JAIPUR DEVELOPMENT AUTHORITY, JAIPUR

BID DOCUMENTS

(PRE QUALIFICATION)

FOR THE WORK OF

Name of Work:- **Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur.**

Period of Download Period of Upload	:	From 17.11.2025 to 17.12.2025 From 17.11.2025 to 17.12.2025
Date of Pre Bid Meeting	:	26.11.2025 at 3:00 PM Interested bidders may submit their queries for the pre-bid meeting latest by 25.11.2025 upto 3:00 PM on E-Mail : zephe1jda@yahoo.in
Date of Opening of Technical Bid	:	23.12.2025 at 3:00 PM (Room No. 133, First Floor, Main Building, JDA Campus, Jaipur.)
Tender Cost of Bid Bid processing Fee Earnest Money	:	Rs.5000.00 payable online only Rs. 2500.00 payable online only. Amount (INR): 2% (Rs. 1,79,42,280/-) for AA class contractor or equivalent contractor registered in other Govt. department and 0.5% (44,85,570/-) for AA Class contractor enlisted in JDA. If a joint venture is allowed in the Bid then 2% (Rs 1,79,42,280.00) in form of BG shall be deposited by bidders (Submitted BG in JV firm name) If any one of the partners of JV wish to dposit 2% earnest money (bid Secuity) than it shall b deposited n the for of online method as per bid document
Completion period	:	24 Months

Executive Engineer (PHE-I)
JDA, Jaipur

Signature valid
Digitally signed by Dilip Lamba
Designation : Executive Engineer
Date: 2025.11.14 10:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392
eSign 1.0

जयपुर विकास प्राधिकरण, जयपुर

कमरा नं. 135 मुख्य भवन, रामकिशोर व्यास भवन, इन्दिरा सर्किल जवाहर लाल नेहरू मार्ग, जयपुर–302004

क्रमांकः जविप्रा/अधि.अभि. (पीएचई–।)/2025/डी– दिनांकः–

निविदा सूचना

निविदा सूचना सं0 अधि. अभि. (पीएचई–।) 16/2025–26

जयपुर विकास प्राधिकरण द्वारा ''**Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur.**'' जिसकी अनुमानित लागत रू 8971.14 लाख के लिए ऑनलाईन बिड्स दिनांक 17.12.2025 को सायं 6:00बजे तक आमन्त्रित की जाती है। निविदा बोली का ऑनलाईन आवेदन व भुगतान जविप्रा पोर्टल पर करने की अन्तिम तिथि 17.12.2025 को सायं 6:00 बजे तक है। निविदा बोली के दस्तावेजों का विस्तृत विवरण www.sppp.rajasthan.gov.in, www.eproc.rajasthan.gov.inand www.jda.rajasthan.gov.in पर देखा जा सकता है।

1. **(UBN No.)**

निविदामें भाग लेने वालो को निम्न शर्तो की पूर्ति करनी होगी।

1. निविदादाता जयपुर विकास प्राधिकरण की वेबसाईटूण्रकंण्तंरेंजींदण्हवअण्पदपर पंजीकृत हो एवं निविदा में भाग लेने के लिए बोलीदाता को आवेदन करने के लिए निविदा दस्तावेज शुल्क, निविदा अमानत राषि, आर.आई.एस.एल. प्रोसेसिंग शुल्क ऑनलाईन जमा करनी होगी।
2. ऑनलाईन निविदा प्रस्तुत करने के लिए निविदादाताओं का राजस्थान सरकार के ई–प्रोक्योरमेंट पोर्टल मचतवबण्तंरेंजींदण्हवअण्पद पर पंजीकृत होना आवश्यक है।

अधिशाषी अभियन्ता (पीएचई–।)
जविप्रा, जयपुर

प्रतिलिपिः–

1. जन सम्पर्क अधिकारी, जविप्रा को तकनीकी सहायक (निदेशक अभियान्त्रिकी–प्रथम) के मार्फत समाचार पत्र में नियमानुसार प्रकाशन हेतु।
   JDA/EE PHE I/A & F/2025-2026/May/078 Dated : 12/05/2025

अधिषाषी अभियन्ता (पीएचई–।)
जविप्रा, जयपुर

Signature valid
Digitally signed by Dilip Lamba
Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392
eSign 1.0

JAIPUR DEVELOPMENT AUTHORITY, JAIPUR

Room No. 135, Main Building, Ram Kishore Vyas Bhavan, Indira Circle, Jawaharlal Nehru Marg, Jaipur – 302 004 Telephone: +91-141-2569696 Email:- zephe1jda@yahoo.in, ee.phe01.jda@RAJASTHAN.GOV.IN

No: - JDA/EE(PHE-I)/2025/D- **Dated:**

NOTICE INVITING BID

NIB No. : JDA/EE (PHE-I)/16/2025-26

Online Bids are invited up-to 6.00 PM of 17.12.2025 for **"Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur"** Estimated cost of Rs. 8971.14 Lacs. The last date for Applying Bid and making online payment on JDA portal is up-to 6.00 PM of 17.12.2025 Details may be seen in the Bidding Document at our office or the State Public Procurement Portal website www.sppp.rajasthan.gov.in, www.eproc.rajasthan.gov.in and www.jda.rajasthan.gov.in.

1. **(UBN No.)**

To participate in the bid, bidder has to be:

1. Registered on JDA website www.jda.rajasthan.gov.infor participating in the Bid, the Bidder has to apply for the Bid and pay the Bidding Document Fee, RISL Processing Fee and Bid Security Deposit online only.
2. Registered on e-Procurement Portal of Government of Rajasthan www.eproc.rajasthan.gov.in for online e-Bid submission.

Executive Engineer (PHE-I)
JDA, Jaipur

Copy to :-

1. PRO Cell, JDA, Jaipur through TA to DE (I) for publication in News paper as per rules.

JDA/EE PHE I/A & F/2025-2026/May/078 Dated : 12/05/2025

Executive Engineer (PHE-I)
JDA, Jaipur

Signature valid
Digitally signed by Dilip Lamba
Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392
eSign 1.0

JAIPUR DEVELOPMENT AUTHORITY, JAIPUR

Room No. 135, Main Building, Ram Kishore Vyas Bhavan, Indira Circle, Jawaharlal Nehru Marg, Jaipur – 302 004
Telephone: +91-141-2569696 Email: zephe1jda@yahoo.in, ee.phe01.jda@RAJASTHAN.GOV.IN

No: - JDA/EE(PHE-I)/2025/D- **Dated:**

NIB No. : JDA/EE(PHE-I)/16/2025-26

Name & Address of the Procuring Entity	➢ Name: Executive Engineer (PHE-I), Jaipur Development Authority Address: Room No. 133, Main Building, Ram Kishore Vyas Bhavan, Indira Circle, Jawaharlal Nehru Marg, Jaipur – 302 004 Telephone: +91-141-2569696 E.mail: zephe1jda@yahoo.in, ee.phe01.jda@RAJASTHAN.GOV.IN
Subject Matter of Procurement	➢ **Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur.** ➢ **Job No. : 078/2025-26**
Bid Procedure	➢ Pre-qualification Method Tender (eg. TWO-stage Two part) open competitive) eBid procedure athttp://eproc.rajasthan.gov.in
Bid Evaluation Criteria (Selection Method)	➢ Pre-qualification Method L1 (eg.Least Cost Based Selection (LCBS)-L1)
Websites for downloading Bidding Document, Corrigendum's, Addendums, etc.	➢ Websites: www.sppp.rajasthan.gov.in,www.eproc.rajasthan. gov.in, www.jda.rajasthan.gov.in
Website for online Bid application participation and payment *	➢ Website: www.jda.rajasthan.gov.in ➢ For participating in the Bid, the Bidder has to apply for this Bid and pay the Bidding Document Fee, RISL Processing Fee and Bid Security Deposit online only. o Bidding document fee: Rs. 5000/- Rupees (Five ThousandOnly) o RISL Processing Fee: Rs. 2500/- (Rupees Two Thousand Five HundredOnly) Requisite Bid Security Deposit
Estimated Procurement Cost	➢ INR 89,71,14,000.00 (Rupees Eighty Nine Crore Seventy One Lacs Fourteen Thousand Only)
Bid Security Deposit	➢ Amount (INR) : 2% (Rs. 1,79,42,280/-) for AA Class contractor registered in other department and 0.5% (44,85,570.00/-) for AA Class contractor enlisted in JDA. ➢ If a joint venture is allowed in the Bid then 2% (Rs 1,79,42,280.00) in form of BG shall be deposited by bidders (Submitted BG in JV firm name) If any one of the partners of JV wish to dposit 2% earnest money (bid Secuity) than it shall b deposited n the for of online method as per bid document. Eligibility: Bidder who is AA Class or equivalent contractor registered in other Govt. Department and Bidder registered as contractor in AA in JDA.
Date/Time/Place of Pre-Bid	➢ 26.11.2025 at 3.00 PM in "Manthan Hall", Third Floor, Main Building, Ram Kishore Vyas Bhavan, Indira Circle, Jawahar Lal Nehru Marg, JDA Campus, Jaipur ➢ Interested bidders may submit their queries for the pre-bid meeting latest by 25.11.2025 upto 3:00 PM on E-Mail : zephe1jda@yahoo.in
Applying Bid and making Online Payment on JDA portal (www.jda.rajasthan.gov.in)	➢ Start Date: 17.11.2025 at 9:30 AM ➢ End Date: 17.12.2025 at 6:00 PM ➢ In case EMD in from BG Original Bank Guarantee is to be submitted in Room No MB-SF-225A (Room No. of DD (E&B) of Main Building, Jaipur Development Authority by 18.12.2025 10.00 AM to 22.12.2025 upto 5.00 PM
Bid Submission on e-Procurement Portal of GOR	➢ Start Date: 17.11.2025 at 9:30 AM ➢ End Date: 17.12.2025 at 6:00 PM
Date/Time/Place of Technical Bid Opening	➢ 23.12.2025 at 3:00PM, Room No. 133, Main Building, JDA, Jaipur
Date/ Time/ Place of Financial Bid Opening	➢ Will be intimated later to the Technically qualified bidders
Bid Validity	➢ 120 days from the date of opening of bid.
Completion period of work	➢ 24 Months
* Jaipur Development Authority has decided to receive, Tender Fee and RISL processing fee online through JDA Portal. The bid security options available in tender for participants are as mentioned below:	
A. Payment Options: **Option-1:**	**RajKaj Ref No.: 18852392**

Signature valid
Digitally signed by Dilip Lamba
Designation: Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

eSign 1.0

Bidder may opt Bank Guarantee (BG) against EMD (Bid Security), for which bidder requires to prepare BG before applying in the tender. The details of BG requires to be fed on JDA portal before paying balance amount (Tender Fee + RISL Processing Fee). This amount will be paid through Payment Gateway only, option to make balance payment through EFT (RTGS/NEFT) will not be available.

If bidder does not opt for BG against EMD, options of making complete payment through Payment Gateway or through EFT (NEFT / RTGS) will be available.

Option-2:

Electronic Fund Transfer (EFT: NEFT/RTGS)

If the bidder selects payment mode as EFT (NEFT/RTGS), "Paying Slip for EFT (NEFT/RTGS)" will be generated by the system for the complete amount. The payment can be made from any Bank any Branch using this Paying Slip through NEFT/RTGS (Claim against payment made through EFT in any other JDA bank account will not be acceptable and bidder stands disqualified from participation in the bid applied for). After successful transaction through NEFT/RTGS, as per the standard procedures it may take 4 to 24 hours in process of confirmation of EFT through Auto-Process depending on the time of EFT done. Therefore, option to make payment through EFT (NEFT/RTGS) will be available till 48 hours prior to closing date of bid participation.

Option-3: Payment Gateway (Aggregator)

The facility to make payment through Debit Card, Credit Card, Net banking etc., will be available. User can use this facility from anywhere any time till the closing date & time of bid participation.

B. Bid Participation Receipt

After confirming payment, the bidder will get Bid Participation Receipt on the basis of which user will get the payment details along with other details for bidding on e-Procurement portal of GOR.

- In case complete payment is done through Payment Gateway, on successful transaction the "Bid Participation Receipt" will be generated on real time basis.
- In case complete payment is done through EFT (NEFT/RTGS), on confirmation of payment from ICICI Bank (Auto Process) "Bid Participation Receipt" will be available on Login of Bidder on JDA portal.

Note:

1. Bidder (authorized signatory) shall submit their offer on-line in Electronic formats both for technical and financial proposal.
2. In case, any of the bidders fails to pay the Tender Fee, BSD, and RISL Processing Fee, online (subject to confirmation), its Bid shall not be accepted.
3. To participate in online bidding process, Bidders must procure a Digital Signature Certificate (Type III) as per Information Technology Act-2000 using which they can digitally sign their electronic bids. Bidders can procure the same from any CCA approved certifying agency, i.e. TCS, Safecrypt, Ncode etc. Bidders who already have a valid Digital Signature Certificate (DSC) need not procure a new DSC. Also, bidders must register on http://eproc.rajasthan.gov.in(bidders already registered on http://eproc.rajasthan.gov.in before 30-09-2011 must register again).
4. JDA will not be responsible for delay in online submission due to any reason. For this, bidders are requested to upload the complete bid well advance in time so as to avoid 11th hour issues like slow speed; choking of web site due to heavy load or any other unforeseen problems.
5. Bidders are also advised to refer "Bidders Manual Kit" available at eProc website for further details about the e-Tendering process.
6. Training for the bidders on the usage of e-Tendering System (eProcurement) is also being arranged by DoIT&C, GoR on a regular basis. Bidders interested for training may contact e-Procurement Cell, DoIT&C for booking the training slot.
   Contact No: 0141-4022688 (Help desk 10 am to 6 pm on all working days) e-mail: eproc@rajasthan.gov.in Address : e-Procurement Cell, JDA, YojanaBhawan, Tilak Marg, C-Scheme, Jaipur
7. The procuring entity reserves the complete right to cancel the bid process and reject any or all of the Bids.
8. No contractual obligation whatsoever shall arise from the bidding document/ bidding process unless and until a formal contract is signed and executed between the procuring entity and the successful bidder.
9. Procurement entity disclaims any factual/ or other errors in the bidding document (the onus is purely on the individual bidders to verify such information) and the information provided therein are intended only to help the bidders to prepare a logical bid-proposal.
10. The provisions of RTPP Act 2012 and Rules 2013 thereto shall be applicable for this procurement. Furthermore, in case of any inconsistency in any of the provisions of this bidding document with the RTPP Act 2012 and Rules thereto, the later shall prevail.

(Dileep Lamba)
Executive Engineer (PHE-I)
JDA, Jaipur

Signature valid
Digitally signed by Dileep Lamba
Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392
eSign 1.0

Process for Participation & Depositing Payment Online

JAIPUR DEVELOPMENT AUTHORITY, has decided to receive Bidding document fee, RISL Processing Fee and through online mode only for which the bidder has to get registered himself on JDA portal www.jaipurjda.org.

To participate in the bid, bidder has to be:

1. Registered on JDA website www.jaipurjda.org(by depositing Rs. 500.00 online, the validity of which remains 3 (three) years).
   For participating in the Bid, the Bidder has to apply for this Bid and pay the Bid Document Fee, RISL Processing Fee and Bid Security Deposit, online only.

2. Registered on e-Procurement Portal of Government of Rajasthan www.eproc.rajasthan.gov.in for online e-Bid submission.

Methods for depositing on line amount

Option-1: Bidder may opt Bank Guarantee (BG) against EMD (Bid Security), for which bidder requires to prepare BG before applying in the tender. The details of BG requires to be fed on JDA portal before paying balance amount (Tender Fee + RISL Processing Fee). This amount will be paid through Payment Gateway only, option to make balance payment through EFT (RTGS/NEFT) will not be available.

Option-2: Electronic Fund Transfer (EFT: NEFT/RTGS)

If the bidder selects payment mode as EFT (NEFT/RTGS), "Paying Slip for EFT (NEFT/RTGS)" will be generated by the system for the complete amount. The payment can be made from any Bank any Branch using this Paying Slip through NEFT/RTGS (Claim against payment made through EFT in any other JDA bank account will not be acceptable and bidder stands disqualified from participation in the bid applied for). After successful transaction through NEFT/RTGS, as per the standard procedures it may take 4 to 24 hours in process of confirmation of EFT through Auto-Process depending on the time of EFT done. Therefore, option to make payment through EFT (NEFT/RTGS) will be available till 48 hours prior to closing date of bid participation.

Option-3: Payment Gateway (Aggregator)

The facility to make payment through Debit Card, Credit Card, Net banking etc., will be available. User can use this facility from anywhere any time till the closing date & time of bid participation.

C. Bid Participation Receipt

After confirming payment, the bidder will get Bid Participation Receipt on the basis of which user will get the payment details along with other details for bidding on e-Procurement portal of GOR.

