplied at the time of handing over of the set to the Corporation. The price of these special tool set is deemed to be included in the rates quoted by the Tenderer. The bid letter shall list out such tools that will be handed over to the Corporation.

OPERATION OF THE SET AFTER INSTALLATION
The Contractor shall arrange to depute, free of charge, a Senior Operator to the site of works to operate the D.G. Set for a minimum period of four weeks after successful installation and approval of the installation by the local authorities. The operator shall impart training to the owners' operator/technicians in proper up-keep of the DG set.

COMPLETION DRAWING
On successful completion of the installation and before issuance of the certificate of virtual completion, the Contractor shall prepare and submit to the owner "as built completion". Drawings of the entire installation.

The completion drawings shall include:
Layout of D.G. St and accessories.
b) Exhaust piping arrangement.
c) Fuel oil tank and piping.
d) Electrical single line diagram, control wiring single line diagram, cable layout, panel GA drawings, etc.
e) Location of earth pits and Earth conductor with sizes.

TESTING

1. The following test shall be conducted on each alternator and D.G. Set.

2. Factory Test

i) Routine Tests.
ii) High Voltage Test.
iii) Short circuit Current Test.
iv) Instantaneous short-circuit withstand test.
v) Insulation resistance test.

These tests shall be conducted as per the requirements of the original test certificates shall be furnished to the KMC.

3. Site Tests

After the erection and wiring and earthing for DG set, the following tests shall be conducted:
Insulation resistance of the generator.
Speed, no load voltage and full load voltage regulation.
Frequency at no load, half load and full load.

The readings shall be observed with calibrated meters. Only one meter shall be used for the tests. The reading shall properly tabulated and submitted in triplicate to the Engineer-in-charge.

4. Testing of Controls

All the safety controls and protective devices of the DG set shall be tested for correct calibration and operation. The result of the tests shall be tabulated and submitted in triplicate.

OPERATION

DG set with individual Auto Transfer starting facilities is required to provide electric power to the essential loads in the events of failure of normal power supply or when normal supply is switched off under abnormal conditions like fire. When normal power fails or is tripped manually, the D.G. set should start automatically and restore electrical supply for essential loads. It should have provision to start all the equipments one by one so as to reduce higher starting current. The DG set shall Also, run continuously to supply power to the loads till restoration of normal power supply.

A potential free Contract (NO) closing on under voltage will be made available by means of a suitable control cable at the Auto Transfer control panel to indicate failure or absence of normal supply. The DG set shall start on receipt of this signal with an adjustable time delay of 0.5 secs, the time shall be of self - reset type. The starting time of each of the DG set should be as less as possible, but not exceeding 15 sec. to come on load. In case the first starting operation is not successful, two more attempts with preset time intervals should be attempts; the particular set should be locked out. When an engine speeds up and alternator develops desired voltage in frequency, generator circuit breakers will be switched on.

INSTALLATION

The Contractor shall carry out the installation of the DG sets including but not limited to the following:

a) Installation of the DG Set, testing, commissioning, alignment, mounting along with AVM pads on ready floor, foundation to be made by the Contractor and the cost shall be included in the rate for supply and installation of the D.G. set.
b) Installation of fuel oil system complete with day tank and Lube oil system with necessary piping, valves, fittings, supports, etc.
c) Installation of air intake system, exhaust gas system complete with residential type silencer, expansion bellows, etc. and necessary piping, valve, fitting. Supports etc.
d) Installation of Auto Transfer Switch and any other electrical panel.
e) The Contractor to supply and install the required 8" Dia MS exhaust pipe up to the required height (as stipulated by Pollution Control Board Authorities) above the building in which the D.G. set are housed. The scope Also, includes providing insulation.
f) Installation and charging of battery along with leads, battery stand, etc.

CAPACITIES

The capacity of each of the D.G. set shall be suitable as per design of STPs. Generator shall be rated for critical process requirement only. The excitation system shall be designed to maintain the rated voltage constant even if a load of 150% of rated load is imposed on to the Generator for duration of 15 secs. Tenderer shall indicate power consumed by auxiliaries along with the Tender document.

DIESEL ENGINE

The engine shall be suitable for continuous operation to develop design capacity of dg set at site conditions as mentioned above.

The diesel engine shall be indoors type, multi cylinder, totally enclosed, continuous duty, direct fuel injection, series Turbo charged compression ignition, complete with its self-contained lubricating system. The lube oil system shall be provided with Engine Driven Lube Oil Pump only.

Following accessories shall be supplied with the engine and the quoted rate for supply and installation of DG set shall be deemed to have included for the accessories described below:
a) Air filter Air restriction gauge.
b) Lube oil filter.
c) Fuel oil filter.
d) Coupling.
e) Day service Tank.
f) Fly wheel with Guard.
g) Corrosion Resister.
h) Scroll type fuel injection system.
i) Residential type silencer.
j) Electronic governor.
k) Starter motor.
l) Instrument panel.

m) Laid Acid Battery.
n) Exhaust Bellows.
o) First fill of lube oil

DAY FUEL TANK

The fuel oil day tank shall be provided with gauge glass, filling, drainage and vent connections with valves. Fuel Transformer pump between Engine & Day tank should by engine driven only.

LUBRICATING OIL SYSTEM

The Lubricating oil for engine lubrication shall be collected in the oil pan located at the bottom of the cylinder block. From oil pan, the lubricating oil shall be let off to a separate lube oil sump, if required. From the oil pan or from the oil sump the lubricating oil shall be drawn by engine driven lubricating oil pump through foot strainer (in the oil sump) and then Through oil filter of suitable capacity . The lube oil pump shall be of Gear type and Engine driven only and the entire assembly should be filter inside the sump. All the inter connecting oil piping together with valves, fittings, hangers, supports, etc. shall be provided by Contractor.

AIR / EXHAUST SYSTEM

Exhaust gas Driven Turbocharger shall be fitted to each bank and each turbocharger shall have its own self-contained lubricating oil system. Ai shall be normally supplied and ducted to the turbo-charger of low & high pressure one. Air from the Turbocharger compressor passes to the after cooler and then to the engine manifolds. The cooler shall be of Tabular constructed with aluminium bronze MS and cat-Iron water Boxes. An Engine Drive water ump shall cool it.

The engine turbo charging system including exhaust and intake Manifolds, valve timing and arrangement of the cylinder Head shall be designed for optimum performance at High boost pressure with subsequent high specific Engine Power output.

GOVERNING SYSTEM

Electronic governing system shall be provided with the necessary sensors. The governor shall be suitable for operating without external power supply ad shall be provided with adequate speed control system.

FLYWHEEL

The Contractor shall be responsible for determining and providing the necessary flywheel effect. The flywheel shall be both statically and dynamically balanced and capable of rotating at 125% of rated speed without injury. Flywheel guards shall be furnished.

ENGINE COOLING SYSTEM

Radiator shall be offered by the Contractor to cool the water received from the engine or any other cooling system as specified by Engineer-in-charge.

ENGINE STARTING SYSTEM

Manual Electrical starting arrangements of the engine in case of power failure shall be provided. The system will consist of DC starter motor mounted on turning gear will receive power from the set of 24V DC Batteries.

FUEL OIL SYSTEM

The fuel used for the DG set shall be High-speed diesel (HSD) only. The day tank shall be filled manually by operating Hand pump. In order to transfer fuel from day tank to engine has to be done through fuel transfer pump which should be engine driven only.

ALTERNATOR

The generator shall be driven by the diesel engine as described in this specification and shall match the same in all respects. The generator shall Also, conform to 15 4722 or equivalent.

TESTS

1. Equipment shall be tested to conform to the appropriate standard and the following tests shall be conducted in the presence of purchasers.
2. Functional tests, continuity tests and high voltage test on control panel to establish the performance called for in the specification.
3. Power frequency voltage test on switchgear and mechanical / electrical operation check.
4. Routine test for alternator as per IS 4722.
5. Over speed test (1.2 times the rated speed for 2 minutes)
6. Transient response tests for sudden application and rejection of loads of 25°/0/ 50%, 75%, and 100% of rated capacity.
7. Wave from test (type test result are acceptable).
8. Please sequence test.
9. Vibration test.
10. Noise level test
11. Dimensional and alignment.

DG AUTO TRANSFER SWITCH CONTROL PANEL

DG set shall be supplied with automatic transfer switch control panel. This panel shall be floor mounting, free standing, dust tight, vermin proof/ sheet metal enclosed, cubicle type. Cable entry to the ATS control panel shall be from the top or bottom (depending upon site condition) for power and control cable, outgoing cable, of auxiliary equipment and outgoing cable to power centre.

1. The panel shall be free standing, fabrication from 14/16SWG CRCA sheet metal enclosed, dust and vermin proof type with a hinged door and having a degree of protection IP 52 as per IS 2147 unless otherwise specified. The panel shall be powder coated with Siemens graycolour shade after completing 7-tank pre-treatment process. Curing shall be by baking. Finish shall be structural finish (70-80 microns). Power and control equipment shall be segregated inside the Panel as far as practicable. The maximum height of the operation handle / switches shall not exceed 1000 mm and the minimum height shall not below 300 mm. All hardware shall be made corrosion resistant and bolts, nuts and washer shall be made of galvanized zinc passivated cadmium plated high quality steel. Unless otherwise specified the panel shall be suitable for bottom cable entry. Necessary glands shall be provided with panel.

All auxiliary devices for control, indication, measurement and alarm such as push buttons control/selector switches, indicating lamps, metering instruments, annunciation, etc. shall be mounted on the front door of the panel. Adequate number of potential free contact shall be provided in the control panel for any remote control, monitoring of the generator set.

2. All switches shall be load-break, heavy-duty type. All fuses shall be non-deteriorating HRC cartridge pressure filtered, link type. The Contractor shall be air brake type having AO3 duty rating. Thermal overload relays shall be three elements, positive acting, ambient temperature compensated type with adjustable setting range and built in protection feature against single phasing. All control/selector switches shall be rotary back connected type having cam operated contact mechanism with knob type handle 'STOP' push buttons shall be stay put type.

3. Wiring for power, control and signalling circuits shall be done with PVC insulated copper conductors having 1100V grade insulation. Minimum size of control wires shall be 2.5 mm. "ELEMEX" type terminals shall be acceptable for wires up to10 sq mm size and for conductors larger than 10 sq. mm bolted type terminals with crimping lugs shall be provided. A minimum of 10% spare terminals shall be provided on each terminal block.

4. An adequately sized earth bus shall be provided in the panel for connection to the main earth grid. All non-current carrying metallic parts of the mounted equipment's shall be earthed. Doors and movable parts shall be earthed using flexible copper connections.

5. Engraved nameplates shall be provided for all devices mounted on the front of the panel. Nameplate or polyester adhesive stickers shall be provided for ach equipment mounted inside the panel.

The AMF control panel shall be provided with, but not limited to the following devices:

AUTO MAINS FAILURE CONTROL PANEL:
The AMF Panel shall have provision such that on switching over to DG supply; it shall not put all the drives into operation on load at a time. But the same shall be put into operation one by one with suitable time lag. The panel shall be Cubical type, floor mounted, dust and vermin proof control panel with hinged doors, CAM type doorknob, undrilled bottom gland plate, load manager each fitted with:

> Suitable rating Amps 4 phase 36KA MCCB - Similar to MD's make Cat No.25606 with frame size of DPX 630, S-l, Electronic type - 2 NOS.

> Shunt Release 220V A.C coil similar to MDs make, Cat No.26164 & frame size of DPX-630 - 2 Nos.

> Remote control front operated; motor operated similar to MDs make - Cat No.26144 & frame size of DPX-630 - 2 Nos.

> Auxiliary contacts similar to MDs make Cat No.26160 & frame size of DPX-630 - 2 Nos.

> Spreader lines similar to MDs make Cat No.625008 & frame size of DPX-630 - 4 Sets.

> Electronic control unit automatic supply inverter similar to MDs make of Cat No.26196 &frame size DPX-630 - 1 No.

> Automatic transfer switch fixed version supply inverter mounting phase suitable for suitable rating

Amps similar to MDS make, Cat No.26509 & frame size DPX- 630 - 1 No.

> Digital Ammeter of adequate rating with selector switch & CTs - 1 No.
> 0 - 500V digital voltmeter with selector switch & CTs. - 1 Set
> RYB indicating lamp - 2 sets.
> MCCB ON/OFF indicating lamp - 2 sets.
> 2 No. + NC Auxiliary contactor 220V ac - 2 Nos.
> Frequency meter.
> Digital hourly running meter.
> KW meter, Digital.
> KWH meter, Digital.
> Current transformers of suitable ratio of class 1 for metering.
> 3 Nos. current transformers of suitable ratio of Class-I for metering.
> 4 Pole ALB Microprocessor based EDO type contact operated by charging motor and incorporated with shutter Assembly, shunt release etc.
> Micro switch for service position, Test service, 3 indicators for DG ON/OFF/TRIP.
> CT for above ACB's
> Copper Bus Bar (TPN) of adequate rating.

Mains supply Monitor to identify low voltage/complete failure and initiate necessary single for operation of automatic control gear.

> 1 Set Window Annunciation's with audio visual alarm & Trips for:

i) High Water Temp.
ii) Low lubes Oil pressure.
iii) Over speed stop
iv) Set fails to start.

> 1 No. Electronic Hooter.
> 1 Set push button hooter accept/fault clear.
> 1 No. Control switch (ON/OFF - for DG Manual control)
> 1 No. Mode Selector Switch (AUTO/MANUAL/aEST/OFF)
> 1 Set Indicating Lamps for s Load on Set', ' Load on Mains' etc.
> 1 No. Battery Charger consisting of:

Transformer
Rectifier
D.C. ammeter
D.C. voltmeter
Charger selector switch (TRICKLE/BOOST/OFF)
Lamp for battery charging indication.

> 1 Set Instrument fuses.
> 1 Set Bus bars of adequate capacity.
> 1 No. of Automatic Transfer Switch fixed version (750 Amps).

CABLES

1. The specification covers the design, manufacture, performance, inspection at the Manufacturer’s

works and delivery to site of 1100V grade cables.

2. The design, manufacture of performance of the cable should confirm to the latest applicable standards of Bureau of Indian Standards.

3. All cable shall be XLPE and shall comply with the following requirements:

a) Annealed copper conductor, class 2 as per 15:8130 or aluminium.

b) Colour coding shall be provided.

c) Inner sheath shall be extruded type and shall be compatible with the insulation for the cables. The inner sheath shall be with PVC compound type "A'.

d) Armouring for all the cables shall comprise G.I. strips/wires.

e) The outer sheath shall be of an extruded layer of type ST-1 compatible with the specified ambient and operating temperature of the cables. The sheath shall be resistant to water, ultra violet radiation, fungus, termite and rodent attacks. The outer sheath shall be of black colour.

f) Cables shall be subjected to routine and acceptance tests in accordance with 15:1554 and other relevant standards.

4. General Conditions

a) The quantities given in the schedule are subject to change to suit site conditions.

b) The Manufacturer should have in house testing facilities as per IS.

5. Specifications for Installing LT cables and Control Cables

The method of installing cable shall be broadly classified into four main categories:

Laid in prepared trenches/Hume pipes

All cables laid inside the substation building shall be laid in prepared trenches. For easy identification all cables laid shall have cable marker tied to it by means of steel wire and showing the size and name of panels embossed on it.

Laid Underground

The procedure stated in technical specification shall be followed. However, before laying all precautionary procedure shall be adopted by the Contractor. Layer of sand then cables and then layer of sand again with half round RCC pipe shall be laid.

Fixed on walls etc.

If cables are to be fixed on walls, etc. then the same shall be done by using MS galvanized spacers and GI saddles using screws, etc.

Laid on cable trays

Generally, cables laid on trays shall be fixed on the rungs of the trays using nylon lockable cable ties of approved make. As far as possible, cables shall not cross each other unnecessarily on tray, so that a neat and easily identifiable cable system is achieved.

INSPECTION

All cables shall be inspected by the Contractor upon receipt at site and checked for any damage during transit.

JOINT IN CABLE

The Contractor shall take care to see all the cables received at site are apportioned to various location in such a manner as to ensure maximum utilization and avoidance of jointing cables. The apportioning shall be got approved by the owner before the cables are cut to length. Straight joints are prohibited unless specifically allowed in the schedule of quantities.

EXCAVTION AND BACKFILL

All excavation and backfill including timbering, shorting and pumping required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Backfill for trenches shall be filled in layer not exceeding 150 mm. Each layer shall be properly rammed and consolidated before laying the next layer. The Contractor shall restore all surface, roadways, sidewalks, curbs walls or other works by excavation to their original condition, satisfactory to the KMC. Back filling shall be done with soft earth only.

TERMINATION OF CABLES & JOINTS

a) For termination of cables of size 16 sq.mm. and above, suitable copper cable sockets of appropriate size and capacity shall be provided at terminal ends. This condition is applicable to single PVC insulated wires of 16 sq. mm. and above Also,.

b) Generally, reducer/spade type sockets shall be used where grub screw/clamp type fixing arrangement is available at the terminating end. Tubular sockets shall be used where bolt and nut arrangement is available at terminating end.

c) The cable socket shall generally be fixed to the cable cores by crimping process.

d) Irrespective of the size of the cable and the method of termination, the core end shall be cleaned and immediately covered with an oxide inhibiting/corrosion inhibiting compound before termination.

e) The tail end wire shall be finished in an appropriate colour by using PVC insulating tape.

14.8.4 TESTING, MANUFACTURER TESTS, PRE-COMMISSIONING TESTS AND COMPLETE COMMISSIONING

The general intent of this specification is to mention the relevant tests to be done and furnished to the client by the Contractor. These are guidelines. However, the Contractor shall carry out all such tests and complete all formalities as per relevant Indian Standard Specifications, Tariff Advisory Committee's rules and fire Insurance Requirements and or Electricity Rules and Regulations as per Govt. Gazette and Publications.

Testing of Equipment

All equipment before installing on the site Work shall be tested and at such results produced to the Engineer in charge nothing shall absolve the Contractor from re-performing any tests that the Contractor may be called upon specifically by the consultant/KMC or supply company or electrical inspector. All equipment shall be tested jointly with the Consultants/KMC as required by various sections of the specifications and test data shall be furnished as required at Manufacturers Work before dispatch of material at site.

Pre Commissioning Test

All rules, regulations and requirements of Uttar Pradesh Electricity Department, Govt. and local authorities and of Indian Standard specifications and/or Rules and regulations stated in Indian Electricity Act shall be strictly complied.

On completion of erection the Contractor shall clean all the equipment thoroughly and inspect the entire installation for correctness and shall furnish a report of completion to the consultants, pre-commissioning tests shall commence only on approval of this report by the consultants.

All tests and the certification thereof shall only be carried out by those authorized. Skilled, experienced and certified permit holders of the supervisor category of state government Industries and Labour Department. No unauthorized personnel shall ever carry out any such tests as stated herein under.

1) Phantom load tests for protective relays.
2) Insulation tests at the following points by 1000 Volts and or 500 Volts megger.
3) Mechanical operation tests for all movable parts of switchgears breakers tripping devices, etc.
4) Phase sequence test at all the relevant points for connecting correct R, Y and B as per the supply authorities positions.
5) All panels to be tested for interlocks, control tripping and breakers to be tested for sequential tripping.
6) Capacitors banks shall be tested for all residual voltages on the terminal of the units and it should not exceed 50V after one minute.
7) Continuity tests shall be done for noting any short circuits and or earthing of phases.

Commissioning

a) Prior to commencement of installation Work the Contractor shall obtain the approval of the substation drawings, if any and electrical layout prepared by him from the electrical inspector. The time involved in this is included in the overall completion period of the Contract.
b) The Contractor shall obtain the written permission and sanction of commissioning the equipment and substation from electrical inspector and form consultants/PMC.
c) All costs incidental to obtaining such sanctions shall be to the Contractor account.
d) Contractor shall furnish all the necessary tests and test reports to the Electrical supply authorities and complete all formalities required to comply as per the Rules and regulations laid down for release of Electric supply. If called on, the Contractor shall carry out all such tests and prove the results to the entire satisfaction of the local and electric supply authorities.

All costs and expenses incidental to the release of electric supply shall be to the Contractor account and no demand whatsoever shall be to the KMC, except for any security deposits that the supply authorities would deem necessary for charging of the line, except as may be provided for in the schedule of quantities.

All such documents forwarded and or letter and or correspondence exchanged in this regard shall be made available for inspecting and the Contractor shall furnish 3 sets of documents and drawings for the KMC records.

After release of electric supply to KMC premises, the Contractor shall furnish six sets of all tests declared to the supply Co. authorities and shall furnish all such documents, officially exchanged.

Contractor shall Also, obtain and furnish the relevant completion certificate from the Electrical Inspector, Fire Officer and/or any other Authority thereof whichever may be applicable.

14.8.5 TECHNICALSPECIFICATION:

ENGINE

Engine shall be water cooled tube charger with water cooler, under NTP condition of BS: 5514 with at overload capacity of 10% for one hour in any 12 continuous hrs Operation.

The engine shall complete with following accessories:

a) Radiator with blower fan or Heat Exchanger.
b) Corrosion inhibitor coolant.
c) Paper element filter-fuel, lube oil and by-pass.
d) Flywheel housing and flywheel to suit double bearing alternator.
e) Spider flexible coupling.
f) Dry type air cleaners and vacuum indicators.
g) Residential Silencers.
h) Stainless Steel exhausts flexible bellow.
i) Motor driven primping pump.
j) Electric Starter.