- In case of BG as the remaining payment will be done through Payment Gateway, on successful transaction the "Bid Participation Receipt" will be generated on real time basis.
- In case complete payment is done through Payment Gateway, on successful transaction the "Bid Participation Receipt" will be generated on real time basis.

In case complete payment is done through EFT (NEFT/RTGS), on confirmation of payment from ICICI Bank (Auto Process) "Bid Participation Receipt" will be available on Login of Bidder on JDA portal.

While participation in the bid, a receipt will be generated through the system showing the submission details as per Bid Participation Receipt (Sample Enclosed). The bidder is required to fill the instrument numbers for various heads on e-Procurement portal www.eproc.rajasthan.gov.in as mentioned in the receipt.

Procedure for bidding:

Single part bid system:

Single part (Two-envelope) (2 docket) system will be adopted, Docket-1 being for Document Fee, RISL Processing Fee and Bid Security Deposit, online only. Docket-2 being for Financial Bid.

Signature valid
Digitally signed by Dilip Lamba
Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved
Rajkaj Ref No: 18852392
eSign 1.0

Docket-1:- is for proof of deposition of Bid Security, cost of bidding document and bid processing fee along with copy of GST registration, signed Annexure “B” and copy of enlistment as contractor/ bidder in required category.

Docket-2:- is for financial bid.

The financial bid will be opened only for bidders whose proper Bid Security, copy of GST registration, proof for deposition of bidding document fee, RISL processing fee, copy of enlistment of contractor in the required category and signed Annexure “B” are found to be in order. Bid Security will be accepted only in the form of online deposition or in the form of Bank Guarantee.

1. **Two-part bid system:**

Two part (Two-envelope) (2 docket) system would be adopted, Docket-1 being for Technical Bid and Docket-2 being for Financial Bid.

Docket-1:- There will be three separate folders- Folder-1 is for proof of deposition of Bid Security, cost of bidding document and bid processing fee alongwith copy of GST registration, signed Annexure “B” and copy of enlistment as contractor/ bidder in required category. Folder-II is for bid document and folder-III is for technical bid.

Docket-2:- There will two separate folders-1 is for financial bid and 2 is for bill of quantities.

The technical bid will be opened only for bidders whose proper Bid Security, copy of GST registration, proof for deposition of bidding document fee, RISL processing fee, copy of enlistment of contractor in the required category and signed Annexure “B” are found to be in order. Bid Security will be accepted only in the form of online deposition or in the form of Bank Guarantee

Executive Engineer (PHE-I)
JDA, Jaipur

Signature valid
Digitally signed by Dilip Lamba
Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.:
18852392
eSign 1.0

JAIPUR DEVELOPMENT AUTHORITY, JAIPUR

SCHEDULE AND SPECIFICATIONS

Name of Work:- **Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur.**

1.	NIB No.	:	EE (PHE-I)/16/2025-26
2.	Approximate cost	:	₹ 8971.14 Lacs
3.	Cost of the Bid document	:	₹ 5000, Through On Line Payment only.
4.	Bid Processing Fees	:	₹ 2500, Through On Line Payment only.
5.	Bid Security	:	Amount (INR) : 2% (Rs. 1,79,42,280/-) for AA class contractor or equivalent contractor registered in other Govt. department and 0.5% (44,85,570/-) for AA Class contractor enlisted in JDA. If a joint venture is allowed in the Bid then 2% (Rs 1,79,42,280.00) in form of BG shall be deposited by bidders (Submitted BG in JV firm name) If any one of the partners of JV wish to dposit 2% earnest money (bid Secuity) than it shall b deposited n the for of online method as per bid document
6.	Download of Bid document	:	From 17.11.2025 9.30 AM to 17.12.2025 upto 6:00 PM
7.	Upload the Bid Document	:	From 17.11.2025 9.30 AM to 17.12.2025 upto 6:00 PM
8.	Date of Pre Bid Meeting	:	26.11.2025 at 3:00 PM in "Manthan Hall" Main Building, Second Floor, JDA Campus, Jaipur Interested bidders may submit their queries for the pre-bid meeting latest by 25.11.2025 upto 3:00 PM on E-Mail : zephe1jda@yahoo.in
9.	Last Date of submission of Bid cost, Bid Process cost.	:	17.12.2025 up to 6.00 PM through online only.
10.	Date of opening of Bid	:	23.12.2025 at 3:00PM (Room No. 135, First Floor, Main Building, JDA Campus, Jaipur)
11.	Completion period of work	:	24 Months

SCHEDULE AND SPECIFICATIONS

SCHEDULE – A: INFORMATION USEFUL FOR THE CONTRACTORS:

The bidder should see the site and fully understand the conditions of the site before bidding and include all leads, lift etc for the material in his item rate/percentage to be quoted on the rates given in Schedule 'G'. The work shall be carried out in accordance with the Rajasthan PWD detailed specification and to the entire satisfaction of the Engineer – In – Charge of the work.

SCHEDULE – B: LIST OF THE DRAWING TO BE SUPPLIED BY THE DEPARTMENT

The drawing may be seen in the office of the undersigned.

Signature valid
Digitally signed by Dilesp Lamba
Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved
RajKaj Ref No.: 18652992
eSign 1.0

SCHEDULE – C: LIST OF THE DRAWING TO BE SUPPLIED BY THE CONTRACTOR: List of the drawing to be supplied by the contractor NIL. But the contractor shall have to arrange at his own cost drawings required for the work after deposition necessary cost with JDA.

SCHEDULE - D: TEST OF THE MATERIALS:

The test of the materials and workmanship shall be conducted by the JDA staff as necessary. The result of such tests should confirm to the standards laid down in the Indian standard & or the standards laid down in the detailed specifications of the work by the contractor. Qualified personnel required as per the contractor enlistment rules shall have to be engaged at site by the Contractor. The authority reserves the right to engage such staff and recover the expenses from the contractor on such account in case of his failure to do so.

SCHEDULE – E: SAMPLES OF THE MATERIALS:

The sample of the materials to be used by the contractor shall be deposited 15 days in advance with the Engineer In charge and be got approved by him before use.

SCHEDULE - F: TIME OF COMPLETION:

The work should start within 10 days of the issue of the work order and complete within time limits.

SCHEDULE – G: ATTACHED SEPARATELY BASED ON APPLICABLE BSRs IN JDA.

SCHEDULE – H: SPECIAL CONDITION: Attached Separately.

SCHEDULE – I: COST OF TENDER DOCUMENTS, PROCESSING FEES & BID SECURITY.

The Bid Processing fee is payable in favor of M.D. RISL & Cost of bid document & Bid Security is payable in Favour of the Secretary, JDA, Jaipur. Bidders have to pay bid processing fees, cost of bidding documents, and Bid Security Online. **If a bidder opts to deposit the bid security through bank guarantee, the bank guarantee should be valid for the next seven months after the bid opening date. A copy of the such bank guarantee will be required to be attached with the bid submission documents uploaded on the E-procurement portal of GOR. The bank guarantee will be physically handed over upto prescribed time to Nodal officer of the on-line tendering system of JDA i.e. D.D(E&B) in room No. 215N Extension building, JDA, JLN marg, Jaipur, as per specified in bidding documents,**

Annexure-1. Special Conditions of Contract regarding defect liability period.

Annexure-2A. Bank guarantee will be in specified Performa enclosed with this bidding document for Bid Security.

Annexure-2B. Bank guarantee will be in specified Performa enclosed with this bidding document for Performance Security.

Annexure-A. Compliance with the code of integrity and no conflict of interest (RTPP Act/Rules).

Annexure-B. Declaration by the bidder regarding qualifications (RTPP Act/Rules).

Annexure-C. Grievance Redressal during the procurement process (RTPP Act/Rules).

Annexure-D. Additional Conditions of Contract (RTPP Act/Rules).

Annexure-E. Process for Tender Participation & Depositing Payment on 'Online Tender Participation'Portal of JDA & Bid Submission on 'e-Procurement Portal' of Government of Rajasthan.

EXECUTIVE ENGINEER (PHE-I)
JDA, Jaipur

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Designation : Executive Engineer
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Reason: Approved

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SPECIAL CONDITIONS

SCHEDULE 'H'

01. If there is any typographical error or otherwise in the 'G' Schedule, the rates given in the relevant BSR on which Schedule 'G' has been prepared, shall prevail.
02. The bidder shall follow the provisions of the builder labour regulation and abolition Act, 1970 & Rule, 1971.
03. The JDA shall have the right to cause an audit for technical examination of the work and the final bills of the bidder including all supporting vouchers, abstracts etc. to be made within two years after payment of the final bills and if as a result of such audit, any amount is found to have been overpaid / excess in respect of any work done by the bidder under the contract or any work claimed by him to have been done under this contract and found not to have been executed, the bidder shall be liable to refund such amount and it shall be lawful for the JDA to recover the such sum from him in the manner prescribed in special condition no. 8 or any other manner legally permissible and if it is found that the bidder was paid less then that was due to him under the contract in respect of work executed by him under it, the amount of such underpayment shall be paid by the JDA to the bidder.
4. Wherever any claim against the bidder for the payment of a sum of money arises out of under the contracts, the JDA shall be entitled to recover the sum by appropriating in part or whole of the performance security of the bidder, In the event of the security being insufficient or if no security has been taken from the bidder then the balance of the total sum recoverable as the case may be deducted from any sum then due or which at any time their contract with the JDA should this sum be sufficient to recover the full amount recoverable. The bidder shall pay to JDA on demand the balance remaining due. The JDA shall further have the right to affect such recoveries under P.D.R. Act.
5. The rate quoted by the bidder shall remain valid for a period of 120 days from the date of opening of the bids.
6. By submission of the Bid the bidder agrees to abide by all printed conditions provided in the PWD manual from 64 (Chapter 3-para 36) and subsequent modification.
7. No conditions are to be added by the bidder and the conditional Bid is liable to be rejected.
8. If any bidder withdraws his Bid prior to the expiry of said validity period given at S. No. 5 or mutually extended prior or makes modifications in the rate, terms and conditions of the Bid within the said period which are not acceptable to the authority or fails to commence the work in the specified period, fails to execute the agreement the authority shall without prejudice to any, other right or remedy, be at liberty to forfeit the amount of bid security given in any form absolutely. If any bidder, who has submitted a Bid does not execute the agreement or start the work or does not complete the work and the work has to be put to rebidding he will stand debarred for six months from participating of Biding in JDA in addition to forfeiture of bid security/ Performance Security and other action under agreement
9. Any material not conforming to the specifications collected at the site have to be removed by the bidder within a period of 3 days of the instruction, issued by the Engineer -In charge in writing failing which, such material shall be removed by the Engineer-In charge at risk and cost of the bidder after the expiry of 3 days period.
10. The material collected at the site and paid provisionally shall remain under the watch and ward of the bidder till it is consumed fully on the work.
11. The rates provided in the Bidding documents are inclusive of all Taxes and royalties otherwise specified.
12. No extra lead of earth/material shall be paid over and above as specified in 'G' Schedule, Source/ borrow pit area for the earth shall have to be arranged by the Bidder at his own cost.
13. Undersigned has full right to reject any or all Bids without giving any reasons.
14. As per the Supreme Court decision "All contracts with Governments shall require registration of workers under the building and other construction workers (Regulation of Employment and Conditions of Service) Act, 1996 and extension of benefits to such workers under the etc."

15. Special Conditions of the Contract regarding the Defect Liability Period (DLP) for works costing Rs. 25.00 lacs and more shall be applicable (Annexure-I).
16. The Bidder is required to submit a copy of their enlistment as a contractor.
17. Conditions of RPWA-100 will be mandatory & acceptable to the bidder.
18. The bidder will have to install display boards at the site of work as directed by Engineer in charge.
19. All the provisions of THE RAJASTHAN TRANSPARENCY IN PUBLIC PROCUREMENT ACT, 2012 and Rules, 2013 and amendments issued from time to time by the Finance Department, GOR shall be applicable. If there are any contradictions in existing special conditions and provisions of THE RAJASTHAN TRANSPARENCY IN PUBLIC PROCUREMENT ACT, 2012 and Rules, 2013

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provisions of THE RAJASTHAN TRANSPARENCY IN PUBLIC PROCUREMENT ACT, 2012 and Rules 2013 shall prevail.

20. In case the rate received in the bid is below than BSR rate, additional Performance security shall be deposited by the bidder as per Rule 75 (A) of RTPP Rules.

21. The Annexure "B" (RTPP Act/Rules) is mandatory to be fulfilled & signed with sealby the bidder failing which the bid shall summarily be rejected without asking for any clarification.

22. Contractors enlisted in JDA, should be get reviewed periodically. The registered bidder who has not been reviewed within a period of 5 years 3 months, shall not be allowed to participate in the bid. Contractors enlisted in other departments shall be as per the provision of PWF&AR

23. As built drawing Submission after completion work for the final payment of the bill. The final drawing shall be submitted in one reproducible set and 5 copies of an approved size. The contractor shall submit all the completion drawing in workable soft copy (CD/pen drive) with GPS location/GEO tagging of manholes with proper directory of site.

24. The bidders are requested to pay special attention towards Section-7, Special condition of contract for safety, health and environment (SHE) and the related penalty clause. The agency ensure all safety measures during execution to avoid any accident at work site. The Agency will solely be responsible for any accident/ Mishappening may occur at site during execution of work.

25. All the applicable permits/NOC's/Traffic diversion permission shall have to be arrange and borne by the bidder at their own cost. However JDA may assist in obtaining such permissions/NOC. Any delay in obtaining such permits/NOC shall not be considered for delay in works as per agreement.

26. Any damages of the utilities and underground services, during execution of work caused by contractor/machinery/labour will have to be restored by the bidder at his own cost for which no extra payment shall be made.

27. Job Mix design for concrete work shall have to be got done by NABL accredited lab or MNIT and got approved by JDA before execution of work. No extra payment shall be made on this account.

28. Bidder should submit on the date of downloading of the bid documents, the documentary proof of Tax Registration Certificate. Works Executed photocopies of completion / execution certificate issued by an officer not below the rank of Executive Engineer giving detail of contract including date of start, date of completion, amount of work done, nature of work etc.) and turnover of above pre-qualification requirement. Please note that copies of award letters will not be accepted taken as proof for meeting the pre-qualification criterion.

29. The rates quoted by the bidder should be inclusive of all the taxes.

30. The rates quoted/negotiated shall be firm. No price variation is admissible.

31. Operation service costs, which include the operation, maintenance and management of the entire system or any part thereof, shall not be less than 10% of the quoted construction cost of the STP plant for a period of 10 years. In case a bidder quotes O&M costs lower than 10% of the construction cost of the entire system than the bid liable to rejection.

32. "Addition Performance Security" for unbalanced bid order JDA/Dir(Fin.)/2022/D-37 dated 22.09.22 shall be applicable. According to this order Addition Performance Security for unbalanced bid shall be deducted as per Finance (G&T) Department Notification No. F. 2(1) FD/G&T(SPFC)/2017 dated 22.10.2021.

As per the rules "75A. Additional Performance Security.-

(1) In addition to Performance Security as specified in rule 75, an Additional Performance Security shall also be taken from the successful bidder in case of unbalanced bid. The Additional Performance Security shall be equal to fifty percent of Unbalanced Bid Amount. The Additional Performance Security shall be deposited in lump sum by the successful bidder before execution of Agreement. The Additional Performance Security shall be deposited through e-Grass, Demand Draft, Banker's Cheque, Government Securities or Bank Guarantee.

Explanation: For the purpose of this rule,-

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(i) Unbalanced Bid means any bid below more than fifteen percent of Estimated Bid Value.
(ii) Estimated Bid Value means value of subject matter of procurement mention in bidding documents by the Procuring Entity.
(iii) Unbalanced Bid Amount means positive difference of eighty five percent of Estimated Bid Value minus Bid Amount Quoted by the bidder.

(2) The Additional Performance Security shall be refunded to the contractor after satisfactory completion of the entire work. The Additional Performance Security shall be forfeited by the Procuring Entity when work is not completed within stipulated period by the contractor. Provision for 'Unbalanced Bid' and 'Additional Performance Security' shall be mentioned in the Bidding Documents by the Procuring Entity."

33. The cost of samples including transportation's as well as of the testing shall be borne by the contractor. The third party agency shall be any one of the following:-

1. M/s. CEIL
2. M/s. RITES
3. M/s. SGS

Or "by any other" as approved by Engineer-In-Charge

33. Price Escalation: Clause of agreement no. 45& 45A for Price Escalation variation is not applicable/ payable so deleted.

34. If qualifying work of STP as per qualification condition/ criteria 2(b) is executed by JV firm and both the firms participated in this bid either individually or in JV with other firms, then the experience of only that firm with higher sharing in original JV will be considered. Working experience of the same STP will not be considered separately. Experience of other items excluding STP can be used by both the firms as per their share.