Battery charging alternator.

i) Solid-state potentiometer.

ELECTRONIC CONTROL PANEL (Displaying the following)

> Battery voltage
> Coolant water temperature.
> Lubricating oil pressure.
> Engine speed.
> Safety Control: High water temperature (HWT)
> (Trip & Indication): Low lube oil pressure (LLOP)
> Over speed stop.

ALTERNATOR

Approved make, standard design alternator, suitably rated at 600 W/ required rating at 0.8 p.f.(lag), 415, 3 phase, 4 wire, 50 cycles/ sec. 1500 RPM, self-excited and self-regulated with brush less excitation, bank of voltage regulation + 2.5% of rated voltage, from no load to full load. Insulation class "H". the alternator generally conforms to BS: 5000/15:4722.

BASE FRAME

Sturdy, fabricated, welded construction, channel iron base frame for mounting the Engine and Alternator.

FUEL TANK

Fuel tank of suitable storage capacity sufficient to run the DG Set for minimum 8 hours, with mounting brackets, complete with level indicator fuel inlet and outlet air vent, drain plug, inlet arrangement for direct filling with pumping arrangement of suitable rating and capacity and set of 5 fit or as per the requirement of site long fuel hoses.

BATTERY SET
Set of Batteries: 12 Volts, 27 plates, dry, uncharged batteries with leads and / terminals.

CABLING WORKS
All cables from D.G. Set to AMF panel and from AMF panel to existing control panel and transformers of suitable rating as per the D.G. Set rating should be provided. The Tenderer should inspect the site before quoting the offer.

AUTO MAINS FAILURE CONTROL PANEL
Floor mounting, cubicle type, Automatic Mains failure panel, compressing of:
TPN motorized Air Circuit Breaker for Mains for 2 Nos. of transformers and
Nos. outgoing to control panel.
TPN 4 Pole motorized Microprocessor based Air Circuit Breaker.
TPN 4 pole motorized Air Circuit Breaker for Alternator.
Natural Contractors for Main & Alternator.
Voltmeter with selector switches for MAINS & ALTERNATOR.
Ammeter with selector switch.
Current transformer.
Frequency meter.
KWH Meter.
KW Meter.
Battery charger consisting of Transformer/Rectifier with surge protection.
Selector switch for current adjust.
Mains supply failure monitor (voltage sensing).
Supply failure timer.
Restoration timer.
Control unit incorporating 3 impulse Automatic Engine Start/ Stop and "Failure to Start" lockout.
Impulse counter with locking and reset facility.
OFF/manual/Auto Test Selector switch.
Control circuit ON/OFF switch.

LAMP INDICATION & TRIP ANNUNCIATION SCHEME

Mains ON	Yes	-
Generator ON	Yes	-
Load on MAINS	Yes	-
Load on Generator	Yes	
Low Lube Oil Pressure	Yes	Yes
High water temperature	Yes	Yes

Set/Fails to Start (with Alarm)	Yes	
Mains ON	Yes	-

Push Buttons/Switches for :

> Engine Start/Stop
> Alternator breaker ON/OFF
> MAINS Breaker OFF
> AMF Test

WORKING OF THE PANEL

a) Auto Mode

When the mains supply fail, the "Mains supply failure Monitor" operates after a preset time of approx. 10 Sec. This actuates the "3 impulse Engine Start" control. We do not recommend plug type relays. The control unit gives three starting impulses with an interval of 1-5 sec. If the engine starts at the first impulse, the unit shuts off. If not, it gives further two impulses, during which time, if the engine, does not start, the unit shuts off, activating the audio-visual alarm for "Set fails to Start".

b) Test Mode

By operating the "AMF Test" Push Button, the conditions of Mains Failure are stimulated as explained in Auto Model above, without disturbing the supply through Mains switchgear.

ENGINE INSTRUMENT PANEL

a) Starting switch with key.
b) Lube oil pressure gauge.
c) Battery charging ammeter.
d) Charge regulator.
e) Set of documents comprising spare’s part book maintenance.

Mains supply monitor to identify low voltage/complete failure and initiate necessary single for operation of automatic control gear.

1 set window Annunciation's with audio visual alarm and trips for:

a) High Water Temp.
b) Low Lube oil pressure.
c) Over speed stop.
d) Set fails to Start.

ii) 1 No. Electronic Hooter.
ii) 1 Set Push Button - Hooter Accept/Fault Clear.
iii) 1 No. control switch (ON/OFF for DG manual Control)
iv) 1 No. mode selector switch (Auto/Manual/Test Off)

v) 1 Set indicating lamps for load on set, load on mains, etc.
vi) 1 No. battery charger cosseting of:

a) Transformer
b) Rectifier
c) D.C. ammeter
d) D.C. Voltmeter
e) Charge range selector switch (Trickle/Boost/off)
f) Lamp for battery charging indication
vii) 1 Set instrument fuses.
viii) 1 Set bus bar of adequate capacity.

SOUND PROOF ENCLOSURE

Sound proof enclosure of DG set shall be fabricated out of M.S. 16 gauge sheet steel and special type of sandwich material shall be used for sound absorption. DG set can be operated without any duration.

The DG set shall be suitable for direct mounting inside MS fabricated container with proper clamping, mounting and supporting arrangement. M.S. sheet metal enclosure with hinged/sliding type doors shall be provided for protection from sound, dust and rain.

The Salient features of outdoor D.G. Set Canopies (for noise control) are as under:

> Enough space to house DG Set pane! and fuel tank outside canopy.
> Provision of Air-Intake and Air-Exhaust Silencer(S) for preventing leakage of sound.
> Openable Doors for easy access to virtually every part of DG set for comfortable.
> Maintenance Doors are double wall all steel insulated SOUND REDUCTIN DOORS.
> Provision of additional screen and hoods for multi medium noise suppression.
> Two layers of sound - suppressing elements:

a) Non-Ferrous sheet sound barrier.
b) Rock-Wool 48 Kg/cu. M. 100 thick.
c) Total thickness of panel - 100 mm.

> High performance most comfortable sound - reduction level to 70 db. at a distance of 3 meters.
> Provision for forced ventilating hot air coming out of engine.
> It can be dismantled completely & engine is accessible from all the sides.

SPECIFICATION OF ACCOUSTIC ENCLOSURE CANOPY

The D.G. Set is mounted on anti-mounts and placed on firm ground. A specially designed transportable acoustic chamber encloses the generator set. The acoustic chamber attenuates the noise of the generator set. The weather proof acoustic chamber is designed to reduce the noise level to an average of 70 ±_5 db. (A) at three meter away from the enclosure as measured in free field condition. The enclosure shall be designed to the following requirement:

a) Modular type weather proof design so that this can be installed in open space (No engine room is required).
b) Sufficient space around the genset to meet the day to day maintenance of engine, alternator, batteries etc.

c) Suitable grills for air suction for engine cooling/aspiration, outlets for hot exhaust gases, air for ventilation, air inlet and outlet without affecting the engine performance etc.
d) Frame Work made out of heavy gauge steel sections and suitably reinforced.
e) Proper forced ventilation arrangement to maintain enclosure temperature within permissible limits.
f) Electric points, illumination lights, blower fans etc, inside the chamber.

The external surface of the enclosure is cladded with CRCA steel sheets and treated with anticorrosive paints. The interior is lined with fire proof, vermin proof sound absorbing material suitably retained in position using perforated sheets/galvanized wire mesh.

The acoustic enclosure is designed and fabricated to meet the specification and shall Work at the optimum condition and maximum efficiency with proper fresh air blowers.

Adequate number of doors with lockable arrangements are provided for easy access. All the doors are provided with rubber gaskets for weather and sound proofing. The bolted structure of the enclosure facilitates it easy shifting from one place to another if required. The acoustic chamber shall be painted as per the customer colour choice.

MATERIAL USED FOR CONSTRUCTION

A) The outer cover for the acoustic enclosure shall be made out of ribbed type 1.6 thick CRCA steel sheet. Size of the rib shall be 80 mm x 20 mm.
B) All perforated sheets used shall 1 mm thick galvanized iron sheets with 3 mm hole Dia and 5 mm diagonal pitch.
C) The sound absorbing acoustic materials used shall be resin bonded mineral wool/rock wool. It will have a density not less than 65 Kg./Cu.m.

14.8.6 SCOPE OF INSTALLATION & COMMISSIONING

For erection of the equipment in the power house, following Work shall be undertaken.

1. DG Room layouts, preparation of detailed engineering drawings for foundation, electrical panels and other accessories etc.
2. Supply and installation of exhaust pipes from the engine, with necessary supports as per our layout and lagging of pipes. To a maximum of 6 Mtr. additional length will be charged extra.
3. Supply and installation of fuel piping form the engine to fuel tank & return.
4. Supply and laying of power cables between alternator & DG panel.
5. Necessary control cabling between DG set and DG panel.
6. Training of your personnel at site.
7. Unloading and positioning of the DG set.
8. The scope of works Also, includes all types of works to complete the erection and successful commissioning of DG set at site such as:

a) All civil works including mounting on MS frame etc. as per the directives of Engineer-in-charge.
b) Earthing along with earth pits.
c) Outgoing power cables.
d) Obtaining approval from concerned authorities.

14.8.7 ESSENCE OF WORK

Following given points are the essential works of Contract for the subject Work and successful agency will be responsible for completing the same without any extra cost within stipulated Contract period.

1. Even though the technical specification and other details are specified in the Tender document for carrying out the subject Work, the successful agency will be supposed to design the scheme in detail for carrying out the subject Work, matching with the existing system and the scheme prepared should be got approved before starting the execution of Work, the agency should visit the site before quoting the offer to guess the exact quantum of Work.
2. After finalization of the scheme the agency should obtain the required approvals to the various makes of material to be supplied under the Contract before procurement. The D.G. Set and other material to be supplied under this Contract should be got tested at Manufacturers unit in presence of Engineer-in-charge or his representative.
3. The agency should submit the Bar Chart within a period of one week after issue of Work order.
4. It will be the responsibility of the successful agency to complete the statutory requirements from concern authorities for carrying out the subject Work completely as per the requirement of Engineer-in-charge without any extra cost.
5. Proposed D.G. Set under the present Contract shall be installed at STPs. For erection of the same, successful agency will be responsible for carrying out the required foundation work and other connected civil Work Also,. This foundation work and civil work should be carried out in consultation with concern civil authority completely as per the requirement of Engineer-in-charge.
6. Successful agency will be responsible to provide required connecting cables of appropriate size and length to be connected between transformer, AMF panel and D.G. Set etc. completely as per the scheme approved by Engineer-in-charge. This Work will be included in the total scope and no extra payments will be made against this Work.
7. After completion of erection and commissioning Work of proposed rated designed D.G. set, successful agency will be responsible for operating and maintaining the installation for a period of Fifteen years (including defects liability period of two year).
8. The agency shall carry out the Work as per ISO 9001-2000 procedure and maintain necessary records completely as per the directives of Engineer-in-charge.

(b) INSPECTION, TESTING, ERECTION, COMMISSIONING & PERFORMANCE RUN OF MECHANICAL & ELECTRICAL EQUIPMENTS OF PLANT

14.9. General :

All equipments prior to dispatch for the site shall be tested at works as per relevant IS codes. International codes shall be used wherever Indian standards are not available.

14.9.1.1. Test Instruments:

The Contractor shall satisfy the Engineer as to the accuracy of all the instruments used for tests and

if required shall produce recent calibration tests, or otherwise have them calibrated at his own expense by and independent authority.

14.9.1.2. Test Certificates:

Copies of certificates of all works, routine tests shall be provided as detailed.

The Contractor shall obtain and submit to the Engineer and to other parties as may be directed, certificates of test of all items, certifying that they have been satisfactorily tested and describing and giving full particulars of such tests.

Bidder shall note that, all equipment manufactured within India shall be inspected from reputed third party inspection agency such as SGS / Bureau VERITAS / . All costs towards inspection of this material shall be borne by the bidder. In case, the equipment are manufactured outside India then inspection shall be carried out by third party inspection agency such as SGS / Bureau VERITAS / .

14.9.1.3. Manufacturer's Works Inspection Tests and Guarantees:

All Schedules of Particulars shall be completed and the Guaranteed Particulars and the efficiencies of the equipment offered at the duties specified will be binding and may not be varied expect with the consent in writing of the Engineer.

The Engineer shall be provided with the facility for inspection of all equipment and material and shall be given at least 10 days notice when such equipment and material is ready for inspection at manufacturer or vendors workshops.

Full witness testing to the relevant standards and to prove guarantees given will be required for the following items:

i). All pumps for performance testing.

ii). Electric motors for type on routine one motor of each size.

iii). All control panels.

iv). Chlorinator for relevant performance test.

v). All transformers for routine and type test on.

vi) EOT Crane as per relevant standards.

In addition, all other items of equipment not subject to witness testing shall be temporarily erected at the manufacturer's works and tested for satisfactory operation and shall be offered for inspection. Copies of manufacturer's test readings shall be submitted to the Engineer, all prior to packing for shipment.

Such inspection, examination, or testing, shall not release the Contractor, manufacturer or supplier of any

item from any obligation under the Contract.

Certified copies of manufacturer's test readings of all items shall be submitted to the Engineer within 7 days of the satisfactory completion of the tests.

Whilst the Engineer shall be provided with facilities for witness testing and / or inspection of all items of equipment at the manufacturer's works, he may at his discretion advise that the tests shall proceed in his absence. These tests shall be made as if in his presence, and duly certified copies of test readings shall be submitted.

Where items of equipment are of identical size and duty it may be required, at the Engineer's discretion, that a reduced number of the items be subjected to witness tests; However, this shall not relieve the manufacturer from the requirement of carrying out the performance tests on all items prior to offering a witness testing.

If after inspecting, examining or testing any material or equipment, the Engineer shall decide that such items or any pat thereof is defective, or not in accordance with the Specification or performances, he may reject the said items or part thereof, giving to the manufacturer within a reasonable time, notice in writing of such rejection, stating therein the ground upon which the said decision is based. All re-testing shall be at the Contractor's expense.

14.9.1.4. Site Testing:

The Contractor shall arrange for the full site testing of all items of equipment and shall include provision of:

a). All skilled and qualified operating and test staff for the testing of all equipment.

b). Provision and disposal of all services, lubricants, and fuels other than electricity.

c). All measuring and testing instruments to demonstrate equipment operates to the fulfilment of the works sheet.

14.9.1.5. Manufacture's Work Tests

14.9.1.5.1 Power Transformers

i). Measurement of winding resistance.

ii). Ratio polarity and phase relationship.

iii). Impedance voltage.

iv) Load losses.

v). No-load losses and no-load current.

vi). Insulation resistance.

vii). Included over voltage withstand.

viii). Separate source voltage withstand.

14.9.1.5.2 Type Tests

i). Impulse voltage withstand both chopped and full wave.

ii). Temperature rise.

Unless otherwise stated by the Engineer, evidence of type of tests carried out on identical transformers to those being provided under the contract will be accepted in lieu of actual tests.

14.9.1.5.3 Circuit Breakers And Control Gear:

i). Routine tests including pressure test, milli-volt drop (Ductor) tests.

ii). To ensure operation of the closing coil and satisfactory closing of the circuit breaker with the voltage on the coil down to 80% of its rated voltage, and that mal-operation does not occur with a voltage on the coil of 120% of its rated voltage.

iii). To ensure the satisfactory trip operation of the circuit breaker at no load conditions with the trip coil energized at 50% of its rated voltage.

iv). Test figures for heat – run tests performed on identical panel types shall be made available.

v). All interlocking, circuit breaker draws in & out operation.

14.9.1.5.4 Protection and Control Circuits:

Base on the completeness of the circuits in the final manufactured form within the manufacturer's works, the following tests shall be carried out:

i). Primary injection tests to ensure correct operation of the current operated protection relays and direct acting coils over their full range of settings.

ii). Balanced earth fault stability tests by primary current injection. Care must be taken to reproduce accurately the burdens of interconnecting cables. A further test to ensure correct polarity must be made after assembly.

With different pilot wire schemes, it may not be possible to apply primary injection testing. In this case the circuits shall be proved by secondary injection. Current transformer characteristics and calculations associated with the above tests shall be available for inspection by the Engineer.

iii). Correct operation of control circuits at normal operating voltage by operating voltage by operation of local control switches, and simulation of operation from remote control positions.

14.9.1.5.5 Motors:

Motors over 100 KW site rating shall be subject to full performance tests which may be witnessed by the Engineer at the Motor manufacturer's works.

Motors of 5.5 KW to 22 KW site rating shall be subject to performance tests but will not be witnessed.

Motors under 5.5 KW site rating shall be subject to " type test " standards.

Type test certificates which shall include the following shall be provided for all motors :

i). Manufacture to BS.
ii). Class of Insulation.
iii). Type of cable fittings.
iv). Type of bearing sizes and lubricant.
v). Type and raring of motor heaters.

Motor testing shall be carried out in accordance with the requirements of BS 4999.

14.9.1.5.6 Instruments And Meters:
Tests to ensure operation of all ammeters, voltmeters and transducers and checks for correct calibration KWH meters shall be checked for correct rotation and creep tests shall be carried out to ensure that the meter is inoperative with voltage along, if the secondary of the current transformer is left connected with the primary current interrupted.

14.9.1.6. Tests On Cables During Manufacture:
All cables supplied under the Contract shall be subject to routine tests in accordance with the relevant British Standard. Cables will not be accepted on Site for installation until certificates giving proof of compliance with the Specification and date of tests have been received and approved by the Engineer. A certificate shall be applicable to each drum.

The tests to be carried out on every drum at manufacturer's premises shall include:
a). High voltage A.C insulation pressure test between cores, each core to earth metallic sheath or armour as applicable.
b). Insulation resistance test.
c). Core continuity and identification.
d). Conductor resistance test.

14.9.1.7. Process Control and Indicating Instruments:
All flow, level and process measurement controllers, transmitters, recorders, indicators, vacuum and pressure gauges shall be subject to routine in accordance with BS 88, BS 1780 and BS 3680.

Test Certificates shall be provided against each item of equipment.

14.9.1.8. Electrical Measuring Instruments and Meters:
Tests to ensure accurate operation of all meters, voltmeters and kwh meters shall be undertaken in accordance with BS 89 and BS 37.

14.9.1.9. Alarm Systems:
The Contractor shall be responsible for testing all items of equipment comprising the Works alarm system for correct operation and sequence action.

14.9.1.10. Site Tests:
Leakage Tests at the test pressure shall be carried out on all erected pipe work and valves immediately after

erection and before being built in. The Contractor shall advise the Engineer when these tests are to be carried out.

14.9.1.11. Tests on Cable During Installation:
During the period of site installation, the Engineer will carry out inspection of the Works to ensure the standards of workmanship meet the specification and are to his satisfaction. In the event of any part of the cabling installation failing to meet these requirements the Contractor shall remedy the deficiency to the satisfaction of the Engineer.

After completion of various parts of the installation the Contractor shall provide a test engineer, labour and materials to demonstrate to the Engineer that the cables have been correctly installed.

The Contractor shall inform the Engineer prior to the testing of cables and shall be responsible for liaison with any other contractor to whose equipment the cables may be terminated to ensure all parties concerned are aware of the impending tests; to guarantee safety of personnel and that isolation of any particular equipment has been completed. Any special isolation or preparation required to be carried out before cable testing will be completed by the Contractor responsible for that equipment. All tests shall be carried out by the Contractor to the satisfaction of the Engineer.

14.9.1.12 Pumps Sets:
Tenderers shall complete the Schedule of Particulars and Guarantees and shall state therein, inter alia, the guaranteed efficiencies of the pumps and motors offered, and the overall guaranteed rates of energy consumption of the complete pump sets at the duties specified.

The contractor's guarantees given when tendering in respect both of performance and efficiency shall be binding and considered part of the contract.
The fulfilment of these guarantees shall be verified at the test works to be witnessed by Employer and at Site trials in accordance with the procedure given in British Standards 5316 and 4999 etc.

These site trials shall be carried out under the control of the contractor's staff to the satisfaction of the Engineer. The Contractor shall provide all the necessary labour and instrumentation to conduct the tests. The discharge from the pumps shall be measured wherever possible by the volume drawn from a sump or delivered to a tank over timed intervals.

14.9.1.13 Electrical Plant:
After all the deficiencies apparent during the installation inspection have been rectified to the Engineer's satisfaction, the following tests shall be carried out.

14.9.1.13.1 Circuit Breakers and Control Gear:
Routine tests, including H.V. pressure tests.

14.9.1.13.2 Protection And Control Circuits:
Tests at 1.5.4 with the addition of satisfactory operation of all inter-tripping circuits in conjunction with other

items of plant.

14.9.1.13.3 Tests on Cables after Installation:
Every cable shall be subject to the following tests after installation:

High voltage pressure tests:
The following D.C. test voltages shall be applied at full valve.

i) PLYSWS 11,000 volt grade cable
Between cores 30,000 volts between any core and armour 17,500 Volts.

ii) XLPESWAPVCC 3,300 volt grade cables.
Between cores 10,000V Between any core and armour 5,800 V

iii) XLPESWAPVC OR
PVCSWAPVC 1,100 volt grade mains cable
Between cores 3,000 V Between any core and armour 3,000V

Witnessed high voltage pressure tests shall not be carried out on PVCSWAPVC control cables, but it shall remain the responsibility of the Contractor to test the insulation of these cables both between cores and between cores and earth during installation with a 'Megger' 5000 volt hand generator.

The Contractor shall test all cables after installation to ensure correct phasing out of cores, continuity of cores sheath and armour over the whole length of the cable.

14.9.1.14. Earthing System Tests:
The Contractor shall demonstrate to The Engineer that the Resistance of the Electrodes to earth and the earth conductor continuity is in accordance with the Specification and IS 3043. The tests shall be made on completion of the installation.

The test shall be performed from each major item of plant, by using an "Earth Megger" and auxiliary return conductor. Theeach earthing station shall be separately tested and value of earthing resistance shall be displaced under man hole cover.

14.9.1.15. Installation Inspection:
In additional to the progressive supervision and inspection by Employer the Contractor shall offer for inspection to Engineer, the completely created plant/ part of plant on which tests are to be carried out. After such inspection by Engineer, each equipment / sub system shall be tested by the contractor in accordance with the applicable standards in the presence of Engineer. Such tests shall include but not be limited to the tests specified in following clauses.

14.9.1.16. Pre-commissioning Trials, Tests Of Electrical Equipments.
9.1.16.1Start Up:

On completion of erection of the equipment and before start-up, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Engineer and the Contractor for correctness, completeness of installation and acceptability for start-up, leading to initial pre-commissioning tests at site. The list of pre-commissioning tests to be performed shall be as mutually agreed by the Engineer and Contractor.

14.9.1.16.2 Initial Operation (Initial Run)

After the pre-commissioning tests are satisfactorily over, the complete plant shall be placed on Initial Operation during which period the complete equipment shall be operated integral with sub-systems and supporting equipments as a complete plant and necessary adjustments made while operating over the full load range enabling the plant to be made ready or commissioning. The period of Initial Operation shall be as mutually agreed by the Engineer and the Contractor.

An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during Initial Operation shall Also, include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Engineer to enable to latter to accord permission to carry out the commissioning the conduct. Performance and Guarantee Tests on the Plant. However, minor defects which do not endanger the safe operation of the equipment shall not be considered as reasons for withholding the aforesaid permission.

The cost of all labour, energy and consumables other than water required for Pre-commissioning, Initial Operation shall be borne by the Contractor. Water required for running the plant will be supplied free by the Employer.

14.9.1.17. Commissioning:

The plant shall then be commissioned and put on Trial Operation at full load when Performance Guarantee Tests shall be conducted.

During the period of trial operation, the Contractor shall

i). Operate the full works on behalf of the Employer.

ii). Supply the labour and materials including consumable required for the operation and maintenance of the works and bear the cost of electrical energy.

iii). Instruct the Employer's operators in the operation and maintenance of the work; a programme shall be submitted by the Contractor for the training of operators, both supervisory and subordinate levels. This program shall be submitted to the Engineer three months before the scheduled start of commissioning. The training of the employer's staff shall be carried out with reference to the operation and maintenance manual furnished by the Contractor.

iv). Carry out maintenance repairs of defects immediately.

v). During the period of trial operation of working hours of the Contractors shall be 24 hours daily, 7

days week.

The Contractor shall provide for the expenditure on all the consumables any energy required during the trial operation. All labour and cost of any other materials shall Also, be met fully by the Contractor.

The Trail Operation shall be considered successful, provided that each item of the equipment can operate continuously at the specified characteristics, for the period of Trial Operation and the Performance Guarantees are successfully met.

Any special equipment, tools and tackles required for the successful completion of the Performance and Guarantee Tests shall be provided by the Contractor free of cost.

The guaranteed performance figures of the equipments shall be provided by the Contractor during the Performance and Guarantee tests. Should the results of these tests show any decrease from the guaranteed values, the Contractor shall modify the equipments as required to enable them to meet the guarantees? In such case, Performance and Guarantee Tests shall be repeated within one month from the date the equipment is ready for re-test and costs for modifications including labour, materials and the cost of additional testing to prove that the equipment meets the guarantees, shall be borne by the Contractor.

Performance and Guarantee Tests shall make allowance for instrumentation errors as may be.

14.9.1.18. Completion

a) The Works will be certified as virtually completed by the employer only after it has successfully completed trial operation for a continuous period of three months.

b) A Virtual Completion Certificate for plant shall not be issued unless the following documentation are dully compiled and submitted in final formats in duly bound volumes.

i) A Completion of all shop inspection results/ reports of the plant/machinery with due attestation that the plants have been manufactured to specified standards (6 copies)

ii) All erection/construction quality control checks in appropriate approved formats for installation works with attestation that installation has been carried out as per acceptable / stipulated standards (6 copies)

14.9.2 Start Up and Performance Run

14.9.2.1Tests on Completion:

14.9.2.1.1 General

Prior to the commencement of Tests on Completion the Contractor shall submit the following:

Site Acceptance Test Documents

As built drawings

Operation & Maintenance Manuals

Test on completion shall not be commenced until the aforementioned documents are approved.

The initial charges necessary for Tests on Completion shall be provided by the contractor. Electricity required for Tests on Completion will be provided by employer free of charge for a period not exceeding 30 days. In case the test on completion period exceeds 30 days, the cost of power till start of performance run shall be borne by the contractor.

The cost of any consumables and chemicals required for the tests on shall be borne by the contractor.

14.9.2.1.2 Dry Test Requirements

14.9.2.1.2.1 General

As a minimum requirement, the following dry tests shall be carried out as a general requirement:
A general inspection to check for correct assembly and quality of workmanship
A check on adequacy and security of Plant fixing arrangements
A general check to ensure that all covers, access ladders, water-proofing, guard railings etc. are in place,
A check on damp proofing, rust proofing and vermin proofing and particularly the sealing of aperture between building structure, chambers, etc. and the outside.

14.9.2.1.2.2 Civil and Building Works

As a minimum requirement the following dry tests shall be carried out on the civil engineering and building works:
Check for the presence of foreign bodies in pipe work and structures.

14.9.2.1.2.3 Mechanical Works

As a minimum requirement the following dry tests shall be carried out on the mechanical systems:
Carry out preliminary running checks as far is permitted by circumstances in order to ensure smooth operation of Plant.

9.2.1.2.4 Electrical Works

As a minimum requirement the following dry tests shall be carried out on the electrical systems:
Check phasing and polarity
Carry out point to point check on all cables
Check on security of cable terminations
Check on completeness and adequacy of earthing systems;
Check setting on protection relays, sizes of fuses and motor overload
Carry out checks on cabling systems in accordance with the requirements the relevant standards
Check operation of main circuit breakers by secondary injection methods
Check rotational direction of drives.
Check instrument loop integrity, functionality and calibration;
Check operation of standby generator installation and mains/generator changeover procedures; a 4 hrs load test (using the normal load| Works) shall be carried out on the generator when the load is available
Check plant functionality

14.9.2.1.3 Process Plants/Equipments

All process plant items/equipments shall be tested to ensure that they meet the Employer's Requirements for quality of workmanship, construction and performance.

14.9.2.1.4 Hydraulic Wet Test Requirement

Hydraulic wet tests shall be carried out on completion of dry tests.

Potable water shall be used for hydraulic wet tests. The purposes of the 1 to prove as far as is practical the hydraulic performance of the Works. In order to demonstrate this Contractor shall ensure that each part of the Works is hydraulically loaded to its maximum rated load throughout for a period of at least seven days at twenty-four hours intervals.

In order to ensure a sufficient supply of potable water to carry out these the Contractor shall provide facilities for the disposal off site in an approved manner.

In order to remove doubt, the following tests inter-alia shall be carried out.
Pressure testing of all piped systems laid direct in ground in accordance to the relevant standards;
Fill all structures and check for leaks as per IS: 3370;
Running of all pumped systems in order to check for

- Correct functionality
- Absence of leaks
- Correct running temperatures
- Smoothness of running and the absence of undue vibration or stress
- Check drive running currents

Carry out calibration of instruments where appropriate
Carry out valving, diversion etc. to fully hydraulically load each element (or where there is a requirement to withstand an over overload each process element;
Demonstrate correct functionality of electrical, control and instrumentation systems.

The Contractor shall simulate where practical the conditions that will when operating as a process in order to demonstrate the correct functions process control loop etc.

During these tests a check on the performance of Plant shall be made, as far as site facilities will allow, to compare its site performance with the factory test data and to identify and constraints on performance due to site conditions.

14.9.2.1.5 Process Wet Test

On approval by the employer the Contractor shall carry out process wet tests.

Raw water shall be used as the primary feed stock for process wet tests. These tests shall be carried out to demonstrate the process performance of the Works. In order to demonstrate this, the Contractor shall ensure that each part of the Works is located to its rated throughput (including a period of overload if required in order to demonstrate compliance with the Employer's Requirements) for continuous stable operating period

of not less than 48 hours.

The Contractor shall provide facilities for the disposal off site in an approved manner.

The following tests inter alia shall be carried out;
Check and rectify leakage on civil structures, pumps and pipe work;
Running of all pumped systems in order to check for;

- Correct functionality,
- Absence of leaks,
- Correct running temperatures,
- Smoothness of running and the absence of undue vibration or stress,
- Check drive running currents where the solution pumped is different from that pumped during hydraulic wet tests;

Carry out calibration of instruments;
Carry out valving, diversion etc to fully hydraulically load each process element (or where there is a requirement to withstand an over load), overload each process element;
Demonstrate correct functionality of electrical, control and instrumentation systems not checked during dry or hydraulic wet tests or which may have changed as a result of the different operating conditions now prevailing.

On completion of process wet test on the various parts of the works the Contractor shall run the plant as a whole in order to demonstrate the full functionality and performance of the Works at various throughput rates for a continuous period of not less than 7 days. This shall be considered as completion of Test on Completion' and shall be certified by employer.

14.9.2.2Performance Run After Start Up
14.9.2.2.1 General
On successful completion of 'Test on Completion' i.e. start up and commissioning, certified by employer, Contractor should start the performance run of the plant for 1 month.

During performance run period, the Contractor shall provide following as minimum for round the clock operation.

(1) Staff

Plant In-charge	:	One
Chemist	:	One
Operators	:	One for each shift
Maintenance Units	:	One fitter, one electrician
Helpers	:	One for each shift
Watchman	:	One for each shift

(2) Chemicals and consumables: As required
(3) Spares: As required for replacement during performance run period. The spares used from the spare supplied under the contract shall be rep the Contractor.

Employer shall supply power and water during Performance Run period free of cost. All other material such as chemicals, consumables, lubricants, tools & plant spares etc. shall be provided by the contractor. The contractor, if required shall provide activated sludge or any other material for the stabilisation of the plant.

The Contractor shall provide operators for various units/plants for three shifts and other staff/supporting personnel in general shift.

The Contractor shall submit a weekly report to the Employer, about the operation and maintenance indicating the manpower, electric power, chemicals consumables consumed and Also, problems faced and rectified.

During this period, the Contractor shall ensure that the design treated quality standards are met in accordance with the specification within the rate of power and chemical consumption as committed by the Contractor. The treated sewage analysis pH, SS, BOD and oil & grease shall be carried out on daily basis from the day of commissioning at a reputed laboratory as approved by Engineer-in-Charge. 90% of the treated sewage samples should fall within prescribed limits of the treated sewage. The sampling location for raw shall be at raw sewage sump and that of treated sewage shall be at chlorine contact tank.

The analysis of sewage for the above parameters at different locations outlet of Cyclic Activated Sludge Process / SBR Process basin shall Also, be carried out on weekly basis Contractor shall take immediate steps to correct the operation of the meet the guaranteed performance. The charges for analysis at the laboratory to be borne by the Contractor.

The Contractor's responsibility includes the safety and security works/plants during the course of performance run of three month

.

The Contractor shall provide the key personnel for performance run minimum qualification and experience as given below.

Sr. No.	Category	Qualification and Experience
1	Plant In charge	Graduate in Engineering/Technology (Civil/ I Environmental Engineering) having 5 years of I experience in O & M/ Maintenance of water /wastewater treatment plant.
2	Plant Operator	Diploma in Engineering/Technology (Civil/ Environmental/ Chemical Engineering) having 3 years j of experience in Operation/ Commissioning of water/ wastewater treatment plants
3	Chemist	Graduate in Environmental Science/ Chemistry having 5 years of experience in sampling/ analysis in water /wastewater treatment plants.

4	Electrician / Fitter	Diploma in respective field with 5 years of experience in erection, commissioning and O&M of M&E equipment in water /wastewater treatment plants.

14.9.2.3Performance Run Certificate

The conditions for issuance of a Performance Run Certificate as detailed in the Conditions of Contract shall comprise:

The completion of the three months operation and maintenance under performance run of the treatment plant to the satisfaction of Employer.

90% of treated sewage samples fall within the prescribed limits of the treated sewage mentioned in the tender-document

The Operation & Maintenance Manual have been updated following three month's operational experience and approved by Employer.

All defects during the three months operation of the works have been rectified.

Employer shall issue a Completion Certificate for "Performance Run of Plant" after successful completion of Performance Run of plant for 90 consecutive days by contractor to the satisfaction of employer

SCHEDULE – I

DEVIATIONS FROM TECHNICAL SPECIFICATIONS

NIL

We undertake that our bid is strictly as per the technical specifications, where given in the bid document.

_____ _____

Signature of Bidder Company Seal

SCHEDULE – II

DEVIATIONS FROM CONDITIONS OF CONTRACT

NIL

We undertake that our bid is strictly as per the conditions and requirements of the bid documents.

_____ _____

Signature of Bidder Company Seal

SCHEDULE – III

DESCRIPTION OF WORK

The bidder shall submit a detailed Description of Work i.e. Technical Write-up, Process & Instrumentation Diagram, Layout, Hydraulic Flow Diagram, Electrical Load List, Power Consumption & Chemical Consumption etc.

_____ _____

Signature of Bidder Company Seal

SCHEDULE – IV

SEWAGE TREATMENT PLANT - OPERATING DETAILS

SL NO	ITEM	UNIT	VALUE
I.	Electrical Loads for STP at Korba		
1	Total connected load	KVA	
2	Maximum running load	KW	
3	Average running load	KW	
4	Average power factor		
5	Daily average power requirement	KWH/day	
6	Annual average power requirement	KWH/year	

SL NO	ITEM	UNIT	VALUE
V.	Chemical Usage		
1	Average dose for Chlorine	mg/l	
	Maximum dose for Chlorine	mg/l	
2	Average dose for Dewatering Polyelectrolyte	mg/l	
	Maximum dose for Dewatering Polyelectrolyte	mg/l	

_____ _____

Signature of Bidder Company Seal

SCHEDULE -V

FUNCTIONAL GUARANTEES

1. General

This schedule sets out the functional guarantees required for the calculation of Liquidated Damages for failing O&M performance guarantees.

The Bidder shall provide values of electrical energy and chemical usage for the quantity and quality of raw sewage given in the technical specifications.

2. Functional Guarantees

The contractor's guarantee for the performance in the O&M period to be as follows:

2.1 Quality of Treated Effluent

The quality of treated effluent shall be as follows:
As specified in "Volume – I - Scope of Work".

2.2 Electrical Energy Usage for STP

The power requirement of STP of 33.00 MLD Capacity	Not more than …….Units per month.

_____ _____

Signature of Bidder Company Seal

SCHEDULE –IX

FORMAT FOR ELECTRICAL LOAD LIST & POWER CONSUMPTION

Sr. No.	Description of Equipment	Motor Rating KW	W	S	T	BKW	Operating Hrs. Hrs./day	Power Consumption (Kw.Hrs./day)
1								
2								
3								
4								
5								
6								
7								
8								
9								

_____ _____

Signature of Bidder Company Seal

SAMPLE FORMS AND FORMAT

GENERAL NOTES

Bidders shall complete and provide the Bid Security in accordance with the requirements of the bidding documents.

Bidders should not complete the Form of Agreement at this time. Only the successful bidder will be required to complete the Form. The Form of Agreement when it is finalized at the time of Contract award, shall incorporate any corrections or modification to the accepted bid resulting from arithmetic corrections, acceptable deviations (time for completion, technical deviations, commercial deviations etc.) spare parts or quantity variations in accordance with the requirements of the bidding documents.

The form of Performance Guarantee, form of Advance Payment Guarantee and others shall not be completed by the bidders at the time of bid preparation. Only the successful Bidder will be required to get these securities in accordance with the forms indicated herein or in another form acceptable to the Employer.

TECHNOLOGY TIE-UP AGREEMENT WITH TECHNOLOGY PROVIDER

(To be made on Rs. 100 stamp paper and notarized to be submitted along with Technical Bid)

This Technology Tie-up Agreement is entered into on …… (Date) by and between …… (Bidder) (Hereinafter referred as 'XXX'), a company incorporated under the Companies Act 1956 with a Registered Office at ……
……

AND

M/s …….. (Technology Provider) (Hereinafter referred as 'YYY'), a company incorporated under the Companies Act 1956 with a Registered Office at
……
…….....
WITNESSETH

WHEREAS 'XXX' is in the business of turnkey execution of Water and Sewage / Wastewater Treatment Plants.

WHEREAS 'YYY' is in the business of Design, Engineering and Supply of Components for Sequential batch Reactor (SBR) Technology for Sewage / Wastewater Treatment Plants.

WHEREAS …… (Client) (Hereinafter referred as 'ZZZ') has invited sealed tenders on prescribed proforma from reputed and experienced agencies on turnkey basis **"Construction of Diversion Weirs, Wet wells and Pump house with pumping machinery at wet well , providing lowering laying jointing and commissioning of DI K-9 pipes Pumping Mains, Construction of 33.00 MLD STPs with Allied Works with 15 years O & M of the entire project.**
"
This Tie-up Agreement is executed specifically for the above mentioned work and cannot be used for any other Works/ Project and this tie-up Agreement does not apply or constitute a Joint Venture.

AND

'XXX' is submitting its bid as lead partner and 'XXX' has decided to enter into an exclusive Tie-up Agreement with 'YYY' to engage them exclusively as Technology Provider for the biological treatment section using SBR Technology as a part of the above mentioned Work for which tenders are invited by 'ZZZ'.

Now, therefore both the parties hereto agree as follows:

1. 'XXX' is submitting its bid only and exclusively with 'YYY'.
2. 'YYY' will be the Technology Provider to 'XXX' for the Sequential batch Reactor (SBR) Technology to be used for in the biological treatment section of the STP.

3. 'YYY' shall provide following Services and Equipments to 'XXX':

a. Basic Engineering for the Sequential batch Reactor (SBR) Technology.

b. Supply of all Equipments and Instruments as part of the Sequential batch Reactor (SBR) Technology along with back-up guarantee for performance as per the tender requirement. Back-up guarantee for performance shall be applicable and valid only in case all design and documents for the complete STP is in accordance with 'YYY' design guidelines and all documents and drawings are reviewed, stamped and signed by 'YYY'.

c. Shall provide supervision assistance during erection, commissioning, performance testing and trial runs of the STP on Sequential batch Reactor (SBR) Technology.

d. Shall provide supervision assistance during O & M period of the STP for the Sequential batch Reactor (SBR) Technology Units of the STP on a chargeable basis, if required.

4. 'XXX' will be the main contractor and the authority to sign the agreement with 'ZZZ' and accept responsibility and obligation for the Works will rest with main contractor and shall be responsible to the client viz. 'ZZZ'. 'YYY', in turn, shall be responsible and liable to 'XXX' for their scope of work. Further 'XXX' shall furnish bank guarantees for due Security, Performance and O&M and all other such obligations under the Project as a whole.

5. 'YYY' shall provide and commit such resources as are necessary to perform their scope of work for the successful completion of the Project. 'YYY' shall Also, attend all review meetings over the Project as and when called for by 'ZZZ' till the completion of the Project.

6. 'XXX' shall make all payments due to 'YYY' or to their accredited representative as per their Offer.

7. Each Party hereto in relation with the other is solely responsible and liable for their respective scope of work, to be mutually agreed between the Parties and incorporated in a detailed Agreement / Purchase Order to be entered into between the Parties before start of work for the above mentioned Work. Such detailed Agreement / Purchase Order shall deal with technical and financial aspects of the Project.

8. Each Party agrees to and undertakes to indemnify and hold harmless the other Party against any liability, loss, cost, damages or expenses sustained as a result of negligent or improper performance or disturbance caused by itself or by any of its sub-contractors, suppliers or associates in connection with its share of Works as per the Contract. If any third party enforces any claim, which is attributable to the scope of work of a certain party, that Party shall settle such claims. The Parties agree to indemnify each other against all claims made by any third party in respect of any infringements of any rights protected by patents, designs or copyrights or trademarks employed in the Project by any Party.

9. In the course of working as associates, 'XXX' / 'YYY' will be sharing information with each other which may be proprietary /confidential information / knowledge acquired by each other. It is hereby agreed that both the parties will maintain complete secrecy regarding such information / knowledge and will not divulge to any party for any other purpose except for the success of the joint execution of the contract.