35. **Capacity of STP is 40 MLD but contractor shall plan the layout of STP such as to utilize the maximum land use for future extension of STP i.e. 80 MLD**.

36. Power consumption parameter has been fixed by the JDA for the design parameter of STP for various limit of inflow at inlet of STP. The payment of power consumption upto the mentioned limit shall be borne by JDA. In case of excess power consumption over the above limit, the successful bidder will be responsible for extra payment and will be recovered from the bidder @ 2 times of prevailing power rates for extra consumption.

Executive Engineer (PHE-I)
JDA, Jaipur

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ANNEXURE '1'

SPECIAL CONDITIONS OF CONTRACT REGARDING DEFECT LIABILITY PERIOD (DLP) FOR WORKS COSTING RS. 25.00LACS AND MORE

Table-1

S.No.	Type of work	DLP Period
1.	**Bridge Work**	**5 Years**
2.	**CD Work**	**5 Years**
3.	**CC Road. PQC Work**	**5 Years**
4.	**CC tiles/Krebs/medians**	**5 Years**
5.	**Drains**	**3 Years**
6.	**Roads**	
	(i)Two-layer WBM/GSB	**6 months or one full rainy season whichever is later**
	(ii)For Renewal/Strengthening	
	(a)BT up to 30 mm thickness	**1 Years**
	(b)BT above 30 mm to up to 40 mm	**2 Years**
	(c)BT above 40 mm to up to 90 mm	**3 Years**
	(d)BT above 90 mm thickness	**5 Years**
	(iii) New Roads	
	(a) BT up to 90 mm	**3 Years**
	(b) BT more than 90 mm	**5 Years**
7.	**Compound wall**	**3 Years**
8.	**Building Work**	
	(i) Work pertaining to Sanitary work electrical works, Joinery works and painting work.	**2 Years**
	(ii) Work pertaining to the Building structure and other civil works	**5 Years**
9.	**Electric work except for maintenance**	**3 years**
10.	**Sewer/Water supply including STP and water supply-related work except for maintenance works.**	**3 Years**

1. ROAD-WORKS

1.1 The Defect Liability Period (DLP) for all Road works excluding patch repair work shall be as per the above table. Road works executed by the Contracting agency shall be maintained by them at their own cost for completion (DLP) from the actual date of completion of work as per the clause in the Contract Agreement and Special Condition of the Contract.

1.2 No extra payment shall be made to the contracting agency on account of maintenance of Road works and removal of defect during the Defect Liability Period.

1.3 The word "Road Works" means all new Road Works construction, widening, strengthening, up-gradation and renewal works

1.4 The word "Maintenance of Road Works during Defect Liability Period" means

(i) Routine maintenance of Road Works,

(ii) To remove the defect as & when appear in part and the entire structure of Road Works, in the specified time and keeping the Road Surface with good riding quality and

(iii) Damages due to improper drainage/drains, local flooding, depressions on roads etc.

1.5 The contracting agency shall do the routine maintenance of Road works, including pavement, road side and cross drains including surface drains to the required standards and keep the entire road surface and structure in Defect free conditions during the entire period of routine maintenance, which begins at the completion of the construction work and ends after complete (DLP).

1.6 The routine maintenance shall consist of the routine maintenance operation defined in the manual for the maintenance of roads of MoRTH and shall be carried out accordingly.

1.7 The routine maintenance activities and their periodicity.

S.No.	Name of Item/Activity	Frequency of Operations in one year
1	Restoration of rain cuts and dressing of berms.	Once in a year, generally after [illegible]
2	Making up of shoulders.	As and when required.

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3	Maintenance of Bituminous surface road and/or gravel road/WBM road including filling pot holes and patch repairs etc.	As and when required.
4	Insurance of proper functioning of drains including civil maintenance and desalting of drains. (If constructed by the same Road agency or not)	As and when required.
5	Maintenance of road signs. (If installed by the same Road agency)	Maintenance as and when required. Repainting **once in every one and a half years.**
6	Road Marking, Kerb Stone / Dand. (If done by the same Road agency)	**Thermoplastic Paint** Maintenance as and when required. Repainting **once in everyone & a half year.** **Ordinary Paint** Maintenance as and when required. Repainting **thrice in every year.**
7	Damages beyond the control of the agency.	Road cuts made by various agencies for utility, duly permitted by JDA / JNN will have to be repaired by the agency on the same rates of the contract agreement till DLP.

2. General

2.1 Inspection of works during the Defect Liability Period

2.1.1 The contracting agency shall undertake a joint detailed inspection along with Engineer-in-charge/A.En., at least once in three months in case of all Road works. The Engineer-in-charge can reduce this frequency in case of an emergency. The Contracting agency shall forward to the engineer in-charge the record of inspection and rectification immediately after the joint inspection. The Contracting agency shall pay particulars attention to those road sections, which are likely to be damaged during rainy season.

2.1.2 One register has to be maintained by every AEN for recording the inspection details of works in his jurisdiction under defect liability period.

2.2 Conditions regarding **Performance Security**

2.2.1 Security for DLP-

The contracting agency shall have to furnish Performance Security in the form of Bank Guarantee valid from the actual date of completion, which shall be assigned by the Engineer-in-charge.

2.2.2 The release of PS amount shall be as per following table 2 :-

S.No.	Released PS / DLP Period	1 Year	2 Years	3 Years	5 Years
1.	After 1 year	100%	40%	20%	10%
2.	After 2 year		60%	20%	10%
3.	After 3 year			60%	10%
4.	After 4 year				20%
5.	After 5 year				50%

The Performance Security will be released as per the above table after a satisfactory performance certificate issued by Engineer-In-Charge:-

2.2.3 Forfeiture of Performance Security

In case the contracting agency fails to rectify the defects within the stipulated period notified to him by the Engineer-in-charge concerned under the contract agreement, the Engineer-in-charge shall serve a final notice for 5 days time reckoned from the date of issue of notice to rectify the defects. In case the contracting agency not responding to the notice and fails in the rectification of defects the Engineer-in-charge will get the defect removed at the risk and cost of the contracting agency. Action such as encashment of Bank Guarantee and action under enlistment rules etc. shall also be taken against the contracting agency by the competent authority.

1.2.4 Force Majeure

The defect that arises due to earthquakes, cyclones, and natural calamities shall not be the responsibility of contracting agency.

2.2.5 Various conditions for managing DLP are as under :-

(i) At the time of completion of work, final component shall be worked out for each individual item like BT/CC/tiles/ drains etc. (as per different categories in Table-I), DLP shall be operative based upon type of individual item ex:- CC-5 years, BT-1/2/3/5 years, Drain-3 years etc.

(ii) If any work, amount is less than Rs. 25 lacs after taking due to extra/excess work if amount of cresses more than Rs. 25 lacs, DLP shall be operative as per rule for each individual item.

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(iii)Similarly, if any work is more than Rs. 25 lacs but after finalization amount of work is less than Rs. 25 lacs, DLP should be operative for six months or rainy season whichever is later.

(iv) During DLP period if contractor fails to repair any work even after the issue of 7 days written notice, the same work shall be got executed by the respective Executive Engineer at the contractor's risk and cost. This process shall be applicable throughout the DLP period. After completion of DLP period in such works contractor should be debarred and blacklisted, from JDA for three years as per RTPP rule 2012 and 2013 where his defaults twice in a single agreement or in two different works.

(v) Quarterly Inspection as per rules shall be carried out and DLP registers shall be maintained by respective Executive Engineers to monitor the DLP repairs.

(vi) Special and regular inspection shall also be carried out as per order no. JDA/XEN & TA to DE-I/2014-15/D-223 dated 12.03.2015 and order no. SE (PMGSY) CIRCULAR 2006/D-115 dated 04.05.2006 Point no. 3.

(vii) In case JDA feels to take up work on any existing DLP road due to any reason, the following procedure should be adopted:

(a) At the time of withdrawal total liability of repairs as per DLP conditions to be carried out and the contractor shall be asked to complete the same. After completion of assessed repairs, DLP period shall be released after deduction amt. as per following table-III.

Table-3

% Recovery on withdrawal of DLP of work order / DLP period	1 Year	2 Year	3 Year	4 Year	5 Year
1 Year	1.12	-	-	-	-
2 Year	2.55	1.43	-	-	-
3 Year	4.38	3.26	1.83	-	-
5 Year	9	7.88	6.45	4.62	2.47

Note:- Calculation is to be done on a quarterly basis.

(b) In case the Contractor fails to carry out these repairs, same shall be carried out at his risk and cost. If the total amt. of such repairs works out to be more than the total retained amount of PS same shall be recovered from other works and as per PDR rules. The amount as per Table 3 is also to be deducted in addition to this amount.

(viii) Based upon the type of work, DLP conditions for works to be carried out during the DLP period with their frequency of the respective type of work shall be prepared by respective SE"s after approval of these periods.

3. In case patch repairs/civil maintenance works costing more than Rs. 25.00Lakhs, defect liability period will as per clause 37(C) of Contract Agreement.

Executive Engineer (PHE-I)
JDA, Jaipur

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Annexure-2A

Specified Bank Guarantee Performa for Bid Security

Section - 6

Form of (Bank Guarantee) -En cashable at the branch of the bank in Jaipur City.

To
Secretary,
Jaipur Development Authority,
Jaipur

Sub:

Bank Guarantee No. _____ dated _____ for [amount of Security in figures] [in words] on behalf of _____ [Name of the Bidder] against Bid Security for the……..**……J**

DA Jaipur WHEREAS, _____ [name of Bidder with address] **(hereinafter called "the Bidder")** has submitted his Bid dated ..... for the work of **Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur.**(here in after called " the Bid ").

KNOW ALL PEOPLE by these presents that we _____ _____ (Name of Bank) of having our registered office at _____[name of country] having our registered office at _____ (hereinafter called "the Bank") are bound unto Secretary, Jaipur Development Authority. (Hereinafter called "the Employer") in the sum of Rupees _____ **[Amount of Security in figures]** _____ (in words) only for which payment will and truly to be made to the said Employer, the Bank binds itself, its successors, and assigns by these presents.
That on demand of JDA , this Bank Guarantee is cashable at the following branch in Jaipur City.

1. Name of Bank:
2. Name of the branch with branch code:
3. Address:
4. E-Mail Id:
5. Telephone No.
6. Fax No.:

SEALED with the Common Seal of the said Bank this _____ day of _____ of 20____.

THE CONDITIONS of this obligation are:

(1) if the Bidder withdraws his Bid during the period of Bid validity specified in the Form of Bid;
(2) if the Bidder refuses to accept the correction of errors in his bid;
(3) If the Bidder, having been notified of the acceptance of his Bid by the Employer during the period of Bid validity;
(a) fails or refuses to execute the Form of Agreement in accordance with the Instructions

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Bidders, or

(b) fails or refuses to furnish the Performance Security, in accordance with the Instructions to Bidders;

We undertake to pay to the Employer up to the above amount upon receipt of his first written demand, without the Employer having to substantiate his demand, provided that in his demand the Employer will note that the amount claimed by him is due to him owing to the occurrence of one or more of the above conditions, specifying the occurred condition or conditions.

This Guarantee will remain in force up to and including the date 90 days after the date of expiration of the Bid Validity, as stated in the Instructions to Bidders, or any such extension thereto as may be agreed by the Bidder, a notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this Guarantee should reach the Bank no later than the above date.

The amount covered under the above Bank Guarantee shall be automatically credited in the accounts of JDA in ICICI Bank, JDA Campus, Jaipur through **ISFC code No ICICI 006754. Bank Account No. 675401700518** on the date of expiry or its validity, unless the agencies get it re-validated well before its expiry date or produce NOC from JDA in writing for its release.

Date _____Signature of the Bank_____

Witness_____ Seal _____

[Signature, Name, and Address]

[**Note: To be furnished on appropriate non-judicial stamps & should be valid for the next 7 months from the bid opening date]**

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Annexure-2B

Specified Bank Guarantee Performa for Performance Security

Section - 6

Form of (Bank Guarantee) -En cashable at the branch of the bank in Jaipur City.

To

Secretary, Jaipur Development Authority, Jaipur

Sub: …….

Bank Guarantee No. _____ dated _____ for [amount of Security in figures] [in words] on behalf of _____ [Name of the Bidder] against Performance Security for the……..**JDA Jaipur**

WHEREAS, _____ [name of Bidder with address] **(hereinafter called "the Bidder")** has submitted his Bid dated ..... for the work of **Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur** (herein after called " the Bid ").

KNOW ALL PEOPLE by these presents that we _____

_____ (Name of Bank) of having our registered office at _____[name of country] having our registered office at _____ (hereinafter called "the Bank") are bound unto Secretary, Jaipur Development Authority. (Hereinafter called "the Employer") in the sum of Rupees _____ **[Amount of Security in figures]** _____ (in words) only for which payment will and truly to be made to the said Employer, the Bank binds itself, its successors, and assigns by these presents.

That on demand of JDA, this Bank Guarantee is cashable at the following branch in Jaipur City.

1. Name of Bank:
2. Name of the branch with branch code:
3. Address:
4. E-Mail Id:
5. Telephone No.
6. Fax No.:

SEALED with the Common Seal of the said Bank this _____ day of _____ of 20____.

We undertake to pay to the Employer up to the above amount upon receipt of his first written demand within valid period of this guarantee.

This Guarantee will remain in force up to and including the date 90 days after the date of DLP period, as stated in the Instructions to Bidders, or any such extension thereto as may be agreed by the Bidder, a notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this Guarantee should reach the Bank no later than the above date.

The amount covered under the above Bank Guarantee shall be automatically credited to the accounts of JDA in ICICI Bank, JDA Campus, Jaipur through **ISFC code No ICIC006754. Bank Account No. 675401700518** on the date of expiry or its validity, unless the agencies get it re-validated well before its expiry date or produce NOC from JDA in writing for its release.

Date_____Signature of the Bank_____

Witness_____ Seal _____

[Signature, Name and Address]

[Note: To be furnished on appropriate non-judicial stamps.]

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Annexure A

(RTPP Act/Rules)

Compliance with the Code of Integrity and No Conflict of Interest

Any person participating in a procurement process shall-

i Not offer any bribe, reward or gift or any material benefit either directly or indirectly in exchange for an unfair advantage in the procurement process or to otherwise influence the procurement process;

ii Not misrepresent or omit that misleads or attempts to mislead so as to obtain a financial or other benefit or avoid an obligation;

iii Not indulge in any collusion, Bid-rigging or anti-competitive behavior to impair the transparency, fairness and progress of the procurement process;

iv Not misuse any information shared between the procuring entity and the bidders with an intent to gain an unfair advantage in the procurement process;

v Not indulge in any coercion including impairing or harming or threatening to do the same, directly or indirectly, to any party or to its property to influence the procurement process;

vi Not obstruct any investigation or audit of a procurement process;

vii Disclose conflict of interest, if any; and

viii Disclose any previous transgressions with any entity in India or any other country during the last three years or any debarment by any other procuring entity.

Conflict of interest:

The Bidder participating in a bidding process must not have a Conflict of Interest.

A Conflict of interest is considered to be a situation in which a party has interests that could improperly influence that party's performance of official duties or responsibilities, contractual obligations, or compliance with applicable laws and regulations.

A bidder may be considered to be in conflict of interest with one or more parties in the bidding process if, including but not limited to:

A. Have controlling partners/shareholders in common; or
B. Receive or have received any direct or indirect subsidy from any of them; or
C. Have the same legal representative for purposes of the bid; or
D. have a relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the bid of another bidder, or influence the decisions of the procuring Entity regarding the bidding process; or
E. The bidder participates in more than one bid in a bidding process. Participation by a bidder in more than one bid will result in the disqualification of all bids in which the bidder is involved. However, this does not limit the inclusion of the same subcontractor, not otherwise participating as a bidder, in more than one bid; or
F. the bidder or any of its affiliates participated as a consultant in the preparation of the design or technical specifications of the goods, works or services that are the subject of the Bid; or
G. Bidder or any of its affiliates has been hired (or proposed to be hired) by the procuring entity as engineer-in-charge/consultant for the contract.