10. Disputes if any arising in connection with this agreement shall, at the first place, be referred and settled mutually and amicably between the Parties herein through their respective senior executive without making reference to the arbitration. In the extreme unlikely case, where no reconciliation is reached within sixty (60) days from reference for the dispute to the other party by the dispute raising party, such dispute shall be settled by arbitration in accordance with the provisions of the Arbitration & Conciliation Act, 1996 and/or any statutory amendments thereto. The number of arbitrators shall be three. Each Party shall nominate their respective arbitrators and both the nominated arbitrators shall appoint the third arbitrator who shall act as the Presiding arbitrator. The venue of arbitration shall be Korba and the language used shall be English. The arbitral award shall be final and binding upon the Parties. Neither Party shall be released from its obligations to comply with any of the provisions of this Agreement, the contract and the detailed agreement as a result of reference of disputes to arbitration or during the course of arbitral proceeding.

11. This Tie-up Agreement shall be effective from the date as mentioned in the first page of the Tie-up Agreement and shall remain valid till the project completion and shall terminate on the happening of any of the following:

a. The bid submitted by 'XXX' is rejected or 'XXX' is unsuccessful in the bid.

b. The Contract for the Works has been awarded to other Third Parties.

c. The client notifies the Parties that they will not proceed with the Project.

d. Any of the Parties to the Agreement is declared insolvent by a Court of Competent Jurisdiction.

12. This Tie-up Agreement shall be subject to the laws in India and shall be subject to the jurisdiction of the court at Korba.

13. 'YYY' is incorporating a B.G. of Rs. 5.0 Lacs (Rs. Five Lacs only) vide BG.No…… date of ……. Bank which shall be retained by the KMC in case of the successful bidder.

13. For the sake of correspondence, following Addresses and the Persons concerned are to be contacted:

'XXX'	'YYY'
Address:	Address
Tel No. :	Tel No.:
Fax No. :	Fax No.:
Contact Person:	Contact Person:
Designation:	Designation:

For 'XXX'

(Authorized Signatory)
Name:
Designation:

For 'YYY'

(Authorized Signatory)
Name:
Designation:

BID FORM (WITH OUT PRICE)

Bidders are required to fill up all blank spaces in this Bid Form

…….
…….
……
……..

Dear Sir,

Sub: "Design, Construction, Supply, Installation, Testing, Commissioning of 33.00 MLD Capacity STP based on SBR Technology followed by Operation & Maintenance for 5 years at Korba".

1. Having visited the site and examined the Bid Documents, Drawings, Conditions of Contract, Specifications, Schedules and the Pricing Schedules etc. (Tender document) and Addenda/Amendments to the above, for the execution of the above Contract, we the undersigned offer to procure engineered items, construct, complete, commission, operate and maintain the whole of the said Works for Fifteen years as given in Conditions of Contract, Instruction to bidders and in conformity with the said Drawings, special Conditions of Contract, Specifications, Preamble to and the Pricing Schedules, Schedules, Bidding Documents, including Addenda Nos. …….. (Insert numbers).

2. We agree that:
If we fail to provide required facilities to the Engineer's Representative for carrying out the inspection and testing of materials and workmanship.
If we incorporate into the works, materials before they are tested and approved by the Engineer's Representative
If we fail to produce treated effluent of required quality or fail to satisfy other performance parameters, according to the conditions/stipulations of the contract, the Executive Engineer will be at liberty to take any action as per the condition of this contract.

3. We undertake, if our Bid is accepted to complete and deliver the Works in accordance with the Contract within 30 months, inclusive of monsoons, from the commencement date.

4. We agree to abide by this Tender until..... {120 days after the latest date of submission} and it shall remain binding upon us and may be accepted at any time before that date. We acknowledge that the Appendix forms part of this Letter of Tender.

5. In the event of our Bid being accepted, we agree to enter into a formal Contract Agreement with you incorporating the conditions of Contract hereto annexed but until such agreement is prepared, this Bid together with your written acceptance thereof shall constitute a binding Contract between us.

6. We agree, if our Bid is accepted, to furnish Performance Bank Guarantee in the forms and of value specified in the Special Conditions of Contract for due performance of the Contract.

7. We have independently considered the amounts of liquidated damages as specified in conditions of contract and special conditions of contract and agree that they represent a fair estimate of the damages likely to be suffered by you in event of the Work not being completed by us in time.
8. We understand that you are not bound to accept the lowest or any Bid you may receive.

Dated this ……. Day of ……..20 .

_____
(Name of the Person)

_____
(In the capacity of

_____
(Name of firm)

Company Seal

Duly authorised to sign bid for and on behalf of
(Fill in block capitals)

Witness

Signature : _____

Name : _____

Address : _____
_____

_____ _____
Company Seal Signature of the Bidder

FORMAT OF CONTRACT AGREEMENT

This Agreement made the .....day of .....20..... between .....of..... (Hereinafter called "the Employer") of the one part and ..... of..... (Hereinafter called "the Contractor") of the other part.

Whereas the Employer desires that the Works known as ..... should be executed by the Contractor, and has accepted a Tender by the Contractor for the execution and completion of these Works and the remedying of any defects therein.

The Employer and the Contractor agree as follows:

1. In this Agreement words and expressions shall have the same meaning as are respectively assigned to them in the Conditions of Contract hereinafter referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Agreement.

(a) The Letter of Acceptance dated .....
(b) The Letter of Tender dated .....
(c) The Addenda nos. .....
(d) The Conditions of Contract
(e) The Employer's Requirements
(f) The completed Schedules, and
(g) The Contractor's Proposal.
(h) Concept Drawings and Soil Investigation Report

3. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the employer to design, execute and complete the Works and remedy any defects therein, in conformity with the provisions of the Contract.

4. The Employer hereby covenants to pay the Contractor, in consideration of the execution and completion of the Works and remedying of defects therein, the Contract Price at the times and in the manner prescribed by the Contract.

In witness whereof the parties hereto have caused this Agreement to be executed the day and year first before written in accordance with their respective laws.

SIGNED by : .....

For and on behalf of the Employer in the presence of

Witness: .....

SIGNED by: .....

For and on behalf of the Contractor in the presence of

Witness: .....

Name:	Name: .....
Address:	Address: .....
Date:	Date .....

FORMAT OF MOBILIZATION ADVANCE SECURITY (BANK GUARANTEE)

To: _____ [name of Employer]
_____ [address of Employer]
_____ [name of Contract]

In accordance with the provisions of the Contract, Sub-Clause ……. of Volume-II Price Schedules ("Mobilization Advance") of the above mentioned Contract _____ [name and address of Contractor] (hereinafter called "the Contractor") shall deposit with _____ [name of Employer] a bank guarantee to guarantee its proper and faithful performance under the said clause of the Contract in an amount of _____ [amount of guarantee] _____ [in words].

We, the _____ [bank or financial institution], as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to _____ [name of Employer] on its first demand without whatsoever right of objection on our part and without its first claim to the Contractor, in the amount not exceeding _____ [amount of Guarantee] _____ [in words].

We further agree that no change or addition to or other modification of the terms of the Contract or of Works to be performed there under or of any of the Contract documents which may be made between _____ [name of Employer] and the Contractor, shall in any way release us from any liability under this guarantee and we hereby waive notice of any such change, additions or modification.

This guarantee shall remain valid and in full effect from the date of the advance payment under the contract until_____ [name of Employer] receives full repayment of the same amount from the Contractor. Such guaranteed amount shall be reduced by the amounts of the advance payment repaid to you, as evidenced by your notices issued under Sub-Clause 14.6 of the Conditions of Contract. Following receipt (from the Contractor) of a copy of each purported notice we shall promptly notify you of the revised guaranteed amount accordingly.

Yours Truly .....
Signature and Seal .....
Name of Bank/Financial Institution .....
Address .....
Date .....

FORMAT OF SECURITY DEPOSIT – BANK GUARANTEE

To: ..... [name of Employer]
..... [address of Employer]

WHEREAS _____[name and address of Contractor] (hereinafter called "the Contractor") has undertaken, in pursuance of Contract No. _____ dated _____ to execute _____ [name of Contract and brief description of works] (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 by a recognized bank for the sum specified therein as security for compliance with its obligations in accordance with the Contract.

AND WHEREAS we have agreed to give the contractor such a Bank Guarantee.

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you, on behalf of the contractor, up to a total of _____ [amount of Guarantee] _____ [in words], such sum being payable in the types and proportion of currencies in which the Contract Price is payable, and we undertake to pay you, upon first written demand and without cavil or argument, any sum or sums within the limits of _____ [amount of Guarantee] 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 of the Works to be performed there under or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This guarantee shall be valid until the completion of O&M period.

Signature and Seal of the Guarantor:
Name of Bank :
Address :
Date :

SECTION 9

BILL OF QUANTITIES

Note:

(1) Item for which no rate or price has been entered and will not be paid for by the Employer when executed and shall be deemed covered by the other rates and prices in the Bill of Quantities (refer: ITB Clause 11.2 and CC Clause 37.2).

(2) Unit rates and prices shall be quoted by the Tenderer in Indian Rupees.

(3) Where there is a discrepancy between the rate in figures and words, the lower of the two will govern. [ITT Clause 24.1(a)]

(4) Where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by quantity, the unit rate quoted shall govern [ITT Clause 24.1 (b)]

CONSTRUCTION, TESTING, COMMISSIONING OF ALL THE COMPONENTS OF KORBA SEWAGE MASTER PLAN

PAC (A+B) = 8224.70+2469.70 = 10694.40 Lacs		
	% Break for Part A Capital work	
S.N.	**Particulars**	**% Cost**
Annexure-F-I	Design &Construction of Diversion weir at Kosabadi Nallah	0.55
Annexure- F-II	Design &Construction of inlet chamber, screen chamber & grit settlement chamber at Kosawadi, on Railway colony Nallah, Sitamani Nallah no.1,2 &3, Durpa Nallah, Moti Sagarpara Nallah, Purani Basti Nallah, Patel Sagarpara Nallah, Ratakhar Nallah, Gerva Nallah at 11 locations	3.13
Annexure-F-III	Design &Construction of Wet well (Sump) cum pump House at Kosabadi along with inlet & screen chamber.	1.20
Annexure-F-IV	Providing & installation of 1500 KVA substation at Kosabadi wet well & 33 MLD STP (Capacity- 1500 KVA)	3.70
Annexure-F-V	Providing & Commissioning of raw sewer pumping machinery at wet well on Kosabadi nalla	8.74
Annexure-F-VI	Raw sewer rising main from wet well at Kosabadi nalla to STP	21.67
Annexure-F-VII	Interceptor sewer line from Gerva Nala to Kosawadi wet well	15.14
Annexure-F-VIII	Construction of M.S. Cum R.C.C. truss bridge across the Hasdeo river for laying M.S. pipe	10.44
Annexure-F-IX	Design &Construction of 33 MLD Sewage Treatment Plant (SBR Technology) with 4 basin.	30.74
Annexure-F-X	Allied Civil Work (G-Type, H-Type & Guard Room)	1.14
Annexure-F-XI	Land Development Work for wet well (compound wall, internal road & storm water drain)	3.55
	Total =	100.00
Annexure-F-XII	O & M for all components of the project including replacement warranty for 15 years.	As per Part B

ANNEXURE- "F-I"
DESIGN AND CONSTRUCTION OF KT WIER (DIVERSION WIER) AT KOSAWADI,

A) Main Breakup

Sr. No.	Description of work Details	% Break-up
1	Design and constructionofweir at Kosawadi nalla.	0.55%

B) Sub Breakup

Sr. No.	Particulars	% Breakup
1	Physical survey, Hydrological / Geological investigation with foundation ascertaining hydraulic & structural designing and approval from NIT after compliance of KMC	**3.00%**
2	Excavation for foundations for Main Weir, its Key wall, Pier, 4side walls, & wing wall foundation along with apron ofU/stream & D/stream as per approved design & insertinganchor rods for foundation & bedding	**3.50%**
3	RCC foundation casting and all RCC works up to Nallah Bed RLincluding admissibility of part coffer dam payment	**38.00%**
4	All RCC work as per approved drawings & design uptoWalkway level over piers above Nallah Bed RL	**37.00%**
5	All other items including FRP /CI sluice gate, with remaining coffer dam, full dewatering including back filling of excavated material as directed but withhelding an amount for satisfactory trial & testing	**8.50%**
6	WBM approach road on both side& other misc works not listed above	**5.00%**
7	After satisfactory Trial & testing	**5.00%**
	Total =	**100.00%**

ANNEXURE- "F-II"

Design &Construction of inlet chamber, screen chamber & grit settlement chamber on Railway colony Nallah, Sitamani Nallah no.1,2 &3, Durpa Nallah, Moti Sagarpara Nallah, Purani Basti Nallah, Patel Sagarpara Nallah, Ratakhar Nallah, Gerva Nallah

A) Main Breakup

%Break up for work II – 3.13%

Sr. No.	Description of work Details	% Break-up
II/1	Design &Construction of inlet chamber, screen chamber & grit settlement chamber at Kosawadi Nallah	0.41
II/2	Design &Construction of inlet chamber, screen chamber & grit settlement chamber at Railway colony Nallah Sitamani Nallah No.3	0.32
II/3	Design &Construction of inlet chamber, screen chamber & grit settlement chamber at Sitamani Nallah No.3	0.32
II/4	Design &Construction of inlet chamber, screen chamber & grit settlement chamber at Sitamani Nallah No. 2	0.21
II/5	Design &Construction of inlet chamber, screen chamber & grit settlement chamber at Sitamani Nallah No.1	0.30
II/6	Design &Construction of inlet chamber, screen chamber & grit settlement chamber at Durpa Nallah	0.27
II/7	Design &Construction of inlet chamber, screen chamber & grit settlement chamber Moti Sangarpara Nallah	0.23
II/8	Design &Construction of inlet chamber, screen chamber & grit settlement chamber at Purani Basti Nallah	0.27
II/9	Design &Construction of inlet chamber, screen chamber & grit settlement chamber at Patel Sangarpa Nallah	0.26
II/10	Design &Construction of inlet chamber, screen chamber & grit settlement chamber atRatakhar Nallah	0.27
II/11	Design &Construction of inlet chamber, screen chamber & grit settlement chamber at Gerva Nallah	0.27

B) Sub Breakup

Sr. No.	Particulars	% Breakup
1	Physical survey, Hydrological / Geological investigation with foundation ascertaining hydraulic & structural designing and approval from NIT	**3.00%**
2	Excavation for work approved for all soils	**1.50%**
3	All RCC Concrete Item upto GL for whole structures including reinforcement as per approved drawings and design & as directed including part dewatering & coffer dam items	**45.00%**
4	All RCC Work above GL including fixing of Bar Screen as per approved drawings and design with fixing CI sluice Gate as per approved Design.	**30.00%**
5	All rest of items involved for completion of structures including remaining dewatering, refilling of excavated soil including dapuri steps etc. complete withhelding for trial& testing	**15.50%**
6	After satisfactory Trial & testing	**5.00%**
	Total =	**100.00%**

ANNEXURE- "F-III"
DESIGN AND CONSTRUCTIONOF WET WELL (SUMP) CUM PUMP HOUSE AT KOSAWDI ALONG WITH INLET & SCREEN CHAMBERS

A) Main Breakup

Sr. No.	Description of work Details	% Break-up
1	Design &Construction of Wet well (Sump) cum pump House at Kosabadi along with inlet & screen chamber.	1.20%

B) Sub Breakup

Sr. No.	Particulars	% Breakup
1	Physical survey, Hydrological / Geological investigation with foundation ascertaining hydraulic & structural designing and approval from NIT	**3.00%**
2	Excavation for work approved for all soils for Wet well & Inlet cum Screen Chamber with Part dewatering with PCC & Foundation as per approved designs and drawings	**12.00%**
3	All RCC works for Wet well & Inlet cum Screen Chamber upto GL with part dewatering as per approved designs & drawings complete	**25.00%**
4	All RCC Work upto Roof slab of Pump House including part dewatering etc. Complete	**13.00%**
5	All rest of items involved for completion of structures including remaining dewatering, refiling of excavated soil including dapuri steps MS Bar screens, Radiant Crust Gate etc. complete with all Doors & windows, IPS flooring, water proofing to roof slab, Fixing Gantry for pumps as per drawings and designs including exterior & Interior wall painting / trial & testing	**37.00%**
6	Construction of DG house for accommodating DG set	**5.00%**
7	After satisfactory Trial & testing	**5.00%**
	Total =	**100.00%**

ANNEXURE- "F-IV & V "
CONSTRUCTIONOF 1500 KVA ELECTRIC SUB STATION FOR PUMP HOUSE AT KOSAWDI&CONSTRUCTIONOF 1500 KVA ELECTRIC SUB STATION AT STP,&INSTALLATION OF PUMPING MACHINARYAT PUMP HOUES KOSAWADI

A) Main Breakup

Sr. No.	Description of work Details	% Break-up
F-IV	**For Electric substation 1500 KVA& DG set of 1500 KVA**	
1	At Wet well Kosawadi (Raw water)	3.70
2	At 33 MLD STP	
F-V	**For pumping machinery For Raw sewage**	
1	At Kosawadi	8.74%

B) Sub Breakup

Cost as per main breakup of (pumping machinery, Electric substation and electric work of pump house at Kosawadi SPS)

Sr. No.	Description of work Details	% Break-up
1	On supply of equipment at site	**60%**
2	On erection of equipment at site	**20%**
3	On testing and commissioning	**20%**
	TOTAL	**100%**

Sr. No.	Particulars of item for pumping machinery	Unit

Supply, erection, and commissioning of Non-clog submersible sewage pump sets of suitable HP along with allied accessories with transformer sub-station and.: 'PUMPSETS: Supply and delivery at site brand new approved makes sludge submersible pump coupled to approved make squirrel cage induction motor of suitable HP 'F' class insulation for the specified discharge and head mentioned below. The pump set should operate in full range of discharge and should have the following accessories specified in the following detailed specification. The submersible sewage pump shall be Monoblock type with non-clung design. The pumps should be able to pass through soft solids of 100 mm Dia and capable of delivering sludge with specific gravity of 1.05, impellers should be single/double Vane non-clog type of CF 8M material and with wearing rings. The pump should be fitted with contra block cutting and tearing system with special grooving system and suction side for disposal of soft solid materials like long fibre, plastics, solid admixes, sludge etc. Maintenance free, antifriction, deep groove permanently grease filled ball bearings to take care of all the axial and radial forces at any point of operations, should be provided. The pump design should be such as to facilitate automatic installation / removal of pump without having to enter into the sewage pit. Profile gasket should be provided in automatic coupling system to avoid metal to metal contact between the pump and delivery pipe to ensure leak proof joint. The cooling jacket shall be provided in the pump to reduce the dead sewage volume in the sump. 1) PUMP CASING: The pump casing shall be CI as per IS:210 GRFG 260 With 2 to 3% Nickel. The casing shall have central line discharge. 2) IMPELLER: The impeller shall be of stainless-steel grade CF 8M, single/double vane non-clog design additionally a special contra block cutting and tearing system for disposal of material. 3) PUMP SHAFT: The pump shaft shall be hard chrome plate alloy steel of stainless-steel SS/410 as per the manufacturer's standard and shall be of one piece construction. 4) PUMP BEARING: The pump bearing shall be of antifriction type. The bearings shall be able to take normal thrust loads due to unbalanced hydraulic loads on the impellers plus the weight of all the rotating parts of the pump. The pump bearings shall be designed with minimum life of 40,000 hours. The bearing shall be grease lubricated. The KMC reserves the right to select any of stipulated make of pump and motor, as such tenderer should be prepared to provide any of the stipulated makes pump and motor selected by the KMC. 6) The material test certificate and manufacturer's test certificate for pump and motor should be submitted to central office/circle office for clearance before dispatch. Submersible pump set should be installed in the sump and will be submerged with sludge. Hence, the pump set should suit the above system

Sr. No.	Location	Ratings
1	Kosawadi nalla	4 x Peak Discharge 859.12 LPS, Head – 79.75 m, 1 x Avg. Discharge 381.83 LPS, Head – 38.71m, 2 x Lean Discharge 190.92 LPS, Head – 30.20m,
2	STP	Included in scope of STP

	ACCESSORIES FOR PUMP: Suitable Guide rail system,Pedestal coupling, Lifting chain with shackle, Auto coupling with integral bond, Gantry crane (HDT), Sluice valve for delivery, Sluice valve for Header (DI), Valve Actuator, Check valve, Kinetic air valve, MS pipes & specials for delivery & header along with required flanges, nutbolts etc., Dismantling joints (MS), Electro-magnetic Flowmeters on delivery side, Required iron works, Required valve chambers etc.,	Set for each Pump & Motor

ANNEXURE "F-VI"

KORBA SEWAGE MASTERPLAN UNDER AMRUT 2.0
K-6 RAW SEWAGE RISING MAIN from WET WELL AT KOSBADI to STP

ESTIMATE

S.N	PARTICULARS	QTY	RATE	PER	AMOUNT
	Excavation:				
1	Earth work in excavation for pipe trench in ordinary soil areas including dressing, watering, ramming and disposal of excavated earth lead up to 50m and lift up to 1.5m, disposal earth to be levelled, neatly dressed Earth work in excavation for pipe trench in ordinary soil areas including dressing, watering, ramming and disposal of excavated earth lead up to 50m and lift up to 1.5m, disposal earth to be levelled, neatly dressed Earth work in excavation for pipe trench in ordinary soil areas including dressing, watering, ramming and disposal of excavated earth lead up to 50m and lift up to 1.5m, disposal earth to be levelled, neatly dressed.				
	For Lift 0 to 1.5 m				
	8895.90	8895.90		cum	
	(CG PHE Amendment 7, 2022-23, 18.15/51)				
	Extra for every additional lift of 1.5m or part there of			cum	

S.N	PARTICULARS	QTY	RATE	PER	AMOUNT
	2071.68	2071.68		cum	
	(CG PHE Amendment 7, 2022-23 18.20.1/52)				
2	Earth work in excavation for pipe trench in Hard soil areas including dressing, watering, ramming and disposal of excavated earth lead up to 50m and lift up to 1.5m, disposal earth to be levelled, neatly dressed.				
	Chhattisgarh PHED USOR Amendment No. 07 /2022-23; Item No.18.17.3 & 18.19.5; Pg.No.52				
	For Lift 0 to 1.5 m				
	4447.95	4447.95		cum	
	Chhattisgarh PHED USOR Amendment No. 07 /2022-23; Item No.18.17.3 & 18.19.5; Pg.No.52				
	Extra for every additional lift of 1.5m or part there of			cum	
	1035.84	1035.84		cum	
	(CG PHE Amendment 7, 2022-23 18.20.1/52)				
3	Earth work in excavation for pipe trench in all kinds of rocks in areas including dressing, stacking of useful material and disposal of unserviceable material up to lead up to 50m and lift up to 1.5m. Soft rock with or without blasting or bituminous pavement / cement concrete road. Chhattisgarh PHED USOR Amendment No.07 /2022-23; Item No.18.19, 18.19.3 & 18.19.7; Pg. No.51 & 52 **For Lift 0 to 1.5 m**				
	2668.77	2668.77		cum	
	Chhattisgarh PHED USOR Amendment No.07 /2022-23; Item No.18.19, 18.19.3 & 18.19.7; Pg. No.51 & 52				

S.N	PARTICULARS	QTY	RATE	PER	AMOUNT
	Extra for every additional lift of 1.5m or part there of			cum	
	621.50	621.50		cum	
	(CG PHE Amendment 7, 2022-23 18.20.1/52)				
4	Earth work in excavation for pipe trench in all kinds of rocks in areas including dressing, stacking of useful material and disposal of unserviceable material up to lead up to 50m and lift up to 1.5m.				
	Hard rock requiring chiselling / where blasting is prohibited				
	For Lift 0 to 1.5 m				
	889.59	889.59		cum	
	Chhattisgarh PHED USOR Amendment No.07 /2022-23; Item No.18.19.3 & 18.19.7; Pg. No.51 & 52				
	Extra for every additional lift of 1.5m or part there of			cum	
	207.17	207.17		cum	
	(CG PHE Amendment 7, 2022-23 18.20.1/52)				
5	For muddy area extra rate for Item of quantity extra percentage rate is applicable in respect of each item but limited to quantities of works executed in these difficult conditions of soft soil				
	For Lift 0 to 1.5 m				
	889.59	889.59		cum	
	(CG PHED SOR, Amendment No.07 /2022-23 18.18, Pg No.-51; +20% Extra)				
	Extra for every additional lift of 1.5m or part there of			cum	
	207.17	207.17		cum	
	(CG PHE Amendment 7, 2022-23 18.20.1/52)				
6	Pumping out water caused by springs,	9000		KL	

S.N	PARTICULARS	QTY	RATE	PER	AMOUNT
	tides or river seepage, broken water mains.				
	15 KL for 10 hrs a day for 60 days				
	(CG PHED USOR Amendment No.07/2022-23; Item No.18.17.3 &18.21; Pg. No.52)				
7	Providing, laying and jointing socket & spigot centrifugally cast (Spun) Ductile Iron pressure pipes with inside cement mortar lining (class K-9) Conforming to IS 8329/2000 with suitable Rubber Gasket (Push on) joints as per IS:5382/85 including testing of joint (laying Conforming to IS 12288 : 1987)				
	700mm Dia	9124.00		Mtr	
	(CG PHED USOR Amendment No.07/2022-23; Item No.4.3; Pg. No.3)				
8	Providing and Laying including testing Ductile Iron Double Socket 90° Bends conforming to IS:9523/2000 having dimension as per table 15 of IS:9523/2000 in the following nominal diameter/sizes with external bitumen coating and internal cement mortar lining.				
	(CG PHE, SOR AMENDMENT 07/2022-23, ITEM NO. 4.13/P 7)				
	700mm Dia	19.00		Each	
9	Providing and Laying including testing Ductile Iron Double Socket 45° Bends conforming to IS:9523/2000 having dimension as per table 16 of IS: 9523 /2000 in the following nominal diameter/sizes with external bitumen coating and internal cement mortar lining.				
	(CG PHE, SOR AMENDMENT 07/2022-23, ITEM NO. 4.15/P 8)				
	700mm Dia	13.00		Each	

S.N	PARTICULARS	QTY	RATE	PER	AMOUNT
10	Providing and Laying including testing Ductile Iron Double Socket 22.5° Bends conforming to IS:9523/2000 having dimension as per table 17 of IS:9523/2000 in the following nominal diameter /sizes with external bitumen coating and internal cement mortar lining.				
	(CG PHE, SOR AMENDMENT 07/2022-23, ITEM NO. 4.17/P 8)				
	700mm Dia	10.00		Each	
11	Providing and Laying including testing Ductile Iron Double Socket 11.25° bends conforming to IS:9523/2000 having dimension as per table 18 of IS:9523/2000 in the following nominal diameter/ sizes with external bitumen coating and internal cement mortar lining.				
	700mm Dia	10.00		Each	
	(CG PHE, SOR AMENDMENT 07/2022-23, ITEM NO. 4.19/P 9)				
12	Providing and Laying including testing Ductile iron Mechanical joint collar with follower glands conforming to IS: 9523/2000 having dimension as per table 24 of IS: 9523/2000 in the following nominal diameter/sizes with external bitumen and internal cement mortar lining.				
	(CG PHE, SOR AMENDMENT 07/2022-23, ITEM NO. 4.11/P 6)				
	700mm Dia	56.00		Each	
13	Providing and Laying including testing ductile PN 16 type iron flanged spigot conforming to IS:9523/2000 having dimension as per table 24 of IS:9523/2000 in the following nominal diameter/sizes with external bitumen coating and internal cement mortar				

S.N	PARTICULARS	QTY	RATE	PER	AMOUNT
	lining with finishing as per clause 13 of IS:9523/2000.				
	(CG PHE, SOR AMENDMENT 07/2022-23, ITEM NO. 4.9/P 5)				
	(Flanged Spigot)700mm Dia	4.00		Each	
14	Providing and Laying including testing ductile iron PN 16 type flanged sockets conforming to IS: 9523/2000 having dimension as per table 23 of IS: 9523/2000 in the following nominal diameter/sizes with external bitumen coating and internal cement mortar lining with finishing as per clause 13 of IS:9523/2000.				
	(CG PHE, SOR AMENDMENT 07/2022-23, ITEM NO. 4.7/P 4)				
	(Flanged Socket Tail Piece)700mm Dia	4.00		Each	
15	Labour only for cutting following Ductile Iron pipes of any type and class.				
	(CG PHE, SOR AMENDMENT 07/2022-23, ITEM NO. 19.4/P 60)				
	700mm Dia	56.00		Per Cut	
16	Chamfering of CI/DI pipes of all types and classes to make suitable for tyton joints.				
	(CG PHE, SOR AMENDMENT 07/2022-23, ITEM NO. 19.6/P 61)				
	700mm Dia	112.00		Each End	

S.N	PARTICULARS	QTY	RATE	PER	AMOUNT
17	Fabrication of M.S. pipes & specials from steel plates as per relevant IS specifications inclusive of cost of all materials, for any thickness as per design, inspection charges, testing, transit insurance, loading/ unloading, FOR site and stacking etc. complete as per direction of the Engineer in charge. Fabricating of pipes and specials from steel plates.				
	(CG PHED USOR ; Item No.10.20; Pg. No.143)	39068.67		Kg	
	Labour only for lowering and laying of MS pipe and specials as per approved specification complete as directed by Engineer in charge	39068.67		Kg	
	(CG PHED USOR ; Item No.10.3; Pg. No.143)				
18	Providing & fixing of following Ductile iron double flanged sluice valves as per IS 14846:2000 fitted with cap including jointing & testing with cost of jointing material such as bolts, nuts, rubber insertions etc. all complete				
	700 mm PN1.6 with Bypass	4.00		each	
	(CG PHED USOR Amendment No.07/2022-23; Item No.4.41; Pg. No.18)				
19	Providing & fixing of following Ductile iron double flanged sluice valves as per IS 14846:2000 fitted with cap including jointing & testing with cost of jointing material such as bolts, nuts, rubber insertions etc. all complete				
	Scour Valve				
	200 mm Dia	2		each	
20	Filling with murum / river sand for pipe bedding or over the pipe including supply .				

S.N	PARTICULARS	QTY	RATE	PER	AMOUNT
	3000 x 1.30 x 0.15	585		Cum	
	(CG PHED USOR Amendment No.07/2022-23; Item No.18.24; Pg. No.52)				
21	Filling available excavated earth in trenches, plinth sides of foundation in layers not exceeding 20cm. in depth including consolidation of each layer by ramming watering, lead up to 50m and lift up to 1.5m in all kinds of soils				
	Chhattisgarh PHED USOR Amendment No.07/2022-23; Item No.18.22; Pg. No.-52	17120.02		Cum	
22	Construction of RCC valve chamber with RCC precast covers 100mm to 600mm Dia				
	For 300mm - 800 mm Dia	4.00		each	
	(cost as per annexure II enclosed)				
23	Construction of RCC valve chamber with RCC precast covers for valves				
	For Scour Valve	2		Each	
	For Air Valve	20		Each	
	(cost as per annexure I enclosed)				
24	Providing, Laying and jointing non-pressure (NP2) RCC socket & spigot pipes with rubber gasket joint including testing of joints. [Conforming to IS ; 458-1988, ISI marked laying as per IS 783:1985)				
	200 mm Dia for draining Scour sewer to Hasdeo river	0.00		Rmt	
	suitable for 700 mm Dia pipe line				
25	Providing & fixing following ductile iron single chamber triple function temper proof air valves, small orifice with screwed end as per IS : 14845 -2000 including jointing & testing with cost of jointing material and rubber insertion all				

S.N	PARTICULARS	QTY	RATE	PER	AMOUNT
	complete as per IS :13095-1991(Including Bridge Crossing)				
	Chhattisgarh PHED USOR Amendment No.07/2022-23; Item No.4.50; Pg. No.-21 -- Type PN-16				
	100 mm	20.00		Each	
26	Providing and laying design mix reinforced cement concrete with crushed graded stone aggregate 20mm nominal size using batching plant, transit mixer and concrete pump, in all works upto plinth level excluding cost of form work.				
	Chhattisgarh PHED USOR Amendment No- 07 2022-23, Item No. 18.42.1 ; Pg. No.54				
	RCC M-20				
	In plinth and foundation, M-20 for thrust blocks	73.944		Cum	
27	Manufacturing, Supplying at site & laying, jointing of following M.S. pipes as per IS specifications, duly testing for usage in Drinking water inclusive of all materials, inspection charges, transit insurance, loading/unloading, FOR site and stacking etc. complete as per direction of Engineer-in-Charge.(Excluding protective coating)				
	Dia of pipe 700.00 mm (I.D) **Thickness of pipe 10mm**	770		m	
	Chhattisgarh PHED SOR; Item No.10.1.13; Pg. No.-141				
28	Providing & applying inside 20 mm thick 1:2cement mortar on inside face of pipe as per relevant IS specification including testing as directed by Engineer in Charge				

S.N	PARTICULARS	QTY	RATE	PER	AMOUNT
	Chhattisgarh PHED SOR; Item No.10.1.13; Pg. No.-141	1692.46		Sqm	
29	Providing and apply in covering coat of grey graphite of approved quality including dusting the surface etc complete				
	Chhattisgarh PHED SOR; Item No.17.7; Pg. No.-217	2103.486		Sqm	
		Total			**178203555.85**

ANNEXURE "F- VII"
K-7 INTERCEPTING SEWER LINE FROM NALLAH
NALLAHs AND PARALLEL TO RIVER OF RCC NP3 pipe

TENTATIVE ESTIMATE (Total Length 5960 m)

S.N.	PARTICULARS	QTY	RATE	PER	AMOUNT
	Excavation:				
1	Earth work in excavation for pipe trench in ordinary soil areas including dressing, watering, ramming and disposal of excavated earth lead up to 50m and lift up to 1.5m, disposal earth to be levelled, neatly dressed				
	Chhattisgarh PHED USOR Amendment No.07/2022-23; Item No.18.15, Pg. No.51				
	Lift 0.0 to 1.5 m	15635.13		cum	

S.N.	PARTICULARS	QTY	RATE	PER	AMOUNT
	Lift 1.5 to 3.0 m	11588.09		cum	
	Lift 3.0 to 4.5 m	7897.75		cum	
	Lift 4.5 to 6.0 m	4595.27		cum	
	Lift 6.0 to 7.5 m	1783.76		cum	
	Lift 7.5 to 9.0 m	114.47		cum	
	Lift 9.0 to 10.5 m	0.00		cum	
		41614.46			
2	Earth work in excavation for pipe trench in Hard soil areas including dressing, watering, ramming and disposal of excavated earth lead up to 50m and lift up to 1.5m, disposal earth to be levelled, neatly dressed.				
	Chhattisgarh PHED USOR Amendment No. 07 /2022-23; Item No.18.17.3 & 18.19.5; Pg.No.52				
	Lift 0.0 to 1.5 m	3908.78		cum	
	Lift 1.5 to 3.0 m	2897.02		cum	
	Lift 3.0 to 4.5 m	1974.44		cum	
	Lift 4.5 to 6.0 m	1148.82		cum	
	Lift 6.0 to 7.5 m	445.94		cum	
	Lift 7.5 to 9.0 m	28.62		cum	
	Lift 9.0 to 10.5 m	0.00		cum	-
		10403.62			
3	Earth work in excavation for pipe trench in all kinds of rocks in areas including dressing, stacking of useful material and disposal of unserviceable material up to lead up to 50m and lift up to 1.5m.				
	Chhattisgarh PHED USOR Amendment No.07 /2022-23; Item No.18.19, 18.19.3 & 18.19.7; Pg. No.51 & 52				
	Soft rock with or without blasting or				
	bituminous pavement / cement concrete				
	road.				
	Lift 0.0 to 1.5 m	9771.96		Cum	
	Lift 1.5 to 3.0 m	7242.55		Cum	
	Lift 3.0 to 4.5 m	4936.09		Cum	

S.N.	PARTICULARS	QTY	RATE	PER	AMOUNT
	Lift 4.5 to 6.0 m	2872.04		Cum	
	Lift 6.0 to 7.5 m	1114.85		Cum	
	Lift 7.5 to 9.0 m	71.54		Cum	
	Lift 9.0 to 10.5 m	0.00		cum	-
		26009.04			
4	Earth work in excavation for pipe trench in all kinds of rocks in areas including dressing, stacking of useful material and disposal of unserviceable material up to lead up to 50m and lift up to 1.5m.				
	Hard rock requiring chiselling / where blasting is prohibited				
	Chhattisgarh PHED USOR Amendment No.07 /2022-23; Item No.18.19.3 & 18.19.7; Pg. No.51 & 52				
	Lift 0.0 to 1.5 m	7817.57		Cum	
	Lift 1.5 to 3.0 m	5794.04		Cum	
	Lift 3.0 to 4.5 m	3948.87		Cum	
	Lift 4.5 to 6.0 m	2297.64		Cum	
	Lift 6.0 to 7.5 m	891.88		Cum	
	Lift 7.5 to 9.0 m	57.23		Cum	
	Lift 9.0 to 10.5 m	0.00		cum	-
		20807.23			
5	For muddy area extra rate for Item of quantity extra percentage rate is applicable in respect of each item but limited to quantities of works executed in these difficult conditions of soft soil				
	(CG PHED SOR, Amendment No.07 /2022-23 18.18, Pg No.-51; +20% Extra)				
	Lift 0.0 to 1.5 m	1954.39		Cum	
	Lift 1.5 to 3.0 m	1448.51		Cum	
	Lift 3.0 to 4.5 m	987.22		Cum	
	Lift 4.5 to 6.0 m	574.41		Cum	
	Lift 6.0 to 7.5 m	222.97		Cum	
	Lift 7.5 to 9.0 m	14.31		Cum	
	Lift 9.0 to 10.5 m	0.00		cum	-

S.N.	PARTICULARS	QTY	RATE	PER	AMOUNT
		5201.81			
8	Demolishing stone rubble masonry manually/ mechanical means including stacking of serviceable material and disposal of unserviceable material within 50 meter lead as per direction of engineer-in-charge. (In lime mortar)	1000		cum	
	(CG PHED SOR, Amendment No.07 /2022-23; Item N.-18.27, Pg No.-52)				
	Extra for carriage by mechanical	1000		cum	
	means upto 5 Kms				
	PHE SOR 2013, Item				
9	Providing, constructing coffer dam in river basin/dam storages as per type design including excavation, filling the middle portion with B.C. soil (in gunny bags if required). Providing impervious /semi pervious materials on both side of B.C. soil (in gunny bags if required) including ramming compacting to the satisfaction of Engineer-in-Charge, till the completion of work including dismantling coffer dam after completion of works and disposing off the materials as directed by the Engineer-in-charge. (PHE SOR I. No. 24.1 of P. No. 268)				
	750 x 3.0 x ((5+2)/2)	7875		No.	
	Chhattisgarh PHED USOR Amendment No. 07 /2022-23; Item No.20.1; Pg.No.71				
10	Pumping out water caused by springs, tides or river seepage, broken water mains or drains.	36000		KL	
	15 KL for 12 hrs a day for 200 days				
	(CG PHED SOR AMEND 7 P.52 It.No. 18.21)				
11	Close timbering in trenches including strutting, shoring and packing cavities (wherever required) complete				

S.N.	PARTICULARS			QTY	RATE	PER	AMOUNT
	(Measurement to be taken of the face area timbered)						
	(CG PHED SOR, Amendment No.07 /2022-23; Item N.-18.65, Pg No.-57)						
	Lift 0 to 1.5 m [for non-water logged area]			4690.30		sqm	
	Lift 1.5 to 3.0 m			2262.80		sqm	
	Lift 3.0 to 4.5 m			189.00		sqm	
12	Supply & Filling crusher stone dust for pipe bedding or over the pipe (including supply of crusher stone dust.)						
	(Amendment 7/2022 / I.N. 18.25)						
	Crusher stone dust						
	Bedding below pipe		As per SEWER Statement for Bedding				
				1142.25		cum	
13	Providing and laying mechanically mixed cement concrete with crushed stone aggregate excluding cantering and shuttering (with 40mm nominal size graded stone aggregate)						
	(Amendment 7/2022 / I.N. 18.40.1.4)						
	Bedding and half encasing of Pipe in						
	M-15			801.33		cum	
14	Providing and Laying non-pressure (NP3) RCC socket & spigot pipes with rubber gasket joint including testing of joints. [Conforming to IS ; 458-1988, ISI marked laying as per IS 783:1985)						
	(CG PHE SOR 2020 I.No. 15.3 page No. 195)						
	450	mm dia	154	154.00		Mtr	
	500	mm dia	1744	1744.00		Mtr	
	600	mm dia	1585	1585.00		Mtr	
	700	mm dia	83	83.00		Mtr	

S.N.	PARTICULARS			QTY	RATE	PER	AMOUNT
	800	mm dia	750	750.00		Mtr	
	900	mm dia	1501	1501.00		Mtr	
	1000	mm dia	119	119.00		Mtr	
	1100	mm dia	24	24.00		Mtr	
			5960				
15	Supplying of and application of Polymer based protective Elastomeric coating with zero V.O.C. for complete inside surface of RCC sewers, with minimum dry film thickness of 1mm, Acid resistant, Abrasive resistant, Adhesive to concrete surface, Durable and pinhole /break free, with smooth surface and after application, complete, as per applicable Technical specification clause, including all labour, HOM of equipment, lead, lifts, taxes etc., complete, spray coating applied by approved and controlled mechanical spray method, for RCC sewers prior to delivery of sewers t site or applied at site, as approved by BWSSB, including all surface preparation, testing, Rate shall be inclusive of all materials, tools and plants, testing and inspection etc., complete.						
	(BWSSB CSR I.No. 5 page No. 74)			12714.7314		sqm	

S.N.	PARTICULARS	QTY	RATE	PER	AMOUNT
16	Construction of RCC manhole chambers of 1:1.5:3 proportion or approved type pre-cast RCC manhole chambers, constructed using form vibrators of standard type, with barricading, danger lighting and using of sight rails and boning rods wherever necessary, shoring and strutting wherever required using Ordinary Port Land Cement, using 1:1.5:3 proportion RCC with 20 mm and downgraded jelly, well graded sand and steel of approved quality, 200 mm thick top concrete slab, having wall thickness and raft thickness as in approved drawings and with an offset in raft all-round the chamber as in approved drawing, benching concrete with 1:6 slope towards the central drain finished smooth, including fixing and grouting of pipes, including conveying to work spot supply and fixing SFRC manhole cover and frame (Heavy duty) conforming to IS:12592 with latest amendments, on a bed of CC 1:2:4 supplying and fixing of minimum 3 mm thick encapsulated plastic footsteps (as per IS 10910) on 12 mm dia. Grade Fe-415 steel bar (as per IS 1786) staggered at 300 mm apart as detailed in Technical specifications, including sand bedding wherever required, disposal of surplus earth, watering, curing, engraving manhole number with flow direction on the inner cylindrical surface etc., complete including cost of reinforcement steel and fabrication charges and Also, cost and conveyance of all materials labour with all lead and lifts for various diameters and depths noted below: asper specification, drawing and as directed by the Engineer inclusive of Earth work excavation in all type of soil.				
	(BWSSB CSR I.No. 54 page No. 81-82)				
	1.2 m Manhole				
	2m	5.00		Each	
	3m	14.00		Each	
	1.5 m Manhole				
	4m	9.00		Each	
	5m	9.00		Each	

S.N.	PARTICULARS	QTY	RATE	PER	AMOUNT
	6m	15.00		Each	
	7m	20.00		Each	
	8m	17.00		Each	
17	Providing and fixing 150mm dia. Cast Iron pipe for ventilating shaft 5 M high with specials and cowl and with suitable grips in CC 1:2:4 pillar using 10mm to 20mm graded hard granite, with 15 cms. thick cement concrete 1:2:4 around upto 1.22 M above the GLR and with a foundation base of 90 x90 x 90 cms. plastered with 12mm thick CM 1:3 to all exposed faces and linking the shaft to the manholes by means of 150mm dia. GSW pipes and specials, jointing with tar dipped hemp 1:1.5 CM caulking, curing. The cost include all lead and lifts for all materials, earth work excavations and refilling in all strata, disposal of surplus earth etc. complete.				
	(BWSSB CSR Item No. 37 page 174)	23.00		No.	
18	Filling available excavated earth in trenches, plinth sides of foundation in layers not exceeding 20cm. In depth including consolidation of each layer by ramming watering, lead upto 50m and lift up to 1.5m in all kinds of soils				
	(CG PHED SOR, Amendment No.07 /2022-23; Item N.-18.27, Pg No.-52)				
		99676.10			
	Total Refilling	99676.10		cum	
				Total	**124538477.00**

ANNEXURE- "F-VIII"
CONSTRUCTIONOF M.S. CUM RCC TRUSS BRIDGE ACROSS THE HASDEO RIVER FOR LAYING M.S. PIPE LINE

A) Main Breakup

Sr. No.	Description of work Details	% Break-up
1	Design and constructing of R.C.C. Cum M.S. truss bridge across the Hasdeo river for laying of M.S. pipe 700 mm Dia (rate analysis) Note- Structural drawing of bridge (steel) including of RCC foundation, abutment & piers & cap etc will be submitted along with design calculation for approval by Engineer-in-charge before starting of construction of fabrication& execution and shall be got approved from IIT/ NIT	10.44%

The contractors offer shall be for 750 m long bridge. In case of increase or decrease in length, offer shall be increased or decrease on prorata basis for making payment.