Signature valid
Digitally signed by Dilip Lamba
Designation: Executive Engineer
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Annexure B

(RTPP Act/Rules)

Declaration by the Bidder regarding Qualifications

Declaration by the Bidder

In relation to my/our Bid submitted to .....for procurement of .....in response to their Notice inviting Bids No.....Dated.....I/we .....hereby declare under Section 7 of Rajasthan Transparency in Public Procurement Act, 2012 that:

1. I/we possess the necessary professional, technical, financial and managerial resources and competence required by the Bidding Document issued by the Procuring Entry;
2. I/we have fulfilled my/our obligation to pay such of the taxes payable to the union and the state government or any local authority as specified in the Bidding Document.
3. I/we are not insolvent, in receivership, bankrupt or being wound up, not have my/our affairs administered by a court or a judicial officer, not have my/our business activities suspended and not the subject of legal proceedings for any of the foregoing reasons;
4. I/we do not have, and our directors and officers not have, been convicted of any criminal offense related to my/our professional conduct or the making of false statements or misrepresentations as to my/our qualifications to enter into a procurement contract within a period of three years preceding the commencement of this procurement process, or not have been otherwise disqualified pursuant to debarment proceedings;
5. I/we do not have a conflict of interest as specified in the Act, Rules and the Bidding Document, which materially affects fair competition;

Date:

Place:

Signature of the bidder

Name:

Designation:

Address:

Note:- Annexure "B" is mandatory to be fulfilled & signed with seal by the bidder failing which the bid shall summarily be rejected without asking any clarification.

Signature valid
Digitally signed by Dilip Lamba
Designation: Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392
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Annexure C

(RTPP Act/Rules)

Grievance Redressal during Procurement Process

The designation and address of the First Appellate Authority :

For works costing up to Rs. 300.00Lakhs - Jaipur Development Commissioner, JDA, Jaipur.
For works costing above Rs. 300.00Lakhs - Executive Committee, JDA, Jaipur.

The designation and address of the Second Appellate Authority:

For works costing up to Rs. 300.00Lakhs - Executive Committee, JDA, Jaipur.
For works costing above Rs. 300.00Lakhs - Principle Secretary/ACS, Urban Development & Housing Department, GOR, Jaipur.

(1) Filing an appeal: -

if any bidder or prospective bidder is aggrieved that any decision, action or omission of the procuring entity is in contravention to the provisions of the Act or the rules or the guidelines issued there under, he may file an appeal to First Appellate authority, as specified in the Bidding document within a period of ten days from the date of such decision or action, omission, as the case may be, clearly giving the specific ground or grounds on which, he feels aggrieved:

Provided that after the declaration of a bidder as successful the appeal may be filed only by a bidder who has participated in procurement proceedings:

Provided further that in case a procuring entity evaluates the technical bids before the opening of the financial bids, an appeal related to the matter of financial bids may be filed only by a bidder whose technical bid is found to be acceptable.

(2) The officer to whom an appeal is filed under Para (1) shall deal with the appeal as expeditiously as possible and shall Endeavour to dispose it of within thirty days from the date of the appeal.

(3) If the officer designated under Para (1) fails to dispose of the appeal filed within the period specified in Para (2), or if the bidder or prospective bidder or the procuring entity is aggrieved by the order passed by the first appellate authority, the bidder or prospective bidder or the procuring entity, as the case may be, may file a second appeal to the second appellate authority specified in the bidding document in this behalf within fifteen days from the expiry of the period specified in Para (2) or of the date of receipt of the order passed by the first appellate authority, as the case may be.

(4) Appeals not to lie in certain cases: -

No appeal shall lie against any decision of the procuring entity relating to the following matters, namely: -

(a) Determination of the need of procurement
(b) Provisions limiting the participation of bidders in the bid process
(c) The decision of whether or not to enter into negotiations
(d) Cancellation of a procurement process
(e) Applicability of the provisions of confidentiality

(5) Form of Appeals: -

(a) An appeal under Para (1) or (3) above shall be in the annexed form along with as many copies as there are respondents in the appeal.

(b) Every appeal shall be accompanied by an order appealed against, if any,
Affidavit verifying the facts stated in the appeal and proof of payment of fee,

(c) Every appeal may be presented to the first appellate authority or second
The appellate authority, as the case may be, in person or through registered post or authorized representative.

(6) Fee for filing Appeal: -

(a) Fee for the first appeal shall be rupees two thousand five hundred and for the second appeal shall be rupees ten thousand, which shall be non-refundable.

(b) The fee shall be paid in the form of a bank demand draft or banker's cheque of a scheduled bank in India payable in the name of the appellate authority concerned.

(7) Procedure for disposal of Appeal: -

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(a) The first appellate authority or second appellate authority as the case may be, upon the filing of the appeal, shall issue notice accompanied by a copy of the appeal, affidavit and documents, if any, to the respondents and fix a date of hearing

(b) On the date fixed for hearing, the first appellate authority of the second appellate authority, as the case may be shall-

(i) Hear all the parties appeal presenting before him; and

(ii) Peruse or inspect documents, relevant records or copies thereof relating to the matter.

(c) After hearing the parties, perusal or inspection of documents and relevant records or copies thereof relating to the matter, the appellate authority concerned shall pass an order in writing and provide a copy of the order to the parties to appeal free of cost.

(d) The order passed under sub-clause (c) above shall also be placed on the state public procurement portal.

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Annexure D

(RTPP Act/Rules)

Additional Conditions of Contract

1. Correction of arithmetical errors

Provided that a financial bid is substantially responsive, the procuring entity will correct arithmetical errors during the evaluation of financial Bids on the following basis:

(i) if there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected unless in the opinion of the procuring entity, there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price shall be corrected;

(ii) if there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected; and

(iii) if there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (i) and (ii) above.

If the Bidder that submitted the lowest evaluated bid does not accept the correction of errors, its bid shall be disqualified and its bid security shall be forfeited or its bid securing declaration shall be executed.

2. Procuring Entity's Right to Vary quantities.

(i) At the time of award of the contract, the quantity of goods, works or services originally specified in the bidding documents may be increased or decreased, by a specified percentage, but such increase or decrease shall not exceed fifty percent, of the quantity specified in the bidding documents. It shall be without any change in the unit prices or other terms and conditions of the bid and the conditions of the contract.

(ii) If the Procuring entity does not procure any subject matter of procurement or procures less than the quantity specified in the bidding document due to change circumstances, the bidder shall not be entitled to any claim or compensation except otherwise provided in the conditions of the contract.

(iii) In case of procurement of goods or services, additional quantity may be procured by placing a repeat order on the rates and conditions of the original order. However, the additional quantity shall not be more than 25% of the value of goods of the original contract and shall be within one month from the date of expiry of the last supply. If the supplier fails to do so, the procuring entity shall be free to arrange for the balance supply by limited bidding or otherwise and the extra cost incurred shall be recovered from the supplier.

3. Dividing quantities among more than one bidder at the time of award (In case of procurement of Goods):-

As a general rule, all the quantities of the subject matter of procurement shall be procured from the Bidder, whose Bid is accepted. However, when it is considered that the quantity of the subject matter of procurement to be procured is very large and it may not be in the capacity of the Bidder, whose Bid is accepted, to deliver the entire quantity or when it is considered that the subject matter of procurement to be procured is of critical and vital nature, then in such cases, the quantity may be divided between the Bidder, whose Bid is accepted and the second lowest Bidder or even more Bidder in that order, in a fair, transparent and equitable manner at the rates of the Bidder, whose Bid is accepted.

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ANEXTURE-"E"

Process for Tender Participation & Depositing Payment on 'Online Tender Participation' Portal of JDA & Bid Submission on 'e-Procurement Portal' of Government of Rajasthan: -

A*Process for Tender Participation & Depositing Payment on 'Online Tender Participation' Portal of JDA

1-Participate in tender

a) Bidder can access 'Online Tender Participation' Portal of JDA at **https://jda.rajasthan.gov.in/jda** or by Single-Sign-On at **http://service.jaipurjda.org.**

b) Create user Login with a valid mobile number to register yourself for various Online Services of JDA.

c) Select 'Proceed as Citizen' and then 'Proceed for Subscription' for 'Tender Online Payment'. The prevailing plan for getting registered for tendering process of JDA is Rs. 500.00 with a validity period of 3 Years (renewable).

d) After successful payment, re-login and upload required documents for KYC (Know Your Client) compliance as per the type of entity viz. Individuals/ Company/ Partnership Firms/ Trusts & foundations. Besides, Bank Passbook / Cancelled Cheque consisting of Bank Account, IFSC Code is mandatory to be uploaded, to refund the bid security of unsuccessful bidder.

e) After receiving the payment successfully and approving KYC documents the bidder will be authenticated by JDA for taking part in Tender.

2-Deposit Tender Fee, RISL processing fee and Bid Security (EMD)

- **Option-1:** Payment Gateway (Aggregator)
  The facility to make payment through Debit Card, Credit Card, Net banking etc., will be available. User can use this facility from anywhere any time till the closing date & time of bid participation.

- **Option-2:** Electronic Fund Transfer (EFT: NEFT/RTGS)
  If the bidder selects payment mode as EFT (NEFT/RTGS), "Paying Slip for EFT (NEFT/RTGS)" will be generated by the system for the complete amount. The payment can be made from any Bank any Branch using this Paying Slip through NEFT/RTGS (Claim against payment made through EFT in any other JDA bank account will not be acceptable and bidder stands disqualified from participation in the bid applied for). After successful transaction through NEFT/RTGS, as per the standard procedures it may take 4 to 24 hours in process of confirmation of EFT through Auto-Process depending on the time of EFT done. Therefore, option to make payment through EFT (NEFT/RTGS) will be available till 48 hours prior to closing date of bid participation.

3-Deposit Bid Security (EMD)

The Bid Security (EMD) can be submitted through Bank Guarantee (BG). Bidder may opt Bank Guarantee (BG) against Bid Security (EMD), for which bidder requires to prepare BG before applying in the tender. The detail of BG requires to be fed on 'Online Tender Participation' Portal of JDA before paying balance amount (Tender Fee + RISL Processing Fee). This balance amount will be paid through Payment Gateway only, option to make balance payment through EFT (RTGS/NEFT) will not be available.

4-Obtain Bid Participation Receipt

After confirming payment, the bidder will get Bid Participation Receipt based on which user will get the payment details along with other details for bidding on e-Procurement portal of GOR.

- In case of BG as the remaining payment will be done through Payment Gateway, on successful transaction the 'Bid Participation Receipt' will be generated on real time basis.
- In case complete payment is done through Payment Gateway, on successful transaction the 'Bid Participation Receipt' will be generated on real time basis.
- In case complete payment is done through EFT (NEFT/RTGS), on confirmation of payment from ICICI Bank (Auto Process) 'Bid Participation Receipt' will be available on Login of Bidder on JDA portal.

B-Bid Submission on 'e-Procurement Portal' of Government of Rajasthan**

1- Online e-Bid can be submitted after registration at e-Procurement Portal of Government of Rajasthan www.eproc.rajasthan.gov.in

2- It is mandatory to upload Bid Participation Receipt with the bid submission.

3- Details of online payment available on Tender Participation Portal of JDA have to be used in 'online payment' section of e-Procurement portal.

RajKaj Ref No.: 14852392

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Note

1- Bidder (authorized signatory) shall submit their offer on-line in electronic formats both for technical and financial proposal.
2- In case, any of the bidders fails to pay the Tender Fee, BSD, and RISL Processing Fee, online (subject to confirmation), its Bid shall not be accepted.
3- To participate in online bidding process, Bidders must procure a Digital Signature Certificate (Type III) as per Information Technology Act-2000 using which they can digitally sign their electronic bids. Bidders can procure the same from any CCA approved certifying agency, i.e., TCS, Safecrypt, nCode etc. Bidders who already have a valid Digital Signature Certificate (DSC) need not procure a new DSC. Also, bidders must register on http://eproc.rajasthan.gov.in (bidders already registered on http://eproc.rajasthan.gov.in before 30-09-2011 must register again).
4- JDA will not be responsible for delay in online submission due to any reason. For this, bidders are requested to upload the complete bid well advance in time so as to avoid 11th hour issues like slow speed; choking of web site due to heavy load or any other unforeseen problems.
5- Bidders are also advised to refer "Bidders Manual Kit" available at eProc website for further details about the e-Tendering process.
6- Training for the bidders on the usage of e-Tendering System (eProcurement) is also being arranged by DoIT&C, GoR on a regular basis. Bidders interested in training may contact e-Procurement Cell, DoIT&C for booking the training slot.

Contact No: 0141-4022688 (Help desk 10 am to 6 pm on all working days) e-mail: eproc@rajasthan.gov.in

Address: e-Procurement Cell, JDA, Yojana Bhawan, Tilak Marg, C-Scheme, Jaipur

7- The procuring entity reserves the complete right to cancel the bid process and reject any or all of the Bids.
8- No contractual obligation whatsoever shall arise from the bidding document/ bidding process unless and until a formal contract is signed and executed between the procuring entity and the successful bidder.
9- Procurement entity disclaims any factual/ or other errors in the bidding document (the onus is purely on the individual bidders to verify such information) and the information provided therein are intended only to help the bidders to prepare a logical bid-proposal.
10- The provisions of RTPPA Act 2012 and Rules thereto shall be applicable for this procurement. Furthermore, in case of any inconsistency in any of the provisions of this bidding document with the RTPP Act 2012 and Rules thereto, the later shall prevail.

Signature valid
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Designation : Executive Engineer
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18852392
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Jaipur Development Authority, Jaipur. Bid Participation Receipt	
	Date & Time:-
Bid Detail	
Bid ID: Bid Title: Bid Value:	Procurement Entity:- Bid Opening Place:
Bidder Detail	
Name of Entity: Registration Type: Payment Mode: Instrument No.:	Mobile No.: Instrument Amount: Payment Channel: Instrument Date:

Dates Detail		
Sr. No.	Event Name	Event Date
1 2	Publishing Date Bid Opening Date	

Specific Instrument for eProc Rajasthan			
Instrument Type			
Instrument Number	Head Name	Amount	Date
	Tender Fee RISL Processing Fee Bid Security Deposit		
Issuer Detail: Jaipur Development Authority		Challan Number:	

More details about Registration Process, Terms and Conditions and FAQ along with contact detail is available on JDA website www.jda.rajasthan.gov.in.

Signature valid

Digitally signed by Dilip Lamba
Designation: Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392

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AnnexureF:

जयपुर विकास प्राधिकरण, जयपुर

www.Jda.urban.rajasthan.gov.In

क्रमांक जविप्रा/अधि. अभि./त.स.नि.अ.–I/2021/डी– 75 दिनांक :–26/8/2021

To

Contractor's Association
Jaipur Development Authority
Jaipur.

जयपुर विकास प्राधिकरण में विभिन्न कार्यो हेतु कार्यो की प्रकृति के अनुसार निविदाऐं, कार्यालय आदेश क्रमांक JDA/Ex.En. (TA to Dir.Engg.-I)/2014-15/D-202 Dated:16.02.2015 द्वारा एकल बिड व Two bid में invite की जाती है। निविदाऐं प्राधिकरण की EC द्वारा अनुमोदित निविदा दस्तावेज के अनुसार की जाती है। निविदाओं के evaluation के दौरान प्रायः यह देखा जाता है कि निविदाकर्ता द्वारा निदिदा प्रपत्र में अंकित दिशानिर्देशों के अनुसार प्रस्तुत किए गये आवश्यक दस्तावेज या तो अधूरे होते है या चाहे गये प्रफोर्मा प्रपत्र के अनुसार नहीं आवेदित किए जाते है। इस कारण से कई बार निविदाएं छोटी–छोटी गलतियों की वजह से निरस्त हो जाती है या Particular bidder disqualify हो जाते हैं। कुछ सामान्य गलतियां निम्नानुसार है:–

1. Schedule 1 to 4 को नहीं भरना।
2. RTPP प्रपत्र A,B,C,D को नहीं भरना व हस्ताक्षर नहीं करना।
3. निविदा दस्तावेज विभिन्न दस्तावेजों पर स्वयं के या नोटेरी के हस्ताक्षर नही होना।
4. रजिस्ट्रेशन की प्रति नहीं लगाना।
5. EMD Receipt नहीं लगाना।
6. Work performance certificate नहीं लगाना।
7. Non Judicial Stamp पर दी जाने वाली सूचनाएं सामान्य प्रष्ठ पर देना।
8. Two bid निविदाओं में वर्ष वार कार्य की मात्राएं एवं राशि नहीं देना।
9. अनावश्यक दस्तावेज उपलब्ध कराना।
10. Online bidding के लिए आवश्यक विभिन्न शुल्क जमा नहीं कराना।
11. GST Clearance Certificate नहीं लगा होना।
12. Certificate having quantities financial year wise should not be missing.
13. Certificate of maximum value of similar nature work executed in any one last financial year out of last five financial year.
14. Annual turn our certificate by CA नहीं लगाना।
15. मशीनरी की details संलग्न नहीं करना।
16. Bid Fee, Bid Processing Fee, Tax Clearance Certificate should not be missing.
17. Completion certificate of required similar nature component is to be enclosed.
18. Litigation History Should be enclosed.
19. Information regarding existing commitments and ongoing works should be enclosed.