B) Sub Breakup

Design & Construction of MS cum RCC truss bridge across Hasdeo river for Laying M.S. pipe line.

Sr. No.	Particulars	% Breakup
1	Physical survey, Hydrological / Geological investigation with foundation ascertaining hydraulic & structural designing and approval from NIT	**5.00%**
2	Excavation for foundation/ drilling of piles for foundation, dewatering with PCC & Foundation as per approved designs and drawings	**15.00%**
3	Pile cap/ work upto river bed level All RCC works including dewatering and as per approved designs & drawings complete	**15.00%**

4	Piers upto platform Level/ truss bottom level	**15.00%**
5	Abutment construction upto truss bottom level	**10.00**
6	Fabrication of truss, erection of truss, casting of platform	**30.00%**
7	EpoxyPainting & other misc works not listed above	**10.00%**
	Total =	**100.00%**

S.N.	**Particulars of Work**	**Unit**
1	Design and constructing of R.C.C. Cum M.S. truss bridge across the Hasdeo river 750 m long for laying of M.S. pipe 700 mm Dia (rate analysis). The work includes required survey of alignment, necessary hydrological and geotechnical investigation, confirmation of HFL from WRD/PWD and all the necessary investigation required for preparation and approval of structural design. The scope of work includes preparation of Structural drawing of bridge (steel) including of RCC foundation, abutment & piers & cap etc to be submitted along with design calculation for approval. The drawings shall be got vetted from NIT/ IIT and approved from competent authority of KMC. The work includes construction of coffer dam for foundation of piers, dewatering, necessary excavation for piers/ piles, pile cap or any suitable foundation, construction of pier, pier cap, pedestal for resting trusses etc. All RCC work shall be with minimum M 30 grade concrete. Work includes fabrication and erection of truss, platform for laying pipe line, 1.0 m wide 3 mm thick chequered plate walkway for movement of DG set and welding set for maintenance. Width of bridge shall be at least 2.10 m with chairs for resting pipe line. One third diameter of the pipe shall rest on M.S. chairs. Top shall be clamped with 50mm x 3 mm clamp. Bottom of pipe line shall be minimum 300 mm up from platform level. Platform level shall be minimum 1 m above HFL and level shall be got approved from KMC before designing. Design of truss and members shall be got approved by engineer-in-charge before starting offabricationerecting& execution. Providing epoxy painting to all steel work over prime coat. Work includes providingI/GI Hand Railing 1.0 m high on both sides of platform.All relevant BIS codalprovisions has to be scrupulously followed for designing the Bridge. Scope of work Also, includes Construction of approach road on both ends from the existing BT road up to entry and exit of bridge.	

ANNEXURE- "F-IX"
DESIGN AND CONSTRUCTION OF SEWAGE TREATMENT PLANT OF 33.00 MLD CAPACITY WITH SBR TECHNOLOGYWITH FOUR BASINS

A) Main Breakup

Sr. No.	Description of work Details	% Break-up
1	Design & Construction of 33.00 MLD STP with SBR technology with four basins at Pragati Nagar, Korba	30.74%

B) Sub Breakup

Construction of 33.00 MLD STP with SBR technology at Pragati Nagar, Korba

Sr. No.	Items	Release of Payments
1.0	**Approval of Drawings and Documentation**	**5% of the main breakup as per A.**
	Approval of Basic Engineering Package	1.50%
	Approval of Detailed Engineering Package	3.5%
2.0	**Civil Works**	**40% of the main breakup as per A.**
2.1	**Liquid Retaining Structures**	
	On Completion of Excavation	1%
	On completion of bottom raft on pro-rata basis against monthly running bills	6%
	On completion of Side wall up to half of the height on pro-rata basis against monthly running bills	6%
	On completion of Side wall up to full height on pro-rata basis against monthly running bills	4%
	On completion of water proofing and tightness test on pro-rata basis against monthly running bills	1%
	On completion of balance work & other misc works	1%
	On completion of commissioning and after 30 days of issuance of taking over certificate	1%
2.3	**Various Buildings / Sheds**	

	On Completion of Excavation	1%
	On completion of on foundation on pro-rata basis against monthly running bills	4%
	On completion of Superstructure including roof slab on pro-rata basis against monthly running bills	4%
	On completion of brick work/block work on pro-rata basis against monthly running bills	4%
	On completion of Internal and External Plaster on pro-rata basis against monthly running bills	1%
	On completion of Painting on pro-rata basis against monthly running bills	1%
	After Providing Lift and Aluminium cladding to building	1%
	On completion of erection works of machinery.	1%
	On completion of commissioning and after 30 days of issuance of taking over certificate	1%
	On completion of road, and RCC built up drains	1%
	On completion of Landscaping and site cleaning	0.8%
	On completion of Rainwater Harvesting, Bridge and other allied works& other misc works not listed above	0.2%
3.0	**Supply, Installation and Commissioning of mechanical, electrical, instrumentation equipments (both outside and within country) and other Services**	**55% of the main breakup as per A.**
	On supply of Machinery / Equipments on pro-rata basis against monthly running bills	38.50%
	On completion of Erection Works	8.25%
	On successful trial with actual loading	2.75%
	On successful completion of PLC-SCADA, Analyzer, Display Board, IOT Based integration	2.75%
	On completion of commissioning and issuance of taking over certificate	2.20%
	On supply of Golf car	0.55%

ANNEXURE- "F-X"

DESIGN AND CONSTRUCTION OF G TYPE QUARTES ADMEASURING 150 SQM BUILT UP AREA, H TYPE QUARTERS ADMEASURING 330 SQM BUILT UP AREA AND GUARD ROOM OF 20 SQM BUILT UP AREA

A) Main Breakup

Total breakup for F X- 1.14%

Sr. No.	Description of work Details	% Break-up
1	Design and construction H type quarters admeasuring 330 sqm built up area	0.71 %
2	Design and construction of G type quarters admeasuring 150 Sqm built up area,	0.39%
3	Design and construction guard room of 20 sqm built up area	0.04%

B) Sub Breakup

Sr. No.	Items	Release of Payments for H type Quarters	Release of Payments forG type Quarters	Release of Payments for Guard Room
	Approval of Design and Structural drawings	**3**	**3**	**3**
	Foundation complete	5	8	8
	RCC Work up to plinth	5	5	5
	RCC Work up to ground floor slab	**7**	**20**	**20**
	RCC Work up to first Floor slab	**7**	**-**	**-**
	RCC Work upto second floor slab	7	-	-
	Brickwork for Ground Floor	5	10	10
	Brick work for First Floor	5	-	-
	Brick work second floor	3	-	-

	RCC and Brickwork for stair case room	3	5	5
	Internal Plaster	5	7	7
	External Plaster	5	7	7
	Plumbing, Sanitary fittings Rainwater pipes Overhead tank	10	8	8
	Wiring and Electric Fittings complete	**10**	**10**	**10**
	Internal and external Painting	10	10	10
	Plinth protection, court yard paving and fencing, general cleaning Tube Well & other misc works not listed above	10	7	7
	Total	100	100	100

ANNEXURE "F- XI"
LAND DEVELOPMENT WORK AT WET WELL
COMPOUND WALL INTERNAL ROAD STROM WATER DRAIN

Sr. No.	Item	Unit	Qty	Rate	Amount
A)	**Road Work**				
1	Excavation in Soil (by Manual Means.) Excavation for roadway in soil using including loading in tipper for carrying of cut earth to embankment site and unloading with all lifts and lead upto1000 meters as per relevant clauses of section 300.				
	For Storm water drain work	Cum	2904		
	SOR for Road Works,C.G, P.W.D.(2015-16), Item No.3.1; Pg. No. 11	Cum	1056		
2	Removal of Unserviceable Soil with Disposal up to 1000 meter including loading and unloading.				
	SOR for Road Works, C.G, P.W.D. (2015-16), Item No3.8; Pg. No.11	Cum	2550		

3	Construction of granular sub-base by providing graded Material, , carriage of mixed Material to work site, spreading in uniform layers with motor grader on prepared surface watering, rolling and compacting with vibratory power roller at OMC to achieve the desired density, complete as per clause 401				
	Grading-III Material	Cum	1162		
	CG PWD Road SOR 2015, Item No.4.1(i) Pg. No. 16				
4	Dry Lean Cement Concrete Sub-base as per IRC:SP- 49 (Construction of dry lean cement concrete Sub- base over a prepared sub-grade with coarse and fine aggregate conforming to IS: 383, the size of coarse aggregate not exceeding 26.5 mm, aggregate cement ratio not to exceed 15:1, aggregate gradation after blending to be as per table 600-1, cement content not to be less than 150 kg/cum, optimum moisture content to be determined during trial length construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a batching plant, transported to site, laid with a paver with electronic sensor, compacting with 8-10 tonnes vibratory roller, finishing and curing as per clause 601.)				
	CG PWD Road SOR 2015 Item No.6.1 Pg. No. 26	Cum	1162		

5	Cement Concrete Pavement (Construction of un-reinforced, dowel jointed, plain cement concrete pavement as per IRC:58 over a prepared sub-base, coarse and fine aggregate conforming to IS:383 and graded as per table 600-3 mixed in a batching and mixing plant as per approved mix design, transported to site, laid with a fixed form or slip form paver, spread, compacted and finished in a continuous operation including provision of contraction, expansion, construction and longitudinal joints, joint filler, separation membrane, sealant primer, joint sealant, debonding strip, dowel bar, tie rod, admixtures as approved, curing compound, finishing to lines and grades as per drawing as per clause 602.)				
	With Cement concrete grade M-40 and minimum cement content @400 kg/cum.	Cum	2904		
	For Strom water drain Raft	Cum	79		
	For Strom water drain Wall	Cum	158		
	CG Road SOR 2015, Item No.6.2(i) Pg. No. 27		3141.60		
B)	**Landscaping**				
1	Hydraulic excavator of 1.0 Cum bucket require for land leveling	per hour	60.00		
	Planter wall for garden				
	CG PWD Road SOR 2015 Pg. no.7 Item No. 1.4 (V)				
2	Brick work with modular fly-ash lime bricks (FaLG Bricks) confirming to IS:12894-2002 of class designation 4.0 in foundation and plinth in: Cement Mortar 1:4 (1 cement : 4 coarse sand) (For gardening work)				
	CHATTISGARH PWD Building DSR 2015-16Pg. no. 45, Item No. 7.5.2	Cum	146		
	Total	Cum	145.73		

3	Providing and laying nominal mix plain cement concrete with crushed stone aggregate using concrete mixer in all works upto plinth level excluding cost of form work. 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 40mm nominal size).				
	CG PWD Building2015, Item No3.1.4, Pg. No. 23				
	Area A	Cum	15.64		
	Total	Cum	15.64		
4	Providing and making 12mm thick cement plaster of mix: In Cement Mortar 1:4 (1cement : 4 fine sand) (For gardening work)				
	CPWD SOR Building 2015, Item No.11.2.2, Pg. No. 103				
	Area A	Sqm	634		
	Total	Cum	634		
5	Preparation of beds for hedging and shrubbery by excavating 60cm deep and trenching the excavated base to a further depth of 30cm, refilling the excavated earth after breaking clods and mixing with sludge or manure in the ratio of 8:1 (8 parts of stacked volume of earth after reduction by 20% : one part of stacked volume of sludge or manure after reduction by 8%), flooding with water, filling with earth if necessary, watering and finally fine dressing, leveling etc. including stacking and disposal of materials declared unserviceable and surplus earth by spreading and leveling as directed, within a lead of 50m lift upto 1.5 m complete (cost of sludge, manure or extra earth to be paid for separately).				
	CG PWD Building 2015, Item No.22.13, Pg. No. 205				
		Cum	1563.26		
	Total	Cum	1563.26		

6	Supplying and stacking of good earth at site including royalty, loading, unloading and carriage upto 5 km (earth measured in stacks will be reduced by 20% for payment).				
	CG PWD Building 2015, Item No.22.2, Pg. No. 204	Cum	1302.72		
	Total		1302.72		
7	Supplying and stacking at site well decayed cow dung manure from approved source, including loading, unloading and carriage upto 5 km (manure measured in stacks will be reduced by 8% for payment).				
	CG PWD Building 2015, Item No.22.3 Pg. No. 204	Cum	1302.72		
			1302.72		
8	Supplying and planting approved quality of trees				
i)	Providing and planting of 3‟0” to 4‟0” heighted wasingtonia, filipheria/bismarkia novelist palm plants with 1‟6” x 1‟6” depth pit formation and soil preparation, (Mixing organic manure and plantsprotection insecticide). Up to 4 month maintenance.	Nos.	150.00		
	CG PWD Road SOR 2015, Item No.12.6Pg. No. 45				
ii)	Providing and planting of Bogenbelia dwarf, chandni dwarf, kaner dwarf or flower bearing plants with 0‟9” x 0‟9” depth pit formation and soil preparation work’s, (Mixing organic manure and plants protection insecticide). Up to 4 month maintenance.	Nos.	100.00		
	CG PWD Road SOR 2015, Item No.12.8 Pg. No. 46				

iii)	Providing and planting of Golden durenta multi branches plants for showing mass effect in 0"6" x 0"6" distance with soil preparation work"s, (Mixing organic manure and plants protection insecticide). Up to 4 month maintenance.	Nos.	100.00		
	CG PWD Road SOR 2015, Item No.12.11 pg. No. 46				
iv)	Providing and planting of plumeria (Champa) 2"0" to 3"0" heighted plants with 1"0" x 1"0"x1"6" depth pit formation and soil preparation work"s, (Mixing organic manure and plant"s protection insecticide). Up to 4 month maintenance.				
	CG PWD Road SOR 2015 Item No.12.11 pg. No. 46	Nos.	100.00		
v)	Providing and planting maxican carpet grass in mount with soil preparation (with organic manure and plants protection insecticide) and escaping works. Up to 4 month maintenance	Sqm	2605.43		
	CG PWD Road SOR 2015 Item No.12.12 pg. No. 46				
vi)	Tree Guard with MS Angle Iron and Steel Wire (Providing and fixing tree guard 0.60 meter square, 2.00 meter high fabricated with MS angle iron 30 x 30 x 3 mm, MS iron 25 x 3 mm a100mm center to center and steel wire 3 mm dia. welded and fabricated as per design in two halves bolted together, fixed in ground with P.C.C M-10 of dimensions 150x150x200mm.)				
	CG PWD Road SOR 2015 Item No.11.9 pg. No. 44	Nos.	350.00		
C)	**Wall compound work**				
1	Earth work in excavation for pipe trench in ordinary soil areas including dressing, watering, ramming and disposal of excavated earth lead up to 50m and lift up to 1.5m, disposal earth to be levelled, neatly dressed.				

	Lift 0 to 1.5m (for columns)	Cum	867.00		
	Chhattisgarh PHED USOR Amendment No.07/2022-23; Item No.18.15; Pg. No:- 51				
2	Providing & laying mechanically mixed R.C.C. excluding centering & shuttering and reinforcement in foundation/plinth (20mm graded metal)				
	A) RCC M20 (foundation)	Cum	84.38		
	Chhattisgarh PHED USOR Amendment No.07/2022-23; Item No.18.42.1; Pg. No.- 54				
	B) RCC M20 (plinth beam)	Cum	112.50		
	Chhattisgarh PHED USOR Amendment No.07/2022-23; Item No.18.42.1; Pg. No.- 54				
	C) RCC M20 (Columns)	Cum	45.00		
	Chhattisgarh PHED USOR Amendment No.07/2022-23; Item No.18.42.1; Pg. No.- 54				
	D) RCC M20 (Coping)	Cum	17.25		
	Chhattisgarh PHED USOR Amendment No.07/2022-23; Item No.18.42.1; Pg. No.- 54		259.13		
3	Providing & fixing form work i/c centering and shuttering including strutting, propping etc. and removal of form work for:				
	Foundation	Sqm	225.00		
	Chhattisgarh PHED USOR Amendment No.07/2022-23; Item No.18.64.1; Pg. No.- 56				
	Plinth Beams	Sqm	750.00		
	Chhattisgarh PHED USOR Amendment No.07/2022-23; Item No.18.64.4; Pg. No.- 57				
	Column	Sqm	600.00		
	Chhattisgarh PHED USOR Amendment No.07/2022-23; Item No.18.64.5; Pg. No.- 57				
	Coping	Sqm	75.00		
	Chhattisgarh PHED USOR Amendment No.07/2022-23; Item No.18.64.5; Pg. No.- 57				
4	Providing and placing in position cold twisted steel and hot rolled deformed steel reinforcement for R.C.C. work i/c cutting, bending, binding etc. complete i/c cost of binding wire and wastage.				

	Total RCC qty	Cum	166.84		
	Assuming Steel 110 kg per cum	Kg	18352.71		
	Chhattisgarh PHED US0R Amendment No.07/2022-23; Item No.18.44, Pg. No.54				
5	Brick work with modular fly-ash lime bricks (FaLG Bricks) confirming to IS:12894-2002 of class designation 4.0 in foundation and plinth in: Cement Mortar 1:4 (1 cement : 4 coarse sand)(For gardening work)				
	CHATTISGARH PWD Building DSR 2015-16 Pg. no. 45, Item No. 7.5.2	Cum	345.00		
	Deduct columns	Cum	-45		
	Deductions for Gate	Cum	-2.3		
			297.70		
6	In gratings, frames, guard bar, ladder, railings, brackets, gates and similar works				
	Y angles (50X50X6) Unit weight = 4.5 Kg/m	Kg	1462.50		
	Chhattisgarh PHED US0R Amendment No.07/2022-23; Item No.18.47.2, Pg. No.54				
7	Providing and fixing in position G.I. barbed wire (93.8 gram/m) to concrete/ wooden/ angle iron posts (straight or diagonal) including securing and screwing with G.I. tying wire, G.I. stapples, G.I.U- nails or steel pins etc., complete(Cost of posts, struts to be paid for separately)				
	CHATTISGARH PWD Building DSR 2015-16 , Pg. no. 85, Item No. 9.39	Rmt	4500.00		
8	Providing and making 18mm thick cement plaster in two coats with under layer of 12mm thick plaster 1:5 (1 cement : 5 fine sand) and top layer of 6mm thick with cement plaster 1:3 (1 cement : 3 fine sand) finished rough with sponge (Bosth sides)				
	Chhattisgarh PHED US0R Amendment No.07/2022-23; Item No.18.62, Pg. No.56	Sqm	3000.00		

9	Finishing walls with water proofing cement paint of required shade to give an even shade.	Sqm	1911.22		
	Chhattisgarh PHED US0R Amendment No.07/2022-23; Item No.18.75; Pg. No.58				
10	Providing and fixing M.S. gate 2.5 M wide for compound with 40 mm Dia G.I. pipe, approved grill work, RCC M-150 side pillars of 25 cm x 40 cm x 2.5 M height, its foundation, finishing, painting, etc. complete.				
	MJP Maharashtra DSR (2020-21) Section H. Item No. 3 Page no. 58	Nos.	2.00		
				Total	**29,176,759.55**

ANNEXURE- "F-XII"

MAIN BREAKUP OF PAYMENTS SCHEDULE OFFER FOR 15 YEARS O & M OF WHOLE SCHEME FROM KOSAWADI SEWAGE PUMPING STATION TO 33.00 MLD STP (INCLUDING CIVIL AND ELECTRO-MECHANICAL WORK)

Sr. No.	Description of work Details	% Break-up
1	O & M for scheme from Kosabadi nallah to STP at Pragati Nagar Korba	As per Part B

PAYMENT AGAINST O & M WORKS

Sr. No.	Particulars	Release of Yearly % of Payments
	Against Monthly Running Bills	
1	1st year	3.14
2	2nd year	3.46
3	3rd year	3.81
4	4th year	4.19
5	5th year	4.61
6	6th year	5.07
7	7th year	5.58
8	8th year	6.13
9	9th year	6.75
10	10th year	7.42
11	11th year	8.16
12	12th year	8.98
13	13th year	9.88
14	14th year	10.87
15	15th year	11.95
	Total	100 %

Note

:- The Contractor mayclaim the payment for O & M on monthly basisafter submission of required reports and data as mentioned..