इस सम्बन्ध में सभी निविदाताओं को सूचित किया जाता है कि निविदाएं जमा करने से पहले निविदा प्रपत्र में अंकित व चाहि गयी सूचनाएं उचित तरीके से भर कर ही निविदा प्रस्तुत करे जिससे अनावश्यक रूप से निविदा निरस्तीकरण से बचा जा सके। त्रुटीपूर्ण निविदा की स्थिति में निविदाता स्वयं ही जिम्मेदार होंगे।

अधीक्षण अभियन्ता एवं
तक.सहा. निदे. (अभि.–प्रथम)
जविप्रा, जयपुर

रामकिशोरव्यासभवन, इन्दिरासर्किल, जवाहरलालनेहरुमार्ग,जयपुर-302004
दूरभाष- : ईपीबीएक्स - +91-141-2569696 एक्सटेंशन: (7209): फैक्स- +91-141-2574555
e-Mail : (sudhirsharma.jda@rajasthan.gov.in)

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Signature valid
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Designation: Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392
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जयपुर विकास प्राधिकरण, जयपुर

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क्रमांक जविप्रा/अधि. अभि./त.स.नि.अ.–I/2021/डी–75 दिनांक :–26/8/2021

प्रतिलिपि निम्न को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित है:–

1. निजी सचिव, आयुक्त, जविप्रा, जयपुर।
2. निजी सचिव, सचिव, जविप्रा, जयपुर।
3. निदेशक (अभियांत्रिकी–प्रथम/द्वितीय/वित), जविप्रा, जयपुर।
4. समस्त अतिरिक्त मुख्य अभियन्ता, जविप्रा, जयपुर।
5. समस्त अधीक्षण अभियन्ता,जविप्रा, जयपुर।
6. समस्त अधिशाषी अभियन्ता,जविप्रा, जयपुर।
7. रक्षित पत्रावली।

अधिशाषी अभियन्ता एवं
तक.सहा. निदे. (अभि.–प्रथम)
जविप्रा, जयपुर

रामकिशोरव्यासभवन, इन्दिरासर्किल, जवाहरलालनेहरुमार्ग,जयपुर-302004
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e-Mail : {sudhirsharma.jda@rajasthan.gov.in}

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Signature valid
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Reason: Approved

RajKaj Ref No.:
18852392
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Annexure G:

JAIPUR DEVELOPMENT AUTHORITY, JAIPUR

No. JDA/Ex.En. (TA to Dir. Engg.-I)/2015-16/D- 2744 Dated: 3/6/15

Office Order

Subject:- Amendments in provisions of tendering for single bid and two bid systems.

As per the decision taken in the 195th meeting of Executive Committee held on 22.05.2015 w.r.t. agenda no. 195:18 part 'A' related to amendments in provisions of tendering for joint venture.Following decision has been taken :-

Joint Venture limit and conditions

Procedure	Existing Procedures available due to issuance of order vide JDA/Ex.En-Pr 5& TA/2013/D-43 dated 27/02/2013	As per approve in E.C. held on 22.05.2015
Joint Venture	परियोजना में निविदा में Joint Venture हेतु कोई सम्यक मापदण्ड नहीं है। वर्तमान परिपेक्ष में 3.00 करोड़ रुपये से अधिक की निविदाओं में Joint Venture लागू किया जाता है। इसके अलावा Joint Venture विशिष्ट प्रकृति के कार्य में ही सक्षम स्वीकृति उपरान्त लागू किया जावेगा, जिसकी लागत 3.00 करोड़ रुपये से कम भी हो सकती है।	The revision in Joint Venture limit from Rs. 3.00 crore. to Rs. 10.00 crores and its conditions were approved. It was also decided that in case Joint venture is invited for works costing less than Rs. 10.00 crores, a committee comprising of Director (Engg.), Direc.. : (Finance) and Additional Chief Engineer (concerned) be authorized to give necessary approval for the same.

This order shall come in force with immediate effect and henceforth will be applicable on all the bids being issued after issuing of this order.

Conditions of Joint venture shall be as follows:-

In case the bidder comprises a joint venture or consortium, following requirements shall also be complied with:-

a. The total number of J.V. partners shall not exceed 2 (Two). They must designate lead partner duly authorized by all the members who will represent the J.V. Any of the two partners can be lead partner. The lead partner shall be nominated as being partner-in-charge and this authorization shall be evidenced by submitting power of attorney signed by the legally authorized signatories of all the partners.

b. The partner-in-charge (or, the lead partner) shall be authorized to incur liabilities and to receive instructions on the behalf of the partners of the Joint Venture, whether jointly or separately, and entire execution of the contract (including payment) shall be carried out exclusively through the partner-in-charge.

c. The share of one of the two partners shall not be less than 26% and rest of the share shall be held by other partner (For example if share of one partner is 26% then for other partner it will be 74%.) The JDA will only send communication to the lead partner, which will be deemed to have been sent to all the J.V. partners. Similarly, any negotiation and / or agreement with the lead partner shall be deemed to have been concluded with all the J.V. partners. All the members of J.V. shall be bound by the said communication and all acts/deeds of the lead member.

d. Any one of the two partners, alone, should fulfill the Technical Criteria. Similarly, any one of the two partners, alone, should fulfill the Financial Criteria. For rest of the eligibility criteria, qualifications of the two partners may be clubbed together.

e. The individual partner of J.V. alone or with other partners cannot participate in the same bid.

f. Bid capacity is to be calculated by clubbing turn over and work in hand of all the joint venture firms.

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g. Attested copy of the MoU/Agreement/power of attorney entered into by the joint venture/consortium members duly notarized, shall be submitted along with the bid with intended percentage participation nomination of lead member and division of responsibility to clearly define the work of each member etc.

h. All the members of the joint venture/consortium shall be jointly and severally liable for the execution of the Contract.

i. In the event of default by any member of the joint venture/ consortium in the execution of his part of the contract, the partner-in-charge will have the authority to assign the work to any other party acceptable to the employer to ensure the execution of the part of contract.

j. If initially the bid has purchased and submitted by the any partner or by the JV firm, in case of JV bid accepted the work order will be issued in favour of name of JV and the bidder will submit details of JV bank account to which payment is to be deposited by JDA.

k. The experience certificate will be issued as per percentage of the shareholders defined in the JV agreement of the two partners.

Any change in these conditions can be made after due approval from competent authority i.e EC.

Director (Engineering-I)
JDA, Jaipur

Copy to following for information and necessary action:-

1. PS to JDC, JDA, Jaipur.
2. PS to Secretary, JDA, Jaipur.
3. Director Engineer I/II, JDA, Jaipur
4. Director (Env.), JDA, Jaipur.
5. CE, JDA, Jaipur.
6. All Add. Chief Engineers, JDA, Jaipur.
7. All Superintendent Engineers, JDA, Jaipur
8. OSD (RM), JDA, Jaipur.
9. Additional Director (REV.&DP.)
10. CAO (P&A) JDA, Jaipur.
11. Sr. Horticulturist, JDA, Jaipur
12. All Executive Engineer, JDA, jaipur.
13. DD (L&B) JDA, Jaipur.
14. All AOs, JDA, Jaipur.
15. All AAOs, JDA, Jaipur.
16. System Analyst
17. All Contractors' Association, JDA, Jaipur.
18. Guard file

S.E. & TA to Dir. (Engg.-I)
JDA, Jaipur

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SPECIAL CONDITION OF THE CONTRACT FOR

PRE QUALIFICATION OF CONTRACTORS

Name of Work:- **Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur.**

Special conditions of contract for **PRE QUALIFICATION** as detailed here under, shall be applicable in addition to all other terms and condition already prescribed under standard agreement forms/rules and regulations to contract. These conditions are over and above all the conditions.

1. **Procedure:**

Procedure for PRE-QUALIFICATION would be as follow:

(a) Two-envelope (docket) system would be adopted, for PRE-QUALIFICATION, Docket-1 being for Technical Bid and Docket-2 being for Financial Bid.
Docket-1:- There will be three separate folders- **Folder-1** is for proof of deposition of Bid Security, cost of bidding document and bid processing fee along with copy of GST registration, Annexure "B" (RTPP Act/Rules) is mandatory to be fulfilled & signed with seal and copy of enlistment as contractor/ bidder in required category. Folder-II is for bid document and folder-III is for technical bid.

Docket-2:- There will two separate folders-1 is for financial bid and 2 is for bill of quantities.

(b) The technical bid will be opened only of whose bidders that proper Bid Security, copy of GST registration, proof for deposition of bidding document fee, RISL processing fee, copy of enlistment of contractor in required category and signed Annexure "B" are found to be in order. The bid Security will be accepted only in from of online deposition or in form of Bank Guarantee

(c) The Technical Bid envelope would be opened on the date 23.12.2025 at 3:00 PM in the chamber of Executive Engineer.

(d) The Financial Bid envelope would be opened only of those bidders who fulfill all the PRE-QUALIFICATION CRITERIA.

2. **Qualification Criteria:**

Criteria for Pre-Qualification would be as follows: -

(a) The bidder must have completed following STPs work based on SBR technology in last Seven financial year. However, the bidder may opt. current year in the said financial assessment period.

(i) At least one similar completed work of minimum 32 MLD capacity STP

Or

(ii) At least Two similar completed work each of minimum 20 MLD capacity STP

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"Similar completed work" stands for bidders having Designed, Constructed, Erected and Commissioned sewage treatment plants based on SBR Technology in India during last Seven years.

Note:-

(i) Certificate issued by Govt. of India, State Govt., Union Territory and Govt. Undertakings, Autonomous Bodies shall only be considered issued by Ex. Engineer & above or equivalent.

(ii) The bidder must enclose the GST Registration.

(b) It shall be mandatory for the bidders to submit a MOU/Technology tie up agreement duly signed and notarized on a Rs.500.00 non judicial stamp paper with a technology provider who must have a registered company in India fully equipped with trained manpower to extend services as and when required. The technology provider shall have experience of providing SBR technology and technology equipment for at One (1) no STP of 32 MLD capacity or Two (2) STPs each of 20 MLD capacity in India during last seven years and are working satisfactorily for at least three years as on Date and meeting outlet quality as required for proposed STP. The SBR Technology provider shall submit evidence / certificate signed by client, not below the rank of Executive Engineer.

MOU/Technology tie up agreement shall be uploaded as a part of technical bid. Technical bid without MOU/Technology tie up agreement shall be rejected. Date of signing of agreement shall be after the date of publishing of tender notice. 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.

(c) The bidder must have achieved an annual financial turnover of at least 60% of the estimated cost of the work (Bid Cost) in any one of the last 5 financial years (Including current year, if opted by the bidder).

Note:-

(i) The bidder must enclose certificate of Turn over from Chartered Accountant for last Five financial years & audited balance sheet of the year which is considered by the bidder in criteria 2 (c).

(ii) If current year or last year has been opted by bidder whose balance sheet is not submitted till the submission of bid then certificate from Chartered Accountant should be enclosed.

(d) The bidder should give self declaration to deploy the machinery and equipment as specified in Schedule-III for the execution of this work.

(e) Bid Capacity: Bidders who meet the minimum qualification criteria will be qualified only if available bid capacity is equal to or more than the total Bid value.

The available bid capacity will be calculated as under:

Bid Capacity= (A x N x 3 – B)

Where

A = Maximum value of civil engineering works of similar nature executed in any one year during the last seven financial years (updated to present level).

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to account the completed as well as works in progress. However, the bidder may opt current year in the Seven year assessment period.

N = Number of year prescribed for completion of the work for which bids are invited. In present case value of N shall be 2

B = Value, at present price level of existing commitments and ongoing works to be executed during 'N' period (period prescribed for completion of the works for which the bids are invited)

Note:-

(f) Certificate from Chartered Accountant shall be enclosed by bidder clearly indicated maximum value of Civil Engineering Work in one Financial Year.

(g) Litigation History: - Bidder should provide accurate information on any litigation or arbitration resulting from contracts completed or under execution by him over the last Seven years. The maximum value (updated at the present price level) of disputed amount claimed in the litigation/arbitration resulting from contracts executed in last Seven years shall be deducted from the calculated Bid Capacity of the bidder. The details shall be furnished in Schedule VI.

Note:-

(i) The present price level for turnover, cost of completed work & disputed amount of similar nature, the previous year's value shall be given weight age of 10% per year as follows :-

(a)	**For Current Year-**	**2025-26**	**1.00**
(b)	**For first last year -**	**2024-25**	**1.00**
(c)	**For second year**	**2023-24**	**1.10**
(d)	**For thirth years**	**2022-23**	**1.21**
(e)	**For Fourth years**	**2021-22**	**1.33**
(f)	**For Fifth years**	**2020-21**	**1. 46**
(g)	**For Sixth years**	**2019-20**	**1. 60**
(h)	**For Seventh years**	**2018-19**	**1. 76**

3. **Documentation** :
The bidder should furnish the following documents along with the technical bid:

(a) Information regarding financial resources and capability in Schedule –I.
(b) Information regarding works executed in the last SEVEN years in Schedule–II
(c) Certificates from the concerned Engineer–In–Charge in support and verification of the information furnished in Schedule–II
(d) Affidavit regarding machinery and equipment required for deployment as detailed in scheduled – III.
(e) Information regarding details of maximum value of civil engineering works executed during the last five years taking into account the completed as well as works in progress in schedule – IV.

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(f) Information regarding existing commitments and ongoing works to be completed in schedule – V.

(g) Information regarding details of litigation or arbitration contracts to be furnished in schedule – VI.

(h) Calculation of Bid capacity in schedule – VII.

(i) Affidavit as per Annexure I.

(j) Information regarding technical staff to be furnished in Schedule-VIII

(k) MOU/ Technology tie up agreement on Rs. 500 stamp paper with Technology Provider.

Note:- (I) The bidder must fill the power details for complete STP plant as Power guarantee already fixed by the department mentioned in the formats Schedule-VI.

(II)These schedules are mandatory to fill by the bidder, failing which the information be treated as NIL.

4. Important Notes:

(a) The bidder must ensure that all the information required in the Documents is furnished by him complete in all respects. He would not be allowed to withdraw any document, or to rectify any information furnished therein, after submitting the bid.

(b) The bidder should give an affidavit that the information furnished in schedule I, to VII is correct. If any information is found incorrect, the offer of the bidder shall be rejected and action be taken as per rules.

(c) Bidders must do paging of all enclosure of bid documents.

5. Rejection of bids

The department reserves the rights to reject any bid or to disqualify any or all the bidders, without assigning any reasons at any stage.

(i) If Bid is not accompanied with the requisite documents mentioned in clauses 3 (a) to 3 (j) or is not in accordance with procedure specified in Para 1, or is not accompanied with earnest money & GST registration of bidder in required category it would be liable for rejection.

(ii) Furnishing of incorrect or incomplete or concealment of any information required in the bid documents would render the bid liable for rejection.

(iii) The bidder shall prepare bid in the digital/ electronic mode for uploading on e-procurement portal in the format/type of file specified in evaluation qualification criteria" all the documents uploaded should be digitally signed with DSC of authorized signatory, deemed as all the pages of the uploaded documents are signed."

(iv) The self-declaration and annexure "B" enclosed by the bidder regarding qualifications of RTPP Act, 2012 and Rules, 2013 along with bid documents, should be signed by the participating bidders before uploading bid documents otherwise the bid will be rejected as per officer order No. 194 dated 06.09.2022.

6. Price Escalation :

Clause of agreement no. 45& 45A for Price Escalation variation is not applicable/payable so deleted.

Executive Engineer (PHE-I)
JDA, Jaipur

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SCHEDULE-I

FINANCIAL RESOURCES AND CAPABILITY

(Reference clause 3(a)

1. Name of Bidder:-

2. Total financial turnover achieved by the bidder in the last seven financial years;

S.No.	Year	Turnover
(1)	**2025-26**	
(2)	**2024-25**	
(3)	**2023-24**	
(4)	**2022-23**	
(5)	**2021-22**	
(6)	**2020-21**	
(7)	**2019-20**	
(8)	**2018-19**	

Note: Balance Sheets and Profit & Loss Accounts is to be enclosed by the bidder which is considered by him as per criteria 2(a).

3. Total financial Turnover projected in the current financial year.
4. Has the bidder ever been debarred from tendering for Central Government/State Government/any Government undertaking?
   Yes/No, If yes, give details.
5. Has bidder ever been declared insolvent?
   Yes/No, If yes, give details.
6. Name(s) and Address of Branch/(s) for bidder's Bankers.

I/We hereby certify that the above information is correct to the best of my/our knowledge and belief.

Date:

Signature valid
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SCHEDULE-II

(Reference clause 3(b)& 3(c)

DETAILS OF QUANTITIES OF WORKS EXECUTED DURING LAST SEVEN FINANCIAL YEARS

S. No.	Name of Works (with agreement No. & Date)	Client	Place (district/state)	Financial Year	Principal Items of workAs per 2(a)

Note:- Certificates from concerned Engineers-in-charge should be enclosed in support and verification of the above statement.