IMPORTANT NOTE

For works under Annexure VI,VII&XI the payment of R.A. Bills shall be made as per Schedule/SOR for pipe line works (PHED, PWD & WRD with all uptodate amendments), with percentage below or above of contractor's lumpsum offer with respect to PAC.
In case of additional/ reduced work, the additional payment/ deduction shall be made as per Schedule/SOR of PHE/ PWD/ UADD. The percentage above / below shall be applicable on additional work/ reduced work.

For the works whose Lum sum offers has been quoted and accepted, the payment shall be made as per quoted Lum sum offer as per the break up schedule given above
The final payment of STP & other structures shall be equal to the amount fixed by percentage of STP/other structures as shown in NIT.

Note :- Percentage cost in Main Break up will not change However, contractor may submit detail sub breakup for release of interim payment. Sub Break up will be approved by competent authority of KMC. Interim payment shall be released as per approved sub break up.

Secured advance

Advances to contractor are as a rule prohibited, and every endeavor should be made to maintain a system, under which no payments are made for unmeasured work except for work actually done. Exceptions are, However, permitted in the following cases. Cases in which a contractor whose contract is for finished work, requires an advance on the security of materials brought to site, Commissioner may in such cases sanction advances up to an amount not exceeding **75%** of the value of material and **90%** in the case of steel (as assessed by the Executive Engineer) provided that the rate(s) of allowed in no case is/are more than the rate payable for the finished item as stipulated in the contract of such materials, provided that they are of imperishable nature and that a formal agreement is drawn up with the contractor under which Municipal Corporation Korba secures a lien on the materials and is safeguarded against losses due to the contractor postponing the execution of the work or to the shortage or misuse of the materials, and against the expense entitled for their proper watch and safe custody. Payment of such advances should be made only on the certificate of an officer not below the rank of Executive Engineer, that the quantities of materials upon which the advances are made have actually been brought to site, that the contractor has not previously received any advance on that security and that all the materials are required by the contractor for use on items of work for which rates for finished work have been agreed upon. Recoveries of advances so made should not be postponed until the whole of the work entrusted to the contractor is completed. They should be made from his bills for work done as the materials are used the necessary deductions being made whenever the item of work in which they are used; are billed for. Before granting the above-secured advance the contractor shall sign the prescribed Indenture Bond in the prescribed form.

ANNEXURE- "G-I"

GUARANTEE BOND

(To be used by approved scheduled banks)

1. In consideration of Municipal Corporation Korba (here in after called the Corporation) having agreed to exempt..... .... (herein after called the said contractor(s) from the demand under the terms and conditions of an agreement dated ..... made between .....and Municipal Corporation for the work of.....(here after chatted the said Agreement)

Indicate name of work) notified vide N.I.T. N..... Dated .....issued by the Executive Engineer. Municipal Corporation. Korba (herein after called the said Agreement) of earnest money deposited for the due ful[4]ilment, by the said contractor(s) of the terms and conditions contained in the said agreement on production of a Bank Guarantee for Rs . ..... (Rupees ....only.)We to the as "The Bank" at the request of the said contractor(s) do hereby undertake to pay the Municipal Corporation(an amount not exceeding Rs ..... against any loss or damage caused to or suffered or would be caused to or suffered by the Municipal Corporation by the reason of any breach by the said contractor (s) of the terms or condition contained in the said agreement.

2. We ....(`) .....

Bank Ltd.. do hereby under -take to pay the amounts due and payable under this guarantee without any demur merely on a demand from the Municipal Corporation stating that the amount claimed is due by way of loss or damage caused to or suffered by the Municipal Corporation by reason of any breach by said contractor {s) of any of the terms or conditions contained in the said agreement or by reason of the contractor (s) failure to perform the said agreement. Any such demand made on the Bank shall be conclusive, as regards the amount due and -payable by the bank under this guarantee However,, our liability this guarantee shall be restricted to an amount not exceedingRs.....

3. We .....Bank limited further agree with the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said agreement and that if shall continue to be enforceable till all dues of corporation under or by virtue of said agreement have been fully paid and its claims satisfied or till .. .. department ..... certifies that the terms of the said agreement have been fully and properly carried out by the said contractor (s) and accordingly discharges the guarantee unless a demand or claim under this guarantee is made on us in writing on or before the ..... we shall be discharged from all Liability under this guarantee thereafter,

4. We ..... (*) .... Further agree that the guarantee herein contained shall remain in lull *force* and affect during the period that would be taken for the performance of the said agreement and that shall continue to be enforceable till all the dues of the Municipal Corporation under or by virtue of the said agreement have been fully paid and its claims satisfied or discharged or till the Executive Engineer, Municipal Corporation certify that the terms and conditions of the said agreement have been fully and properly carried out by the said contractor (s) and accordingly discharges this guarantee. Unless a demand or claim under this guarantee is made on us in writing on or before the ....(*w).... ..... we shall be discharged from all liability under this guarantee.

5. We.....("`).....
.....further agree with the Municipal Corporation that Municipal Corporation shall be The fullest liberty without effecting in any manner our obligation hereunder to vary any of the terms and conditions or the said agreement to extend time of performance by ....

*(indicate name of the bank)

**Here write a date beyond 9 months of the prescribed date of opening of tenders,

The said contractor(s) from time to Time or to postpone for any time or for time to time, any of the power exercisable by the Government against the said contractor(s) and to forebear or enforce any of the terms and conditions relating to the said agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said contractor(s) or any

Forbearance act or commission on the part of the Municipal Corporation or any indulgence by the Commissioner municipal Corporation to the said contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties, would but for this provision have effect of so relieving us.

6 .This guarantee which not be discharged due to the change in the Constitution of the Bank or the contractors)

7. We.....(*) Bank Limited, lastly undertake not to revoke this guarantee it currency except with The previous consent of the Municipal Corporation, in writing dated .....day of .....

or..... (indicate the name of the Bank)

indicate the name of the Bank.

ANNEXURE- "G-II"

(Revised form of Bank Guarantee Bond)

GUARANTEE BOND

(in lieu of Security Deposit)

(To be used by approved scheduled Bank)

1. In consideration of Korba Municipal corporation (here in after called the Government) having agreed to exempt..... (herein after ailed the said contractors) from the demand under the terms and conditions of an agreement dated .....made between ..... for the work (Name of work) ..... (Herein after called the said Agreement) of security deposit for' the due fulfillment by the said contractors) of the Terms and conditions in the said agreement on production of a Bank Guarantee for Rs .....Rupees.....only..... ..... (*) .....(herein after referred to as "The Bank" (at the request of the said contractors) do here by undertakes to pay to The Municipal Corporation and a amount not exceeding Rs .....against any loss or damage caused to or suffered or would be caused to or suffered by the Municipal Corporation, by reason of any breach by the said contractor (s) of the terms or conditions contained in the said agreement in cache said contractor and the Government for the work of .... (indicate name of work) notified vide N.I.T. No..... Dated ..... issued by the Executive Engineer, Municipal Corporation, Korba (herein after called the said Agreement) of earnest money for the due fulfillment by the said contractor (s) of the germs and condition.

2. We (*) ..... do hereby undertake to pay the amounts due and payable under this guarantee without any demur merely on a demand from The Municipal Corporation stating that the amount claimed is due by way of loss or damage caused to or suffered by The Municipal Corporation by reason of any breach by said contractor(s) of any of the terms or conditions contained in is said agreement or by reason or the contractor(s) failure to perform the said agreement. Any such remand made on the Bank shall be conclusive as regards the amount due and payable by the bank under

is guarantee. However,, our liability under this Guarantee shall be restricted to an amount not exceeding Rs.....

3. We undertake to pay To the Municipal Corporation any money so demanded not withstanding any dispute or disputes raised by the contractor(s) in any suit or proceedings pending before any court or Tribunal relating thereto, our liability under this present being absolute and unequivocal.

4. We (*) ..... further agree That the guarantee herein contained shall remain in full force and effect during the period That would be taken for the performance of ne said agreement and That is shall continue to be enforceable till all the dues of the Municipal Corporation under or by virtue of the said agreement have been fully paid and its chums satisfied or :is charged or till the Executive Engineer, Municipal Corporation, Korba certified That the terms and conditions of the said agreement have been fully and properly carried out by the said contractor(s) and accordingly discharged this guarantee. Unless a demand or claim under this guarantee Is made or 1JtR in writing on or before the ..... (here indicated a date which*%M falls 9 months beyond the due date of completion of the work) .....weshall

be discharged from all liability under this guarantee.

5 . Me (*) …….. further agree with the Municipal Corporation shall have that fullest liberty without our consent and with effecting in any y manner our obligations here under to vary any of the terms and conditions of the said agreement to extend, try e of performance by the said contractors) from time to time or to postpone for any of the powers exercise able by the Municipal Corporation against the said contractors) and to forebear or enforce any of the, terms and conditions relating to the said agreement and we shall not be relieved from our liability by reasons of any such variations, or extension being granted to the said contractor(s) or forbearance, actor commission on the part or the Municipal Corporation or any indulgence by The Municipal Corporation to the said contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision have effect of so relieving us.

6. This guarantee will not be discharged due to, the change in the Constitution of the Bank or the contractor(s).

7. We (*) ..... lastly undertake not to revoke this guarantee its currency except with the previous consent of the Municipal Corporation, in writing

Dated the ……. Day of
…….
For (*)

……...

(*) In indicate the name of the Bank

……..……
……..

ANNEXURE H

SPECIAL CONDITIONS OF N.I.T

(Reference Clause 8 of NIT)

(1) "Additional performance security (APS) shall be deposited by the successful bidder at the time of signing of agreement when the bid amount is seriously unbalanced i.e. less than the estimated cost by more than 10% in such an event the successful bidder will deposit the Additional performance security (APS) to the extent of difference of 90 % of the PAC and bid amount in the shape of FDR, in favor of the Commissioner before signing the agreement. The same shall be refunded along with the normal S.D. after completion of the work. If the contractor fails to complete the work or left the work incomplete, & the additional performance security (APS), Shall be forfeited by the department, & the agreement shall be terminated and action shall be taken in accordance with clause 3 of the agreement. In case the tendered/contractor refuses to deposit Additional performance security (APS) then his bid will be rejected by the sanctioning authority and earnest money shall be forfeited"
Such orders & action shall be final binding and conclusive

(2) Detailed program Construction:

(i) Within 30 days of issue of order to star work, the contractor shall submit in the prescribed Performa a detailed construction programme month wise mentioning start and completion or each item/event involved in the due performance of the contract for contract more than 10 Crores Contractor shall Also, submit detailed proramme month wise for

(a) Materials procurement

(b) Their transport arrangement to work site with details of No. of truck/tippers

(C) Detailing of construction plants &equipments

(d) Cash flow/revised Cash flow

(ii) The contractor shall submit in the first week of each month a statement of "target vis-à-vis actual performance" of each item/event with slippage, if any mentioning reasons of slippage and proposal for revised construction programme to complete the same in targeted date or validly extended date. Failure to submit this monthly statement for 4 (Four) months can be treated as "Fundamental Breach of Contract" and can result in invoking clause 3 of the conditions of contract.
If required, the Executive Engineer shall ask the contractor to extend the validity period of the bank guarantee (s) for such period which be consider it proper and the contractor shall extend the validity period of such bank guarantee accordingly. If the contractor fails to extend the period accordingly, the Commissioner shall encase the B.G. before the expiry of the validity period.

(i) The contractor shall have to carry out all necessary " Rectification" of defects noticed, caused due to any reasons at his own cost within such reasonable period mentioned in such communication notice from the Executive engineer to him.

(ii) Failure of the contractor to rectify the defects properly in the given period, it shall be open for the Executive Engineer/Assistant Engineer to get the defect (s) rectified either departmentally or through other agency (without calling any tender/quotation) and recover the actual cost plus 15% (Fifteen Percent) of such cost from the contactor from any sum, in any form, and available with the department or can be recovered as "Arrears of Land Revenue"
(iv), (v) Deleted in case form date of completion of work (one year)

The performance guarantee will be in addition to the normal security to be deducted as per clause 1 of agreement for the execution of contract.

(3) The tendered/contractor shall give in advance authority letter (s) in favour of the Commissioner, authorizing him to get all bank's fixed deposit receipts, Bank Guarantees (either normal security deposit and or for performance Bank Gurantee) to get these bank receipts and guarantee deeds verified and got confirmed from the concerned bank. It will be only after getting such confirmation that the Commissioner shall pay any amount accordingly or refund the equal amount for which BG submitted has been duly verified and confirmed.

(4) The contractor shall no remove minor mineral fromborrow areas, quarries without prior payment of Royalty charges.

Municipal Corporation Korba Name of Contractor ……

Date or work order …… Due date of completion

Detail work programme – Original/1st Revision/2nd Revision/ …….. Revision)

Work Items

Sr. No.	Items	Unit	Months							
			1	2	3	4	5	6	7	8
1										
2										
3										
4										

Approved Executive Engineer Signature

MONTHLY TARGET Vs. ACTUAL ACHEVEMENT

Cumulative Achievement of item of work for the month ending of

Agt. No. …… Name of Work

Length Date of W.O. ……

……..... Date of Completion……..

Sr. No.	Items	Cumulative Work Programme			Cumulative Achievement actual	Slipage if any (Period)	Reason for slippage (Use add sheet if needed)
		As per Original	1St Revision	Last No. Revision			
1	2	3 (a)	3 (b)	3 C	4	5	6

Comments of Executive Engineer if any

Cash Flow for performing the contract (applicable for works cost)

Name of Division ……. Name of Contractor ……...

Period of Contract ……

Value

(A)	Investment	1st Month	2nd Month	3rd Month	4th Month	5th Month	6th Month
(I)	Initial (E.M.) P.G. Insurance (Establish Site Office)						
(II)	Advance for Procurement of Material (if any)						
(III)	Advance for Procurement of labour (if any)						
(IV)	Purchase of New Equipment (if any)						
(V)	Other overheads staff including head office						
(VI)	Other if any (Furnish details)						
Total Investment(x)							
(B)	Receipt						
(I)	Gross Bill Amount						
	Deductions.						
a	S.D.						
b	Advance						
c	TDS						
d	Other recoveries if any						
(y) Total Receipt							
Net cash flow (x-y)							

Note: - (1) This Should co-relate to work programme/progress of work during the month.

(2) Running bill will be expected to be paid within 15 days of the receipt and checking of measurement, quality and quality of items

(3) Investment less net receipt for 1st 15 days and then during.

(4) (Final bills is expected to be paid within 2 months of satisfactory completion work.

(5) Total investment less Total Receipt (-) be shown in bracket.

Commissioner
Municipal Corporation
Korba

ANNEXURE-I

Guidelines for bidders on using Integrated eProcurement System Govt. of Chhattisgarh.
https://eproc.cgstate.gov.in

Note: These conditions will over-rule the conditions stated in the tender document(s), wherever relevant and applicable.

1. Vendor / Bidder Registration on the e-Procurement System:

All the Users / Bidders (Manufacturers / Contractors / Suppliers / Vendors / Distributors etc.) registered with and intending to participate in the Tenders of various Govt. Departments / Agencies / Corporations / Boards / Undertakings under Govt. of Chhattisgarh processed using the Integrated e-Procurement System are required to get registered on the centralized portal https://eproc.cgstate.gov.inand get approval on specific class (e.g. A, B, C, D, UGE, UDE) from Public Works Department (in case to participate in tenders restricted to vendors / bidders in a particular class).

The non – registered users / bidders who are Also, eligible to participate in the tenders floated using the e-Procurement system are Also, required to be registered online on the e-Procurement system.
Vendors are advised to complete their online enrolment / registration process on the portal well in advance to avoid last minute hassle, it is suggested to complete enrolment at least four days before the last date of bid submission date, failing which may result in non-submission of bids on time for which vendor/end user shall be solely responsible.
For more details, please get in touch with e-Procurement system integrator, M/s. Mjunction Services Limited, Korba – 492 001 on Toll free 1800 258 2502 or email helpdesk.eproc@cgswan.gov.in.

2. Digital Certificates:

The bids submitted online must be signed digitally with a valid Class II / Class – III Digital Signature Certificate to establish the identity of the bidders submitting the bids online. The bidders may obtain pair of Encryption & Signing Class – II / Class – III Digital Certificate issued by an approved Certifying Authority (CA) authorized by the Controller of Certifying Authorities (CCA), Government of India.

Note: It may take upto 7 to 10 working days for issuance of Class-II / Class-III Digital Certificate, Therefore the bidders are advised to obtain it at the earliest. It is compulsory to possess a valid Class-II / Class-III Digital Certificate while registering online on the above mentioned e-Procurement portal. A Digital Certificate once mapped to an account / registration cannot be remapped with any other account / registration However, it may be inactivated / deactivated.

Important Note: bid under preparation / creation for a particular tender may only be submitted using the same digital certificate that is used for encryption to encrypt the

bid data during the bid preparation / creation / responding stage. However, bidder may prepare / create and submit a fresh bid using his/her another / reissued / renewed Digital Certificate only within the stipulated date and time as specified in the tender.
In case, during the process of a particular bid preparation / responding for a tender, the bidder loses his/her Digital Certificate because of any reason they may not be able to submit the same bid under preparation online, Hence the bidders are advised to keep their Digital Certificates secure to be used whenever required and comply with IT Act 2000 & its amendments and CVC guidelines.

The digital certificate issued to the authorized user of an individual / partnership firm / private limited company / public limited company / joint venture and used for online bidding will be considered as equivalent to a no-objection certificate / power of attorney to the user.
Unless the certificate is revoked, it will be assumed to represent adequate authority of the specific individual to bid on behalf of the organization / firm for online tenders as per Information Technology Act 2000. This authorized user will be required to obtain a valid Class-II / Class-III Digital Certificate. The Digital Signature executed through the use of Digital Certificate of this authorized user will be binding on the organization / firm. It shall be the responsibility of management / partners of the concerned organization / firm to inform the Certifying Authority, if the authorized user changes, and apply for a fresh digital certificate for the new authorized user.

3. Online Payment: As the bid is to be submitted only online, bidders are required to make online payment(s) of the Registration fee / Transaction or Service fees / EMD using the online payments gateway services integrated into the e-Procurement system using various payment modes like Credit Card / Debit Card / Internet Transaction / Cash Card / NEFT / RTGS etc.

For the list of available online modes of electronic payments that are presently accepted on the online payments gateway services, please refer the link '**Paymentsaccepted online**' on theProcurement portal**https://eproc.cgstate.gov.in.**
4. Setup of User's Computer System: In order to operate on the e-Procurement system for a bidder / user, the computer system / desktop / laptop of the bidder is required to have Java ver. 765 , Internet explorer 9 / 11, latest Mozilafirefox with IE Tab V2 (Enhanced IE Tab) or any other latest browser. A detailed step by step document on the same is available on the home page. Also, internet connectivity should be minimum one MBPS.

5. Publishing of N.I.T.: For the tenders processed using the e-Procurement system,only a brief advertisement notice related to the tender shall be published in the newspapers and the detailed notice shall be published only on the e-Procurement system. Bidders can view the detailed notice, tender document and the activity time schedule for all the tenders processed using the e-Procurement system on the portal **https://eproc.cgstate.gov.in.**

6. Tender's Critical Dates & Time/Tender Time Schedule: The bidders are strictly advised to follow the tender time for their side for tasks / activities and responsibilities to participate in the tender, as all the activities / tasks of each tender are locked before the start time & date and after the end time & date for the relevant activity of the tender as set by the concerned department official.

7. Download Tender Document(s): The tender document and supporting document(s) if any can be downloaded only online. The tender document(s) will be available for download to concerned bidders after online publishing of the tender and up to the stipulated date & time as set in the tender.

8. Submit Online Bids: bidders have to submit their bid online after successful filling of forms within the specified date and time as set in the tender.
The encrypted bid data of only those bidders who have submitted their bids within the stipulated date & time will be accepted by the e-Procurement system. It is expected that the bidder complete his bid ad submit within timeline, a bidder who has not submitted his bid within the stipulated date & time will not be available during opening.
Bid documents uploading during bid preparation should be less than five MB (for individual document) and over all bid documents should be less than fifty MB.