Date:

Signature valid
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Designation : Executive Engineer
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Reason: Approved

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SCHEDULE-III

(Reference clause 3(d)

Attested photo of the bidder

Self Declaration

I/We……..Proprietor/Partner/ Authorized signatory of M/s…….under take the oath that I/We will deploy the machinery and equipment listed below as and when required in the execution of this work.

S. No.	Name of Machinery	Minimum Requirement	Availability	
			Owned	Leased
1.	Total stations /Auto level	2		
2.	Poklain	1		
3.	Hydra 20 T	2		
4.	JCB	2		
5.	Dumper	6		
6.	Vibrator (Needle/ Plate / screed)	2		
7.	Water Tanker	2		
8.	Tractor with Trolley	2		
9.	Sensor Paver	1		
10.	Vibratory Roller	2		
11.	Static Roller	2		
12.	Earth Compactor	1		

I/We hereby certify that the above information is correct to the best of my/our knowledge and belief.

Signature of Bidder

Note:- This self declaration is mandatory to be signed by the bidder failing which the bid shall summarily be rejected without asking any clarification.

Signature valid
Digitally signed by Dilip Lamba
Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392
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SCHEDULE-IV

(Reference clause 3(e)

DETAILS OF MAXIMUM VALUE OF CIVIL WORKS EXECUTED IN ANY ONE YEAR DURING LAST SEVEN YEARS.

FINANCIAL YEAR IN LAST SEVEN YEARS	COST OF WORK EXECUTED IN FINANCIAL YEAR

Signature valid
Digitally signed by Dilip Lamba
Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392
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SCHEDULE-V

(Reference clause 3(f)

DETAILS OF EXISTING COMMITMENTS & ON GOING WOERKS TO BE COMPLETED

S. No.	Name of Works (with agreement No. & Date)	Client	Cost of work as per Work Order	Stipulated date of commencement	Stipulated date of completion	Value of balance work on date of tender	Likely date of completion of balance work

Signature valid
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Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392
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SCHEDULE-VI

(Reference clause 3(g)

DETAILS OF LITIGATION OR ARBITRATION CONTRACTS

S. No.	Name of Works (with agreement No. & Date)	Client	Work Order	Disputed Amount claimed in Litigation/ Arbitration	Date of Raising Disputed Amount	Actual Award Amount, if the case is Decided	Cause of Litigation & matter in Dispute

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Signature valid
Digitally signed by Dilip Lamba
Designation : Executive Engineer
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SCHEDULE-VII

(Reference clause 3(h)

BID CAPACITY

1.	A= Maximum value of civil Engineering works Executed in any one year during the last Seven Years (Updated to present price level)	……Lacs	Certified details enclosed at Page No…….
2.	N= Number of years prescribed for completion of the work for which bids are invited	2.0	
3.	B= Value, at present price level of existing Commitments and ongoing works to be Completed during the next N Period.	……Lacs	Certified details enclosed at Page No…….

Bid Capacity= A x N x 3-B

= ……Lacs

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Attested photo of the bidder

Schedule- VIII

(Reference clause 3(J)

Details Regarding Evaluation Criteria

Name of work :- Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur".

S. No.	Item	Minimum Requirement (As per Bid)	Remark	Year	Qty.	Page No.
1	Copy of GST Reg. Certificate					
2	Copy of Registration certificate					
3	1. Proof of Bid Security deposition 2. Proof of bidding document cost deposition 3. Proof of RISL fees deposition.					
4	As per Clause 2A of Pre Qualification					
5	As per Clause 2B of Pre Qualification					
6	The bidder should have achieved an annual financial turnover of at least Rs. 60% Lacs of the work (Bid cost) in any one of last five financial year (including current year)					
7	The bidder should give declaration to deploy the machinery and equipment as specified in schedule-III, for the execution of this work. Duly Self attested.					
8	Bid Capacity (AxNx3-B) Here A is Maximum value of civil engineering work executed in any one of last 7 financial years. N is number of Years Prescribed for completion of the work. B is value at present price level of existing commitments and ongoing.					
9	Declaration in support of information finished by bidder in Annexure-I					
10	Schedule-VI (Details of Litigation).					
11	Signed Annexure "B"(RTPP Act/Rules)					

Note:- This sheet must be prepared and submitted by the bidders.

Signature valid

Digitally signed by Dilip Lamba
Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392
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Self Declaration

I/We……Proprietor/Partner/Authorized signatory of M/s……..under take the oath that the information furnished by me/us in schedule I to VIII of the assessment Bid for……is correct to the best of my/our knowledge. If any information id found to be incorrect JDA has right to reject the Bid and to take action against me/us as per rules.

…….

Proprietor/Partner/Authorized signatory

M/s……

……

Note:- This Self Declaration is mandatory to be signed by the bidder failing which the bid shall summarily be rejected without asking any clarification.

Signature valid

Digitally signed by Dilip Lamba
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TECHNOLOGY TIE-UP/MOU AGREEMENT WITH TECHNOLOGY PROVIDER

(To be made on Rs. 500 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 **"Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur".**

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 for ……

Signature valid
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Designation: Executive Engineer
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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 if required on a chargeable basis.

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 **Rajasthan** 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.

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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 **Rajasthan**.

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'**

For **'YYY'**

(Authorized Signatory)

Name:

Designation:

(Authorized Signatory)

Name:

Designation:

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GENERAL INFORMATION OF TENDERER

ANNEXURE 3

Refer clause 6(IV, 1) of Special Conditions of Contract for Pre-qualification of contractors.

A. BIDDER INFORMATION SHEET		
BIDDER s Legal Name	Sole Proprietorship Firm/Partnership Firm /Private Limited Company/Public Limited Company/ Joint Venture/Consortium	
In case of single entity, ownership & control of the Tenderer		
In case of JV/Consortium, Legal name of each partner with percentage participation (also Provide information of each member in separate sheet (page 2 of 2)	Legal Name of JV/Consortium member	% participation
Lead member of JV/Consortium,		
Bidder's actual or intended country of constitution		
Bidder's legal address, telephone numbers, fax numbers, e-mail address.		
Bidder's authorized representative or person-in-charge in case of JV/Consortium, (name, designation address)		

SIGNATURE OF AUTHORIZED SIGNATORY

ON BEHALF OF BIDDER

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B. JV/CONSORTIUM MEMBER INFORMATION	
JV/Consortium Member of Legal Name	
Legal status of the JV/Consortium Member	Sole Proprietorship Firm/Partnership Firm /Private Limited Company/Public Limited Company
Ownership & control of the JV/Consortium Member	
JV/Consortium Member country of constitution	
JV/Consortium Member of legal address, telephone numbers, fax numbers, e-mail address)	
JV/Consortium Member's authorized representative (name, designation address)	

ATTACH ATTESTED COPIES OF FOLLOWING ORIGINAL DOCUMENTS

- Document in support of legal status and ownership & control of the bidder or each member in case of JV/Consortium (undertaking for sole proprietorship/ partnership deed/ Memorandum & Articles of Association
- In case JV/Consortium, submit MoU/Agreement (duly notarized) entered into by the joint venture/consortium members, containing intended percentage participation, nomination of Lead Member and division of responsibility to clearly define the work of each member etc.
- Authorization/POA in favour of authorized representative of tenderer to represent the bidder and also in favour of authorized representative of each member in case of JV/Consortium

SIGNATURE OF AUTHORIZED SIGNATORY

ON BEHALF OF BIDDER

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ANNEXURE 4

(Refer Clause 7)

Bid Evaluation Sheet

Name of Work:-Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur.

S.No.	Criteria	Required Qualification	Bidders qualification	Bidders uploaded document Page No.	Remark
1	2	3	4	5	6
1	Registration Certificate - As per Clause 1e of Special Conditions of Contract for Qualification.	The bidder should have a validRegistration Certificate in "AA" class in JDA/ and AA or equivalent class in Any central Government Department/ State Government Department/ Local body/ Railways, undertakings/corporations, Autonomous Bodies which are owned or control and managed by the State Government and Government undertakings of the Central Government.			
2	GST Registration	GST registration certificate.			
3	Fee Payment Details				
(i)	Cost of Bid Document	Rs.5000			
(ii)	Bid Processing Fee	Rs. 2500			
(iii)	Bid Security Declaration form				
4	for Qualification.				
I 2 (a)	The bidder must have completed following STPs work based on SBR technology in last Seven financial year. However, the bidder may opt. current year in the said financial assessment period. (a) At least one similar completed work of minimum 32 MLD capacity STP. Or (b) At least Two similar completed work each of minimum 20 MLD capacity STP. **"Similar completet work" stands for bidders having Designed, constructed, erected and commissioned sewage treatment plants based on SBR Technology in**				

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	India during last Seven years."				
II 2 (b)	It shall be mandatory for the bidders to submit a MOU/Technology tie up agreement duly signed and notarized on a Rs.500.00 non judicial stamp paper with a technology provider who must have a registered company in India fully equipped with trained manpower to extend services as and when required. The technology provider shall have experience of providing SBR technology and technology equipment for at One (1) no STP of 32 MLD capacity or Two (2) STPs each of 20 MLD capacity in India during last seven years and are working satisfactorily for at least three years as on Date and meeting outlet quality as required for proposed STP. The SBR Technology provider shall submit evidence / certificate signed by client, not below the rank of Executive Engineer. MOU/Technology tie up agreement shall be uploaded as a part of technical bid. Technical bid without MOU/Technology tie up agreement shall be rejected. Date of signing of agreement shall be after the date of publishing of tender notice. 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.				
5 2 (c)	The bidder should have achieved an annual financial turnover of at least 60 % of the estimated Cost of the work (bid cost) in any one of last Five financial years (including current year, if opted by the bidder). As per Clause 2(c) of Special Condition.				
A	Annual Turn over				

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B	Financial Year	To be submitted & uploaded by bidder with signature			
6 **3 (d)**	Affidavit to deploy machinery and equipment as specified in Schedule -III, As per Clause 2d of Special Conditions.	To be submitted & uploaded by bidder with signature			
7 **3 (h)**	Bid Capacity=(A x N x 3 - B) As per Clause 2e of Special Conditions.	To be submitted & uploaded by bidder with signature			
(i) **3 (e)**	A= Maximum value of civil engineering works executed in any one year during the last Five financial years.	To be submitted & uploaded by bidder with signature			
(ii)	N= 2.0 years				
(iii) **3 (f)**	B=Value at present price level of existing commitments and ongoing works to be executed during "N" period.	To be submitted & uploaded by bidder with signature			
8 **3 (g)**	Litigation History- As per Clause 2 (g) of Special Conditions.	To be submitted & uploaded by bidder with signature			
9 **3 (j)**	Affidavit for Correctness of documents Clause 3(j)	To be submitted & uploaded by bidder with signature			
10 **3 (k)**	Declaration by bidder under RTTP Act. (Annexure A, B, C, D)	To be submitted & uploaded by bidder with signature			
11 **3 (i)**	Information regarding technical staff to be furnished in Schedule-VIII	To be submitted & uploaded by bidder with signature			

Signature of Bidder with Seal

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Jaipur Development Authority Jaipur

Name of Work: Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur

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ITB & GCC

Executive Engineer –(PHE-I)

Jaipur Development Authority

Jaipur

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VOLUME-I

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SECTION – 1

(Instructions to Bidders)

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SECTION – 1

INSTRUCTIONS TO BIDDERS

SECTION – 1

INSTRUCTIONS TO BIDDERS

1.1 SCOPE OF WORK

1.1.1 **Percentage Rate Bids** are invited from eligible contractors for the

Name of work: Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur.

1.0 COST OF BID DOCUMENTS, BID PROCESSING FEE AND BID SECURITY

The bidder shall bear all costs associated with the preparation and submission of the bids for the works and Jaipur Development Authority will, in no case, be responsible or liable for any such costs, regardless of the conduct or outcome of the bid process.

1.2.1 Process for participation & Depositing Payment Online

Jaipur Development Authority, has decided to receive Bidding document fee, RISL Processing Fee and Bid Security Deposit (BSD) through online mode only for which the bidder has to get registered himself on JDA portal www.jaipurjda.org.

To participate in the bid, bidder has to be:

1. Registered on JDA website www.jaipurjda.org. (by depositing Rs.500.00 online, the validity of which remains 3 (three) years.)
   For participating in the Bid, the Bidder has to apply for this Bid and pay the bid Document Fee, RISL Processing Fee and Bid Security Deposit online only.
2. Registered on e-Procurement Portal of Government of Rajasthan www.eproc.rajasthan.gov.in for online e-Bid submission.
   Methods for depositing online amount.

- Online through internet Banking, Debit card or Credit Card.
- In case the amount exceeds the online payment limit, the payment may be made through RTGS/NEFT/Transfer in Bank Account Number **675401700586** IFSC Code **ICIC 0006754** of ICICI Bank limited, JDA Campus Jaipur.

In Case of RTGS/NEFT/Transfer the bidder is required to deposit the requisite amount in the dedicated bank account number as mentioned above and has to get the UTR/ Reference number from the bank. This number requires to be updated whiling applying the bid on JDA portal.

While participation in the bid, a receipt will be generated through the system showing the submission details as per Annexure-4. The bidder is required to fill the details.

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for various heads on e-procurement portal www.eproc.rajasthan.gov.in as mentioned in the receipt.

More details about Registration Process, Terms and Conditions and FAQ along with contact details is available on JDA website www.jaipurjda.org under e-Services>>JDA tender.

NOTE: JDA will not be responsible for delay in online submission due to any reason. To avoid this, bidders are requested to upload the complete bid well advance in time so as to avoid 11th hour issues like slow speed, chocking of web site due to heavy load or any other unforeseen problems.

1.3 SITE VISIT

1.3.1 The bidder shall, prior to submitting his bid for the work, visit and examine the Site of works and its surroundings at his own expense and obtain and ascertain for himself on his own responsibility all information that may be necessary for preparing his bid and entering into a Contract - including, the actual conditions regarding the nature and conditions of site, availability of materials, labour, probable sites for labour camps, stores, etc., and the extent of lead and lift required for the work in complete form over the entire duration of the Contract after taking into consideration local conditions, traffic restrictions, obstructions in work, if any, and allow for all expenses likely to be incurred due to any such conditions, restrictions, obstructions, etc., in the quoted Contract price for the work.

1.3.2 A bidder shall be deemed to have full knowledge of the site, whether he inspects it or not, and no extra charges consequent on any misunderstanding or otherwise shall be allowed.

1.3.3 The bidder and any of his personnel or agents will be granted permission by the Director (Engineering) or his authorized nominee, on receipt of formal application in respect thereof a week in advance of the proposed date of inspection of site, to enter upon his premises and lands for purpose of such inspection, but only on the express condition that the Bidder, his personnel or agents, will release and indemnify, the Employer and his personnel and agents from and against all liability in respect thereof and will be responsible for personal injury (whether fatal or otherwise), loss of or damage to property and any other loss, damage, costs and expenses however caused which, but for the exercise of such permission, would not have arisen.

1.4 CONTENTS OF BID DOCUMENTS

1.4.1 The set of Bid Documents issued for the purpose of biding shall comprise the following :

SECTION	DESCRIPTION
SECTION-1	INSTRUCTIONS TO BIDDERS
SECTION-2	GENERAL CONDITIONS OF CONTRACT
SECTION-3	OTHER CONDITIONS OF CONTRACT
SECTION-4	TECHNICAL SPECIFICATIONS
SECTION-5	FORM OF AGREEMENT
SECTION-6	BANK GAURANTEE

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1.4.2 The bidder is expected to examine carefully all instructions, conditions, forms, terms, and performance specification and drawings in the Bid Documents. Failure to with the requirements of Bid submission shall be at the Bidder's own risk. Pursuant to clause 1.18, bids which are not substantially responsive to the requirements of the Bid documents shall be summarily rejected.

1.4.3 At any time prior to the last date for submission of bids, the employer may, for any reason whether at his own initiative or in response to a clarification requested by a prospective bidder, modify the Bid Documents by the issuance of an Addendum.

1.4.4 The Addendum will be prepared in writing and uploaded on E- Tendering portal for information of all prospective Bidder who wish to participate, and will be binding upon them, irrespective of whether the prospective bidder acknowledge receipt of the same or not.

1.4.5. The forms, Bill of Quantities, Performa and schedules provided in these Bid Documents shall be filled without exception (subject to extensions of the schedule in the same format).

1.4.6 The bid prepared by the bidder, and all correspondence and documents relating to the bid exchanged by the Bidder and the Employer, shall be written in the English language only. Supporting documents and printed literature furnished by the bidder may be in another language provided they are accompanied with an appropriate translation of pertinent passages in English language. For the purpose of interpretation of the Bid, the English language shall prevail.

1.5 BID PRICES

1.5.1 Unless explicitly stated otherwise in the Bid Documents, the contract shall be for the whole work based on the departmental design, Bill of quantities, rates and prices submitted by the Bidder.