9. Submission of Earnest Money Deposit: The bidders shall submit their Earnest Money Deposit Either as in usual physically sealed Earnest Money Deposit envelope and the same should reach the concerned office OR Online using payment gateway as stated in the Notice Inviting Tender/ Tender document. Bidders Also, have to upload scanned copy of Earnest Money Deposit instrument OR Online Payment /NEFT/RTGS receipt along with the reference details online.

10. Opening of Tenders: The concerned department official receiving the tenders or his duly authorized officer shall first open the online Earnest Money Deposit envelope of all the bidders and verify the same uploaded by the bidders. He / She shall check for the validity of Earnest Money Deposit as required. He / She shall Also, verify the scanned documents uploaded by the bidders, if any, as required. In case, the requirements are incomplete, the next i.e. technical and commercial envelopes of the concerned bidders received online shall not be opened.

The concerned official shall then open the other subsequent envelopes submitted online by the bidders in the presence of the bidders or their authorized representatives who choose to be present in the bid opening process or may view opened details online.

11. Briefcase: Bidders are privileged to have an online briefcase to keep their documents online and the same can be attached to multiple tenders while responding, this will facilitate bidders to upload their documents once in the briefcase and attach the same document to multiple bids submitting.
For any further queries / assistance, bidders may contact:
1. The Service Integrator of e-Procurement system, M/s. Mjunction Service Ltd. on Help Desk Toll

free No. 1800 258 2502 or email helpdesk.eproc@cgswan.gov.in.

2. Mr. Shailesh Kumar Soni, Sr. Manager, Chhattisgarh Infotech & Biotech Promotion Society (CHiPS) on Tel. No. 0771 - 4014158 or email: pro-chips@nic.in.

Annexure – 'J'

Pre contract Integrity Pact

1. GENERAL

1.1 This pre-bid contract Agreement (herein after called the Integrity Pact) is made on…….day of the month…….20…….between, the KORBA MUNICIPAL CORPORATION acting through Shri……..(Designation of the officer , Department) KORBA MUNICIPAL CORPORATION (hereinafter called the "BUYER" which expression shall mean and include, unless the context otherwise requires, his successors in the office and assigns) and the First Party , proposes to procure (name of the Stores / Equipment /Work/Service) and M/s …….represented by Shri …….Chief Executive Officer (hereinafter called the "BIDDER/Seller" which expression shall mean and include , unless the context otherwise requires, his successors an permitted assigns) and the Second Party, Is willing to offer/has offered.

1.2 WHEREAS the BIDDER is a Private Company/Public Company/Government Undertaking/ Partnership/ Registered Export Agency, constituted in accordance with the relevant law in the matter and the BUYER is a Ministry/Department of the Government, performing its function on behalf of the KORBA MUNICIPAL CORPORATION.

2. OBJECTIVES

NOW, THEREFORE the BUYER and the BIDDER agree to enter into this pre-contract agreement, hereinafter referred to as Integrity Pact, to avoid all forms of corruption by following a system that is fair, transparent and free from any influence/prejudiced dealings prior to during and subsequent to the Contract to be entered into with a view to :-

2.1 Enabling the BUYER to obtain the desired Stores/Equipment /Work/Service at a competitive price in conformity with the defined specifications by avoiding the high cost and the distortionary impact of corruption on public procurement, and

2.2 Enabling BIDDERs to abstain from bribing or indulging in any corrupt practices in order to secure the contract by providing assurance to them that their competitors will Also, abstain from bribing any corrupt practices and the BUYER will commit to prevent corruption, in any form, by its official by following transparent procedures.

3. COMMITMENTS OF THE BUYER

The BUYER commits itself to the following :-

3.1 The BUYER undertakes that no official of the BUYER, connected directly or indirectly with the contract, will demand, take promise for or accept, directly or through intermediaries, any bribe, consideration, gift, reward, favors or any material or immaterial benefit or any other advantage from the BIDDER, either for themselves or for any person, organization or third party related to the contract in exchange for an advantage in the bidding process, bid evaluation, contracting or implementation process related to the contract.

3.2 The BUYER will, during the pre-contract stage, treat BIDDERs alike, and will provide to all BIDDERs the same information and will not provide any such information to any particular BIDDER which could afford an advantage to that particular BIDDER in comparison to the other BIDDERs.
3.3 All the officials of the BUYER will report the appropriate KORBA MUNICIPAL CORPORATION office any attempted or completed breaches of the above commitments as well as any substantial suspicion of such a breach.
In case any such preceding misconduct on the part of such official(s) is reported by the BIDDER to the BUYER with the full and verifiable facts and the same *prima facie found* to be correct by the BUYER, necessary disciplinary proceedings, or any other action as deemed fit, including criminal proceedings may be initiated by the BUYER and such a person shall be debarred from further dealings related to the contract process. In such a case while an enquiry is being conducted by the BUYER the proceedings under the contact would not be stalled.

4. COMMITMENTS OF BIDDERS

The BIDDER commits itself to take all measures necessary to prevent corrupt practices, un fair means an illegal activities during any stage of its bid or during any pre-contract or post- contract stage in order to secure the contract or in furtherance to secure it and in particular commit itself to the following :-

4.1 The BIDDER will not offer, directly or through intermediaries, any bribe, gift, consideration, reward, favour any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the BUYER, connected directly or indirectly with the biding process, or the any person, organization or third party related to the contract in exchange for any advantage in the bidding, evaluation, contracting and implementation of the contract.

4.2 The BIDDER further undertakes that it has not given, offered or promised to give, directly or indirectly any bribe, gift, consideration, reward, favour , any material or immaterial benefit or other advantage, commission, fees, brokerage, or inducement to any official of the BUYER or otherwise in procuring the Contract of forbearing to do or having done any act in relation to the obtaining or execution of the contract or any other contract with the KORBA MUNICIPAL CORPORATION for showing or forbearing to show favour or disfavour to any person in relation to the contract or any other contract with the Government.

4.3 The BIDDER further confirms and declares to the BUYER that the BIDDER in the original Manufacture/Integrator/Authorized KORBA MUNICIPAL CORPORATION sponsored export entity of the stores and has not engaged any individual or firm or company whether Indian or foreign to intercede, facilitate or in any way to recommend to the BUYER or any of its functionaries, whether officially or unofficially to the award of the contract to the BIDDER, nor has any amount been paid, promised or intended to be paid to any such individual, firm or company in respect of any such intercession, facilitation or recommendation.

4.4 The BIDDER, either while presenting the bid or during pre-contract negotiations or before signing the contract, shall disclose any payment he has made, is committed to or intends to make to officials of the BUYER or their family members, agents, brokers or any other intermediaries in connection with the contract and the details of services agreed upon for such payments.

4.5 The BIDDER will not collude with other parties interested in the contract to impair the transparency,

fairness and progress of the bidding process, bid evaluation, contracting and implementation of the contract.

4.6 The BIDDER will not accept any advantage in exchange for any corrupt practice, unfair means and illegal activities.

4.7 The BIDDER shall not use improperly, for purpose of competition or personal gain, or pass on to others, any information provided by the BUYER as part of the business relationship, regarding plans, technical proposal and business details, including information contained in any electronic data carrier. The BIDDER Also, undertakes to exercise due and adequate care lest any such information is divulged.

4.8 The BIDDER commits to refrain from giving any complaint directly or through any other manner without supporting it with full and verifiable facts.

4.9 The BIDDER shall not instigate or cause to instigate any third person to commit any of the acts mentioned above.

5. PREVIOUS TRANSGRESSION

5.1 The BIDDER declares that no previous transgression occurred in the last three years immediately before signing of this Integrity Pact with any other company in any country in respect of any corrupt practices envisaged hereunder or with any Public Sector Enterprise in India or any KORBA MUNICIPAL CORPORATION Department in India that could justify BIDDER's exclusion from the tender process.

5.2 If the BIDDER makes incorrect statement on this subject, BIDDER can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

6. EARNEST MONEY (SECURITY DEPOSIT)

6.1 Every BIDDER while submitting commercial bid, shall deposit an amount as specified in RFP as Earnest Money/Security Deposit, with the BUYER through any of the following instruments :

(i) Bank Draft or a Pay Order in favour of ……..

(ii) A confirmed guarantee by an Indian Nationalised Bank, promising payment of the guaranteed sum to the ……..(BUYER) ……on demand within three working days without any demur whatsoever and without seeking any reasons whatsoever, The demand for payment by the BUYER shall be treated as conclusive proof of payment.

(iii) Any other mode or through any other instrument (to be specified in the RFP).

6.2 The earnest Money/Security Deposit shall be valid up to a period of five years or the complete conclusion of the contractual obligations to the complete satisfaction of both the BIDDER and BUYER, including warranty period, whichever is later.

6.3 In the case of successful BIDDER a clause would Also, be incorporated in the Article pertaining to

Performance Bond in the Purchase Contract that the provisions of Sanctions for violation shall be applicable for forfeiture of Performance Bond in case of a decision by the BUYER to forfeit the same without assigning any reason for imposing sanction for violation of this Pact.

6.4 No Interest shall be payable by the BUYER to the BIDDER on Earnest Money/Security Deposit for the period of its currency.

7. SANCTIONS FOR VIOLATIONS

7.1 Any breach of the aforesaid provisions by the BIDDER or any one employed by it or acting on its behalf (whether with or without the knowledge of the BIDDER) shall entitle the BUYER to take all or any one of the following actions, wherever required :-

(i) To immediately call off the pre contract negotiations without assigning any reason or giving any compensation to the BIDDER. However,, the proceeding with the other BIDDER (s) would continue.

(ii) To forfeit fully or partially the Earnest Money Deposit (in pre-contract stage) and/or Security Deposit/Performance Bond (after the contract is signed), as decided by the BUYER and the BUYER shall not be required to assign any reason therefore.

(iii) To immediately cancel the contract, if already signed, without giving any compensation to the BIDDER.

(iv) To recover all sums already paid by the BUYER, and in case of the Indian BIDDER with interest thereon at 2% higher than the prevailing Prime lending Rate while in case of a BIDDER from a country other than India with Interest thereon at 2% higher than the LIBOR. If any outstanding payment is due to the BIDDER from the BUYER in connection with any other contract such outstanding payment could Also, be utilized to recover the aforesaid sum and interest.

(v) To encase the advance bank guarantee and performance bond/warranty bond, if furnished by the BIDDER, in order to recover the payments, already made by the BUYER, along with interest.

(vi) To cancel all or any other contracts with the BIDDER and the BIDDER shall be liable to pay compensation for any loss or damage to the BUYER resulting from such cancellation / rescission and the BUYER shall be entitled to deduct the amount so payable from the money (s) due to the BIDDER.

(vii) To debar the BIDDER from participating in future bidding processes of the KORBA MUNICIPAL CORPORATION for a minimum period of five years, which may be further extended at the discretion of the BUYER.

(viii) To recover all sums paid in violation of this Pact by BIDDER (s) to any middlemen or agent or broken with a view to securing the contract.

(ix) In cases where irrevocable Letters of Credit have been received in respect of any contract signed by the BUYER with the BIDDER, the same shall not be opened.

(x) If the BIDDER or any employee of the BIDDER or any person acting on behalf of the BIDDER, either directly or Indirectly, is closely related to any of the officers of the BUYER, or alternatively if any close relative of an officer of the BUYER has financial interest/stake in the BIDDER's firm, the same shall be disclosed by the BIDDER at the time of filling of tender Any failure to disclose the interest involved shall entitle the BUYER to rescind the contract without payment of any compensation to the BIDDER.

The term 'close relative for this purpose would mean spouse whether residing with the Korba Municipal Corporation servant or not, but not include a spouse separated from the Korba Municipal Corporation Servant by a decree or order of a competent court, son or daughter or step son or step daughter and wholly dependent upon Korba Municipal Corporation servant but does not include a child or step child who is no longer in any way dependent upon the Korba Municipal Corporation servant, or of whose custody the Korba Municipal Corporation servant has been deprived of by or under any law, any other person related, whether by blood or marriage, to the Korba Municipal Corporation servant or to the Korba Municipal Corporation servant's wife or husband and wholly dependent upon Korba Municipal Corporation Servant.

(xi) The BIDDER shall not lend to or borrow any money from or enter into any monetary dealings or transactions, directly or indirectly with any employee of the BUYER, and if he does so, the BUYER shall be entitled forth with to rescind the contract and all other contracts with the BIDDER The BIDDER shall be liable to pay compensation for any loss or damage to the BUYER resulting from such rescission and the BUYER shall be entitled to deduct the amount so payable from the money(s) due to the BIDDER.

7.2 The decision of the BUYER to the effect that a breach of the provisions of this pact has been committed by the BIDDER shall be final and conclusive on the BIDDER However,, the BIDDER can approach the Monitor (s) appointed for the purpose of this Pact.

8. FALL CLAUSE

8.1 The BIDDER undertakes that if has not supplied /is not supplying similar product/systems or subsystems at a price lower than that offered in the present bid in respect of any other Department of the Korba Municipal Corporation or PSU and if it is found at any stage that similar product/systems or sub systems was supplied by the BIDDER to any other Department of the Korba Municipal Corporation or a PSU at a lower price, then that very price, with due allowance for elapsed time, will be applicable to the present case and the difference in the cost would be refunded by the BIDDER to the BUYER, if the contract has already been concluded.

9. INDEPENDENT MONITORS

9.1 The BUYER will appoint Independent Monitors (hereinafter referred to as Monitors) for this Pact.

9.2 The task of the Monitors shall be to review independently and objectively, whether and to what extent the parties comply with the obligations under this Pact.

9.3 The Monitors shall not be subject to instructions by the representatives of the Parties and perform their functions neutrally and independently.
9.4 Both the parties accept that the Monitors have the right to access all the documents relating to the

project/procurement including minutes of meetings. The Monitor shall be under contractual obligation to treat the information and documents of the BIDDER/Subcontractor(s) with confidentially.

9.5 As soon as the Monitor notices, or has reason to believe, a violation of this Pact , he will so inform the Authority designated by the BUYER.

9.6 The Monitor will submit a written report to the designated Authority of BUYER/Secretary in the Department/within 8 to 10 weeks from the date of reference or intimation to him by the BUYER/BIDDER and, should the occasion arise, submit proposals for correcting problematic situations.

10. FACILTATION OF INVESTIGATION

In case of any allegation of violation of any provisions of this Pact or payment of commission, the BUYER or its agencies shall be entitled to examine all the documents including the Books of Accounts of the BIDDER and the BIDDER shall provide necessary information of the relevant documents and shall extend all possible help for the purpose of such examination.

11. LAW AND PLACE OF JURISDICTION

This Pact is subject to Indian Law, the place of performance and jurisdiction shall be the seat of the BUYER.

12. OTHER LEGAL ACTIONS

The actions stipulated in this Integrity Pact are without prejudice to any other legal action that may follow in accordance with the provisions of the any other law in force relating to any civil or criminal proceedings.

13. VALIDITY

13.1 The validity of this Integrity Pact shall be from the date of its signing and extend up to 5 years or the complete execution of the contract to the satisfaction of both the BUYER and the BIDDER/Seller whichever is later. In case BIDDER is unsuccessful, this Integrity Pact shall expire after six months from the date of the signing of the contract.

13.2 If one or several provisions of this Pact turn out to be invalid; the remainder of this Pact shall remain valid. In such case, the parties will strive to come to an agreement to their original intentions.

The parties hereby sign this Integrity Pact at …….on……...

BUYER	**BIDDER**
Name of the Officer	COMMISSIONER
Designation	
Department /PSU	
Witness	**Witness**
1)……	1) ……
……	…….
2)……	2) ……

Performance Bank Guarantee for Works Contract Period

Option 1: (Demand Guarantee)

[Insert Guarantor letterhead or SWIFT identifier code]

Beneficiary:*[Insert name and Address of the Employer]*

Date:*[Insert date of issue]*

PERFORMANCE GUARANTEE No.:*[Insert guarantee reference number]*

Guarantor: *[Insert name and address of place of issue, unless indicated in the letterhead]*

We have been informed that *[insert name of Contractor,* (hereinafter called "the Applicant") has entered into Contract No. *[insert reference number of the contract]*dated*[insert date]*with the Beneficiary, for the execution of *[insert name of the contract and brief description of the Works]* (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, a performance guarantee is required.

At the request of the Applicant, we as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of *[insert amount in figures]*(*[insert amount in words]*),[1] such sum being payable in the types and proportions of currencies in which the Contract Price is payable, upon receipt by us of the Beneficiary's complying demand supported by the Beneficiary's statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating that the Applicant is in breach of its obligation(s) under the Contract, without the Beneficiary needing to prove or to show grounds for its demand or the sum specified therein.

This guarantee shall be valid until the date of issue of the **Works Contract Completion Certificate**.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010 Revision, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.

_____

[signature(s)]

[Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.]

[1] *The Guarantor shall insert an amount representing the percentage of the Accepted Contract Amount specified in the Letter of Acceptance, less provisional sums, if any, and denominated either in the currency(cies) of the Contract or a freely convertible currency acceptable to the Beneficiary.*

Performance Bank Guarantee for O&M Contract Period

Option 1: (Demand Guarantee)

[Insert Guarantor letterhead or SWIFT identifier code]

Beneficiary:*[Insert name and Address of the Employer]*

Date:*[Insert date of issue]*

PERFORMANCE GUARANTEE No.: *[Insert guarantee reference number]*

Guarantor: *[Insert name and address of place of issue, unless indicated in the letterhead]*

We have been informed that *[insert name of Contractor,*(hereinafter called "the Applicant") has entered into Contract No. *[insert reference number of the contract]*dated *[insert date]*with the Beneficiary, for the execution of *[insert name of the contract and brief description of the Works]* (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, a performance guarantee is required.

At the request of the Applicant, we as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of *[insert amount in figures]*(*[insert amount in words]*),[1] such sum being payable in the types and proportions of currencies in which the Contract Price is payable, upon receipt by us of the Beneficiary's complying demand supported by the Beneficiary's statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating that the Applicant is in breach of its obligation(s) under the Contract, without the Beneficiary needing to prove or to show grounds for its demand or the sum specified therein.

This guarantee shall be valid until the date of issue of the **Final Contract Completion Certificate**.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG) 2010 Revision, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded._____
[signature(s)]

[Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product]

Proposed
STP
33 MLD
GL.282.219

Connected to
NTPC inlet pipe
L-1300M

CANAL

WTP OF NTPC

Dondro River

EXT. WTP
6.81 MLD
G.L.292.365

EXT. WTP
32 MLD
G.L.292.365

PRO. WTP
12 MLD
G.L.292.365

11.NO WARD

Hasdeo River

Belgiri Nalla Kesla River

L-4215

EXISTING
INTAKE WELL

EXISTING ANICUT

CD (Cross drainege-1)

L-4

INLET CHAMBER

WET WELL -2

KORBA PART-1

L-1660

Gerva SPS

Ratakhar Nalla

INLET CHAMBER

L-675

Patel Sagar Para Nalla

L-780

Durpa Nalla

Nalla 2 purani basti nalla

L-735

M Nalla 3 moti sagarpara

L-735 INLET CHAMBER

L-710

Sitamandi 1 Nalla

Sitamandi 2 Nalla

Sitamandi 3 Nalla

L-100

L-165

L-665

Railway Colony Nalla

Kosabadi Nalla

WET WELL

L-100

RCC WEIR

L-100

INLET CHAMBER

Hasdeo River

33.NO ZO
25.NO WARD
24.NO WARD
22.NO WARD
22.NO WARD
21.NO WARD
20.NO WARD
19.NO WARD
18.NO WARD
17.NO WARD
17.NO WARD
16.NO WARD
15.NO WARD
14.NO WARD
13.NO WARD
13.NO WARD
12.NO WARD
12.NO WARD
10.NO WARD
9.NO WARD
8.NO WARD
7.NO WARD
6.NO WARD
5.NO WARD
4.NO WARD
3.NO WARD
2.NO WARD
1.NO WARD

NALLAH NAMES	
01	KOSABADI NALLA
02	RAILWAY COLONY NALLA
03	SITAMANDI 3 NALLA
04	SITAMANDI 2 NALLA
05	SITAMANDI 1 NALLA
06	DURPA NALLA
07	MOTI SAGARPARA NALLA 3
08	PURANI BASTI NALLA
09	PATEL SAGAR PARA NALLA
10	RATAKHAR NALLA
11	GERVA SPS NALLA

PROJECT TITLE	SEWAGE MASTER PLAN, KORBA
CLIENT	MUNCIPAL CORPORATION KORBA (C.G)
CONSULTANT	PURANIK BROTHERS CONSULTING ENGINEERS 61, Nilkanth App. Surendra Nagar,RPTS Road NAGPUR 440015, EMAIL: puranikbrothers@gmail.com

	NAME	DATE
DRAWN	SM	08.06.23
DESIGNED	AA	08.06.23
CHECKED	UB	08.06.23
APPROVED	RPD	08.06.23

DWG. TITLE:

KEY PLAN

RELEASED FOR: INFORMATION; SUBMISSION (V); APPROVAL; CONSTRUCTION

DEPT - CIVIL | JOB NO - | SHEET: 01 OF 01

DRAWING NO. PB-ANWSS-01