1.5.2 The Bidder shall fill in **percentage rate as detailed in BOQ** of works described in the Bill of Quantities in both figures and words. In case, there is any discrepancy in the rates quoted in figures and words, the rate quoted in words will be applicable**.**

If on check there are discrepancies the following procedure shall be followed:-

(i) Where there is a difference between the rates in figures and words, lower of the two rates shall be taken as valid and correct rate.

(ii) When the rate quoted by the contractor in figures and in words tallies, but the amount is not worked out correctly, the rate quoted by the contractor shall be taken as correct and not the amount worked out.

(iii) While quoting rates, if rate/rates against any item or items are found to be omitted, the rate given in the Schedule 'G' by the department for such items will be taken into account while preparing comparative statement and contractor shall be bound to execute such item on 'G' Schedule rates.

In case where percentage is given but the 'above' or 'below' not mentioned, tender will be non-responsive.

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The Contractor should quote his rates only in one language i.e. either in Hindi or English. Rates should be quoted in figures as well as in words. In case a Contractor has quoted rates in both the languages, and the rates so quoted differ, then the lower of the two shall be treated as the rate quoted by the Contractor.

1.5.3 All duties, taxes, fees and other levies (present and future) payable by the contractor under the Contract, or for any other cause, as on the date thirty days prior to the closing date for submission of bids, shall be included in the total Contract Price submitted by the Bidder and the evaluation and comparison of Bids by the Employer shall be made accordingly.

1.6 **BID SECURITY**

Amount (INR) : 2% (Rs. 1,79,42,280/-) for AA class contractor or equivalent contractor registered in other Govt. department and 0.5% (44,85,570/-) for AA Class contractor enlisted in JDA. In case of JV 2% shall be deposited by bidder (JV firm)
Bidder may opt Bank Guarantee (BG) against EMD (Bid Security), for which bidder requires to prepare BG before applying in the tender. The details of BG requires to be fed on JDA portal before paying balance amount (Tender Fee + RISL Processing Fee). This amount will be paid through Payment Gateway only, option to make balance payment through EFT (RTGS/NEFT) will not be available.

1.7 VARIATIONS OR DEVIATIONS IN BID DOCUMENTS

1.7.1 The Bidder shall submit an offer which complies fully with the basic requirements of the Bid Documents as indicated in Drawings and Specifications.

1.7.2 All bidder are cautioned that no conditional offers, variations or deviations by the bidder in respect of any items proposed by the bidder shall be entertained or considered further in the process of bid evaluation. Furthermore, any deviation from contract conditions, specifications, or other requirements stipulated in these Bid Documents shall be summarily rejected as non-responsive.

1.8 VALIDITY OF BID

1.8.1 The Bid shall remain valid for a period of 120 days after the date of opening of bid.

1.8.1 In exceptional circumstances, prior to expiry of the original bid validity period, the Employer may request the Bidder for a specified extension in the period of validity. The request and the responses thereto shall be made in writing through post, fax etc. A bidder may refuse the request without forfeiting his Earnest Money. A bidder agreeing to the request will neither be required nor permitted to modify his bid, but will be required to extend the validity of his Earnest Money correspondingly. The provision of Clause 1.6 regarding discharge and forfeiture of earnest money shall continue to apply during the extended period of bid validity.

1.9 FORMAT AND SIGNING OF BIDS

1.9.1 If the Bid is made by a proprietary firm, it shall be signed by the proprietor with his full name and the full name of his firm with its current address.

1.9.2 If the bid is made by a firm in partnership, it shall be signed by a partner holding the power of Attorney for the firm. A certified copy of the power of Attorney shall accompany the Bid. The Certified copy of the partnership deed, current address of the firm and full name and current address of all the partners of the firm shall also accompany the Bid.

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1.9.3 If the bid is made by a private limited company or a public limited corporation, it shall be signed by a duly authorized person holding the power of attorney for such limited company or corporation. A certified copy of the Power of Attorney shall accompany the Bid. Such Limited company or corporation may be required to furnish satisfactory evidence of its existence before the contract is awarded.

1.9.4 The bid shall be typed or written in indelible ink and shall be signed by a person or persons duly authorized to sign the Bidder legally to the contract in all respects. Proof of such authorization shall be furnished in the form of a written Power of

Attorney which shall accompany the Bid on stamp paper duly notarized. All pages of the Bid where entries or amendments have been made shall be initialed by the person or persons signing the Bid.

1.9.5 The complete bid shall be without alterations, interlineations or erasures, except those to accord with instructions issued by the Employer or as necessary to correct errors made by the Bidder, in which case such corrections shall be initiated by person and persons signing the Bid.

1.10 SEALING AND MARKING OF BIDS

1.10.1 The Bidder shall SUBMIT the Bid THROUGH E-TENDERING ONLY.

1.11 DEADLINE FOR BID SUBMISSION

1.11.1 Bids must be submitted by bidders on E-Tendering portal not later than 6:00PM I.S.T on 17.12.2025, and bid shall be opened at 3:00PM I.S.T on 23.12.2025 in the presence of those bidders who may choose to be present. If such last date is declared as a public holiday by the Employer in the Receiving Office, the next official working day would be deemed as the last date for submission and opening of the bids.

1.11.2 Any Bid submitted by the bidder without depositing requisite fee on the due date and time will not be opened and shall be treated as non-responsive and thus, rejected.

1.11.3 The bidder shall have to submit the original affidavits etc. and other documents uploaded in the Technical Bid as and when demanded by JDA.

1.11.4 **JDA will not be responsible for delay in online submission due to any reason. For this, bidders are requested to upload the complete bid well advance in time so as to avoid 11th hour issues like slow speed: chocking of web site due to heavy load or any other unforeseen problems.**

1.12 MODIFICATION AND WITHDRAWAL OF BIDS

1.12.1 The Bidder may modify or withdraw his bid after bid submission, provided that the modification or notice of withdrawal is received in writing by the Employer in the office of the Director(Engineering-I), Jaipur Development authority, prior to the prescribed deadline for submission of Bids.

1.12.2 The Bidder's modification or notice of withdrawal shall be prepared, sealed, marked and delivered in accordance with the provisions of Clause **1.11** for submission of Bids, with the inner envelopes additionally marked "MODIFICATION" or "WITHDRAWAL" as appropriate.

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1.12.3 Modifications to Bid will be permitted only pursuant to Clause **1.13.1** above. Any subsequent set(s) of modifications will be summarily rejected.

1.12.4 No Bid shall be modified by the Bidder subsequent to the deadline for submission of the Bids, failing which the Earnest Money Deposit shall stand forfeited.

1.12.5 No Bid shall be withdrawn in the interval between the deadline for submission of bids and the expiry of the period of validity of bids specified in the Bid Documents. The withdrawal of bid in any form whatsoever during this interval shall entail the forfeiture of the Earnest Money Deposit pursuant to Clause **1.6,** without any further notice or opportunity to the bidder and without prejudice to any other legal rights and remedies open to the Employer.

1.13 BID OPENING & EVALUATION

1.13.1 Bids, including submissions made pursuant to Clause **1.14** shall be opened by the committee of **Superintendent Engineer-X** or his authorized representative on behalf of the Employer, in the presence of such of the Bidder representatives who choose to attend, at 3:00 PM I.S.T. on 23.12.2025 and at the following address:-

Room No.133, MBFF, Main Building,

Jaipur Development Authority

Indira Circle, Jawahar Lal Nehru Marg

Jaipur – 302004(Rajasthan)

The Bidder's representatives who are present shall sign a register giving evidence to their attendance.

1.13.2 Bids for which an acceptable Notice of withdrawal had been submitted pursuant to Clause **1.12.1** shall not be opened. The Employer will examine bids to determine whether they are complete, whether the requisite bid securities have been furnished, whether the documents have been properly signed and whether the bids are generally in order.

1.13.6 At the Bid Opening the Employer will announce only the Bidders' names, the Bid Prices, written notification of Bid modifications and withdrawals (if any), the deposit of the requisite Earnest Money Deposit, and such other details as the Employer, at his discretion, may consider appropriate.

1.13.7 Minutes of the bid opening including the information disclosed to those present in accordance with sub-clause **1.14** shall be prepared by the Employer for records. and the process of bid opening shall be transparent.

1.13.8 After the public opening of bids, information relating to the examination, clarification, evaluation and comparison of bids and recommendations concerning the award of contract shall not be disclosed to bidders or other persons not officially concerned with such process.

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1.13.9 Any efforts by a bidder to influence the Employer in the process of examination, clarification, evaluation and comparison of bids, and in decisions concerning award of contract, may result in the rejection of the Bidder's bid. Any proved act or attempt by any bidder in breach of the above may immediately entail delisting without prejudice to any other legal rights and remedies available to the Employer.

1.14 CLARIFICATION OF BIDS

1.14.1 To assist in the examination, evaluation and comparison of bids, the employer may ask the Bidders individually for clarifications of their bids as per order issued in JDA vide No.-169 dated 21.11.2014.

1.15 CORRECTION OF ERRORS

1.15.1 Tenders determined to be substantially responsive will be checked by the Employer for any arithmetical errors in computation and summation. The Employer will correct errors as follows:

a) Where there is a discrepancy between the amounts in figures and in words, the amount in words will govern ;

b) In case of any discrepancy between the descriptions in the Scope of Work, Specifications, Drawings, Drawings of Contract and Bill of Quantities, the following order of preference in descending order of importance, shall prevail :

1. Description of Work
2. Specification
3. Drawings
4. Conditions of Contract
5. Bill of Quantities

1.15.2 The amount in the 'Form of Bid' will be adjusted by the Employer in accordance with the above procedure for the correction of errors and, with the concurrence of the bidders, shall be considered as binding upon the bidders. If a bidder does not accept the corrected amount of bid, his bid shall be rejected and the tender Earnest Money shall be forfeited.

1.16 EVALUATION AND COMPARISON OF BIDS

1.16.1 The Employer will evaluate and compare only those bids determined to be substantially responsive to the requirements of the Bid Documents in accordance with Clauses **1.15** and **1.16** hereof and Bid Evaluation Sheet at Annexure 3, duly filled by bidder.

1.16.2 In evaluating bids, the Employer will determine for each bid its Evaluated Bid Price by adjusting the Bid Price by making any corrections for errors in accordance with clause **1.15,** by making an appropriate adjustment for any other applicable or quantifiable variations not reflected in the priced bid in accordance with clause **1.15** and such other factors as the Employer deems necessary.

1.16.3 If the bid of the successful bidder is seriously unbalanced or 'front-loaded' in relation to the Engineer-in-Charge's estimate of the real cost of the work performed under the contract (as determined by the Engineer-in-charge) by the

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than the amount of the performance security, the Employer may require that the amount of the performance security be increased at the expense of the successful bidder to a level sufficient to protect the Employer against financial loss in the event of subsequent default of the successful bidder under the Contract.

1.16.4 Variations, deviations and other factors which are in excess of the requirements of the Tender Documents, or otherwise result in the accrual of unsolicited benefits to the Employer, shall not be taken into account in the tender evaluation.

1.16.5 The comparison of the bid values shall be based on THE EVALUATED PRICE OF THE BIDDER. The evaluated price shall include **Capital Cost (*includes 3 months trial run followed by 1 year O&M*) + 10 years O&M Cost + (1+10) years Electricity Cost** as described under below:

a) Capital Cost (*includes 3 months trial run followed by 1 year O&M*): The Total Price of the Plant, Instruments and Equipment's offered including Civil Works including pipeline works and completion of all facility as specified in the Tender documents. Such price to include all costs as well as taxes, duties and other levies, plus the cost of transportation, Insurance, all installation and other services required under the contract. However, the price of recommended spare parts if quoted on request by the Owner shall not be considered for evaluation of Bids.

b) O&M Cost: Includes Cost Chemicals, maintenance, sludge disposal, Utilities and Manpower and all costs of O&M will be considered for evaluation of prices.

c) Electricity Cost: Includes cost of electricity to operate the plant during (1+10) years of O&M.

Following rates shall be considered for working out lifecycle cost.
Base rate of Electricity@Rs.10.0/KWH

1.17 AWARD OF CONTRACT CRITERIA

1.17.1 Subject to clause **1.19,** the Employer will award the contract to the bidder whose tender has been determined to be substantially responsive to the Tender Documents and who has offered the lowest Evaluated Tender Price PROVIDED FURTHER that, in the opinion of the Employer, the bidder has the capability and resources to carry out the Contract work effectively.

1.18 EMPLOYER'S RIGHT TO ACCEPT ANY TENDER AND TO REJECT ANY OR ALL TENDERS.

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

1.19 NOTIFICATION OF AWARD OF CONTRACT

1.19.1 Prior to the expiry of the period of tender validity prescribed, the Employer will notify the successful bidder by telegram / cable / fax or

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(and subsequently confirm in writing by Registered Letter) that his tender has been accepted. This letter called "Letter of Acceptance" shall name the sum which the Employer will pay to the Contractor in consideration of the execution, completion and maintenance of the work by the Contractor as prescribed by the Contract (called the "Contract Price").

1.19.2 The Letter of Acceptance will form part of the Contract and agreement executed between the parties in accordance with the Form of Agreement provided in the Bid Documents.

1.19.3 Upon furnishing by the successful bidder of a Performance Security in accordance with the provisions of the special conditions of contract, the Employer will promptly notify the unsuccessful bidders that their bids have been unsuccessful and will discharge / return without interest.

1.20 SIGNING OF AGREEMENT

1.20.1 At the same time as he notifies the successful Bidder that his Bid has been accepted, the Employer will instruct the successful bidder to sign and execute the agreement within fourteen (14) days of issue of the Letter of Acceptance.

1.21 **FAILURE TO EXECUTE AGREEMENT**

The contractor shall execute the agreement within fourteen (14) days of issue of Letter of Acceptance, failure to do so shall constitute sufficient grounds for the annulment of the award of contract and forfeiture of the Earnest Money Deposit.

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SECTION – 2

(General Conditions of Contract)

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SECTION - 2

GENERAL CONDITIONS OF CONTRACT

DEFINITIONS

1. The "Contract" means the documents forming the bid and acceptance thereof and the formal agreement executed between the Jaipur Development Authority and the Contractor, together with the documents referred to therein, including these conditions, Notice inviting Bids, Instructions to Bidders, Special Conditions of Contract, Specifications, Drawings and Designs, Tender and other information submitted by the Contractor and instructions issued from time to time by the Engineer-in-charge and all these documents taken together shall be deemed to form one contract and shall be complementary to another.

2. In the contract the following expressions shall, unless the context otherwise requires, have the meanings herein respectively assigned to them :-

   a) The "WORKS OR WORK" shall, unless there be something either in the subject or context repugnant to such construction, be construed and taken to mean the works by, 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 an/or the 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 "CONTRACTOR" shall mean the individual or firm or company, whether incorporated or not, undertaking the works and shall include the legal personal representatives of such individual or the persons composing such firm or company, the successor of such firm or company and the permitted assign of such individual or firm or company.

   d) The "ENGINEER-IN-CHARGE" shall mean the Executive Engineer In charge of Jaipur Development Authority who shall supervise and be in-charge of the work.

   e) The "GOVERNMENT","DEPARTMENT" shall mean the Jaipur Development Authority.

   f) The "Accepting Authority" shall mean Executive Committee of Jaipur Development Authority.

   g) The "Director" or "Chief Engineer" shall mean The Director (Engineering-I) of Jaipur Development Authority.

   h) The 'Superintending Engineer' shall mean the Superintending Engineer of Jaipur Development Authority.

   i) "ESTIMATED COST" shall mean the cost of the work or works as estimated on the basis of the TENDERED rate or rates agreed to between the parties to the contract.

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j) Where the context so requires, words importing the singular only also include the plural and vice-versa. Any reference to masculine gender shall wherever required include feminine gender and vice versa.

k) Headings and marginal notes to these General Conditions of Contract shall not be deemed to form a part thereof or be taken into consideration in the interpretation or construction thereof or of the contract.

The clause 23 of contract agreement i.e. standing committee for settlement of disputes is read as:

If any question, difference or objection, whatsoever shall arise in any way, in connection with or arising out of this instrument, or the meaning of operation of any part thereof, of the rights, duties or liabilities of either party men, save in so far, as the decision of any such matter, as herein before provided for, and been so decided, every such matter/ constituting a total claim of Rs. 50,000/- or above, whether its decision has been otherwise provided for an whether it has been finally decided accordingly, or whether the rights or obligations of the parities, as the result of such termination, shall be referred for decision to the empowered standing committee, which would consist of the followings:

(i) Jaipur Development Commissioner, JDA, Jaipur -Chairman
(ii) Director Engineering-I, JDA, Jaipur
(iii) Director (Finance), JDA, Jaipur
(iv) Director (Law), JDA, Jaipur
(v) Superintending Engineer, JDA, Jaipur - Member Secretary

The Engineer-in-Charge, on receipt of application along with nonrefundable prescribed fee, (the fee would be two percent of the amount in dispute, not exceeding Rs. One lac) from the contractor, shall refer the disputes to the committee within a period of three months from the date of receipt of application.

The contractor shall be furnished, free of cost one certified copy of the contract documents except standard specifications. Schedule of Rates and such other printed and published documents, together with all drawings as may be forming part of the Bid Documents. None of these documents shall be used for any purpose other than that of this contract.

Procedure and application form referring cases for settlement by the Standing Committee shall be, as given in form RPWA 90.

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AGREEMENT No. .....

Year 20

..... Circle.

Division .....

Sub- Division .....

Name of Work .....

Name of Contractor .....

Sanction No. ..... Dt..... RS. .....

Technical Sanction No. .....

Job No. .....

(a) Stipulated Date of Start of work .....

(b) Stipulated Date of Completion of work .....

(c) Actual Date of Completion .....

Extension applied on &sanctioned .....

Vide: C.E. /S.E. /E.E. No..... Dt. 20

Details of Documents Page :

(a) Percentage Rate Tender R.P. W.A. 100

(See rule 322 & note 1 below rule 331)

(b) Schedule A to F

(c) Schedule H

(d) Schedule G

(e) Schedule

(f) General Specification and Conditions of Contract

(g) Contractor's Labour Regulations

(h) .....

(i) .....

No.

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1. Director Engineering-I/ (Finance), JDA, Jaipur
2. Additional Chief Engineer, JDA, Jaipur
3. Additional Director (Revenue)/CAO, JDA, Jaipur
4. The Assistant Engineer / JEN
5. Auditor
6. Shri ..... Contractor
7. M/s .....

Amended up to _____ Effective from _____

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CONTRACT FOR WORK

GENERAL RULES AND DIRECTIONS FOR THE GUIDANCE OF CONTRACTORS

1. All works, proposed for execution by Contract, will be notified in a form of invitation to tender pasted on public places and on a board hung up in the office of and signed by the JDA or other duly authorized Engineer.

   The form of invitation to bid will state the work to be carried out, as well as the date of submitting and opening of bids and the time allowed for arraying out the work, also the amount of Earnest Money to be deposited with the bid and the amount of the Performance Guarantee and/or Security Deposit to be deposited by the successful bidder and the percentage, if any, to be deducted from bills. Copies of the specifications, designs and drawings and estimated rates/scheduled rates and any other documents required in connection with the work signed for the purpose of identification by the Executive Engineer shall be open for inspection by the Contractor at the office of the JDA or other duly authorized Engineer during office hours.

2. In the event of the bid being submitted by a firm, it must be signed separately by each partner, thereof, or in the event of the absence of any partner, it must be signed on his behalf, by a person holding a power of Attorney, authorizing to do so. Such power of Attorney will be submitted with the bid and it must disclose that the firm, is duly registered under the Indian Partnership Act, by submitting the copy or registration certificate.

3. Receipts for payments, made on account of a work when executed, by a firm must also be signed by the several partners, except where the contractors and described in their bid as a firm, in which case the receipts must be signed in the name of the firm by one of the partners or by some other person having authority to give effectual receipts for the firm.

4. Any person, who submits percentage rate bid, shall fill up the usual printed form stating at how much percent above or below the rates specified in Schedule G. he is willing to undertake the work. Only one rate of percentage, more or less, on all the estimated rates/scheduled rates shall be mentioned. Tenders, which propose any alteration in the work specified in the said form of invitation to tender, or in the time allowed for carrying out the work, or which contain any other conditions of any sort will be liable to rejection. No single bid shall include more than one work, but Contractors, who wish to bid for two or more works, shall submit a separate bid for each work. Bids shall have the name and number of work, to which they refer, written outside the envelope.

5. The JDA or other duly authorized Engineer will open the bids in the presence of any contractor(s) or their authorized representatives who may be present at the time, and will announce and enter the rates/amounts of all bids in the Register of Opening of Bids, (Form RPWA 20A). In the event of the bid being accepted, a receipt for the Earnest Money deposited shall be given to the Contractor, who shall sign copies of the specifications and other documents mentioned in Rule 1. In the event of a bid being rejected, the Earnest Money forwarded with such unaccepted bids shall, be returned to the Contractor making the same.

6. The JDA or other duly authorized Engineer shall have the right of rejecting all or any of the bids without assigning any reason.

7. The receipt of an Accountant, Cashier or any other official, not authorized to receive such amount, will not be considered as an acknowledgement of payment to the JDA or other duly authorized Engineer.

8. The memorandum of work tendered for, the memorandum of materials and of plant to be supplied by the Department and their rates, shall be finally approved

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completed in the office of the JDA or duly authorized Engineer before the tender form is issued.

9. If it is found that the bid is not submitted in proper manner, or contains too many corrections and or unreasonable rates or amounts, it would be open for the Engineer-in-charge not to consider the bid, forfeit the amount of earnest money and/ or de-list the contractor.

10. The bidder shall sign a declaration under the Official Secrets Act for maintaining secrecy of the bid documents, drawing or other records connected with the work given to him in form given below. The unsuccessful bidders shall return all the drawings given to them.

Declaration : -

"I / We hereby declare that I/We shall treat the tender documents, drawings and other records, connected with the work, as secret confidential documents, and shall not communicate information derived there form to any person other than a person to whom I/We am/are authorized to communicate the same or use the information in any manner prejudicial to the safety of the same. "

11. Any percentage rate bid containing Item-wise rates, and any item rate bid containing percentage rate below or above estimated/scheduled rates, will be summarily rejected. However, if a bidder voluntarily offers a rebate for payment within a stipulated period, this may be considered.

12. On acceptance of the bid, the name of the accredited representative (s) of the Contractor (with a photograph and signature attested), who would be responsible for taking instruction from the Engineer in charge, shall be communicated to the Engineer-in-charge.

13. Sales tax or any other tax on materials, or Income Tax in respect of the contract shall be governed by Clause 36 A, B and C and B of the Conditions of Contract. Deduction of Income Tax at source will be made as per provisions of the Income Tax Act, in *** from time to time.

14. The bid to work shall not be witnessed by a Contractor of Contractors who himself/themselves has/have bided or who may and has/have bided for the same work. Failure to observe the secrecy of the bids will bid of the contractors, biding as well as witnessing the bid, liable to summary rejection.

15. If on check, there are differences between the rate quoted by the Contractor in words and figures, or in the amount worked out by him, the following procedure shall be followed :-

(i) Where there is a difference between the rates in figures and words, the rate written in words shall prevail.

(ii) When the rate quoted by the contractor in figures and in words tallies, but the amount is not worked out correctly, the rate quoted by the contractor shall be taken as correct and not the amount worked out.

(iii) While quoting rates, if rate/rates against any item of items are found to be omitted, the rate given in the Schedule 'G' by the department for such items will be taken into account while preparing comparative statement and contractor shall be bound to execute such item on 'G' schedule rates.

(iv) In case where percentage is given but the 'above' or 'below' not covered, the bid will be non-responsive.

16. The Contractor shall comply with the provisions of the Apprenticeship Act, 1961 and the rules and orders issued, there under, from time to time. In the fails... his failure will be a breach of the contract and the original sanctioning authority...

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his discretion may cancel the contract. The Contractor shall also be liable for any pecuniary liability arising on account of relocations by him of the provisions of the Act.

17. The Contractor shall read the specifications and study the working drawings carefully before submitting the bid.

18. The site for execution of the work will be made available as soon as the work is awarded. In case, it is not possible for the Department to make the entire site available on the award of the work, the Contractor shall arrange his working programme accordingly. No claim, whatsoever, for not giving the site in full on award of the work or for giving the site gradually in parts will be tenable. The contractor may satisfy himself regarding site, acquisition of land, approach road etc.

19. The bid documents show already the specific terms and conditions on which bids are required by the Government. Hence, all bids should be in strict conformity with the bid documents and should be fulfilled in, wherever necessary, and initiated. Incomplete bids are liable to be rejected. The terms and conditions of the bid documents are firm; as such conditional bids are liable to the rejected.

20. The bidder, while submitting bid, must provide adequate information regarding his financial, technical and organizational capacity and working experience to execute the work of the nature and magnitude.

21. The JDA or other duly authorized Engineer reserves the right in ask for submission of samples as in respect of materials for which the bidder has quoted his rates before the bid can be considered for acceptance. If the bidder, who is called upon, to do so, does not submit within seven days of written order to do so, the Engineer-in Charge shall be at liberty to forfeit the said earnest money absolutely.

22. The Contractor shall submit the list of the works, which are in hand (progress). In the following form :

Name of work	Name and particular of the Sub Division/Division, Where work is being executed	Amount of work	Position of works in progress	Remarks
1	2	3	4	5

23. The Contractor should quote his rates only in one language i.e. either in Hindi or English. Rates should be quoted in figures as well as in words. In case a Contractor has quoted rates in both the languages, and the rates so quoted differ, then the lower of the two shall be treated as the rate quoted by the Contractor.

24. All additions, deletions, corrections and overwriting, must be serially numbered and attested by the Contractor at every page, so also by the officer opening the tenders, so as to make further disputes impossible on this score.

25. After acceptance of the bid, the Contractor or all partners (in the case of partnership firm) will append photograph and signatures duly attested, at the time of execution of Agreement.

26. If any contractor, who having submitted a bid does not execute the agreement or start the work or does not complete the work and the work has to be put to re-biding, he shall stand debarred from participating in such re-biding in addition to forfeiture of Earnest Money/Security Deposit/Performance Guarantee and other action of agreement.

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27. The bid documents shall be issued to those contractors only having valid enlistment as on the date of issue of documents.

28. (a) If a bidder reduces the rates voluntarily after opening of the tenders/negotiations, his offer shall stand cancelled automatically, his earnest money shall be forfeited and action for debarring him from business shall be taken as per enlistment rules.

(b) If a non-bidder offers lower rates after opening of tenders, action for debarring him from business shall be taken as per enlistment rules.

29. Contractors shall submit only unconditional tenders. Conditional bids are liable to be rejected summarily.

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Bid for works

I/ We hereby tender for the execution for the Jaipur Development Commissioner of Jaipur Development Authority of the work specified in the underwritten memorandum within the time specified in such memorandum at the rates, (in figures) ..... % (As well as in words) ..... percent below/above the amount, entered in the schedule G in all respects in accordance with the specifications, designs, drawings and instructions in writing referred to in Rule 1 in all respects in accordance with such conditions so far as applicable. I/We have visited the site of work and am/are fully aware of all the difficulties and conditions likely to affect carrying out the work. I / We have fully acquainted myself/ourselves about the conditions in regard to accessibility of site and quarries/kilns, nature and the extent of ground, working conditions including stacking of materials, installation of tools & plant, conditions effecting accommodation and movement of labour etc. required for the satisfactory execution of contract.

Memorandum

(a) General - description of work :- **Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur.**

(b) Estimated cost :- ₹ 8971.14 Lacs

(c) Performance Guarantee & Security Deposit :

(i) "The security deposit as per Finance (G&T) Department GOR Notification Dated 18.12.2020 or prevailing orders of GOR shall be deducted from each running bill and shall be refunded as per rules on completions of the contract as per terms and condition. However the amount of security deposit deducted from running bills shall not be converted into any mode of securities bank guarantee, FDR etc. The earnest money deposited shall however be adjusted while deducting security deposit from first running bill of the contractor. There will be no maximum limit of security deposit.

However, a contractor may elect to deposit of full amount of security deposit in the shape of bank guarantee or any acceptable form of security before or at the time of executing agreement. However, in case during execution, cost of works exceeds as above, balance security deposit shall be deducted fromthe "Running Account Bills".

(ii) Bank Guarantee shall in all cases be payable at the respective branch of the bank in Jaipur City.

(d) Time allowed for the completion of work (to be reckoned from the 15th day after the date of written order to commence the work) is **24Months**. Should this bid be accepted in whole or In Part, I/We hereby agree to abide by and fulfill all the terms and provisions of the conditions of contract annexed hereto and of the Notice Inviting Bid, or in default thereof, to forfeit and pay to the Jaipur Development Commissioner of Jaipur Development Authority of Rajasthan or his successors in office, the sum of money mentioned in the said conditions.

(e) A sum of Rs. ..... is forwarded herewith in ..... of Cash, Bank Draft, Bankers Cheque as Earnest Money. This amount of ..... is

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money shall absolutely be forfeited to the Jaipur Development Commissioner of Jaipur Development Authority or his successor in office without prejudice to any other right or remedies of Jaipur Development Commissioner of Jaipur Development Authority or his successor in his office, should. I/ We fall to commence the work specified in the above memorandum.

Signature of Witness

Witness's address & occupation

Date:

Signature of Contractor

Address of Contractor

The above bid is hereby accepted by me on behalf of the Jaipur Development Commissioner of Jaipur Development Authority.

Dated:

Executive Engineer (PHE-I)

Signature valid

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CONDITIONS OF CONTRACT

Clause 1: Security Deposit:

The security deposit @ as per Finance (G&T) Department GOR Notification Dated 18.12.2020 or prevailing orders of GOR shall be deducted from each running bill and shall be refunded as per rules on completions of the contract as per terms and condition. However the amount of security deposit deducted from running bills shall not be converted into any mode of securities bank guarantee, FDR etc. The earnest money deposited shall however be adjusted while deducting security deposit from first running bill of the contractor. There will be no maximum limit of security deposit.

A contractor may however, elect to furnish bank guarantee or any acceptable form of security for an amount equal to the full amount of security deposit of the work order before or at the time of executing the agreement. However during execution of the work if cost of work exceeds as shown at the time of furnishing bank guarantee, balance security deposit shall be deducted from the "Running Account Bills".

All compensation or other sums of money payable by the Contractor to Jaipur Development Authority under the terms of his contract may be deducted from or paid by the sale of a sufficient part of his Performance Guarantee and/or Security Deposit, or from interest arising there from, or from any sums, which may be due or may become due to the Contractor by the JDA on any account whatsoever, and in the event of this Security Deposit being reduced by reason of any such deduction or sale as aforesaid, the Contractor shall within ten days thereafter, make good in cash or Bank Guarantee of Nationalized/Scheduled Bank, as aforesaid, any sum or sums which may have been deducted from or raised by sale of his Performance Guarantee and / or Security Deposit or any part thereof.

In case of Bank Guarantee of any Nationalized/Scheduled Bank is furnished by the Contractor to the Jaipur Development Authority, as part of the Security Deposit/Performance Guarantee and the bank goes into liquidation or, for any reason, is unable to make payment against the said Bank Guarantee, the loss caused thereby shall fall on the Contractor and the Contractor shall forthwith, on demand, furnish additional security to the Jaipur Development Authority to make good the deficit.

The liability or obligation of the bank under the Guarantee Bond shall not be affected or suspended by any dispute between the Engineer-in-charge and the Contractor, and the payment, under the Guarantee Bond by the bank to the Jaipur Development Authority shall not wait till disputes are decided. The bank shall pay the amount under the Guarantee, without any demur, merely on a demand from the Jaipur Development Authority stating that the amount claimed is required to meet the recoveries due or likely to be due from the Contractor. The demand, so made, shall be conclusive as regards, to amount due and payable by the bank, under the guarantee limited to the amount specified in the guarantee Bond. The guarantee will not discharged due to the change in the constitution of the Bank or the Contractor.

The Bank Guarantee shall remain valid up to the specified date unless extended on demand by the Engineer-in-charge, which shall include the period of completion of the contract and the defect removal period as per terms or the Agreement, Bank's liability shall cease automatically discharged unless a claim in writing is lodged with the Bank within the period stated in the Bank Guarantee including the extended period. After satisfactory completion of the contract and clearance of all dues by the Contractor, the Director (Engineering)-cum-the authorized Engineer will discharge the Bank Guarantee after expiry of the original

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extended period, as the case may be. In case the date of expiry of the Bank Guarantee is a holiday, it will be deemed to expire on the close of the next working day.

Jaipur Development Authority is not concerned with any interest accruing to the Contractor. On any form of Security (primary or collateral) lodged by him with the bank or any sums payable to sureties obtained by the Bank as counter guarantee to secure its own position. These will be the matters between the Bank and the Contractor.

Clause 2: Compensation for delay:

The time allowed for carrying out the work, as entered in the tender, shall be strictly observed by the Contractor and shall be reckoned from the 15th day after the date of written order to commence the work given to the Contractor. If the contractor does not commence the work within the period specified in the work order, he shall stand liable for the forfeiture of the amount of Earnest Money, Performance Guarantee and Security Deposit. Besides, appropriate action may be taken by the Engineer-in-charge/competent authority to debar him from taking part in future bids for a specified period or black list him. The work shall, throughout the stipulated period of completion of the contract, be proceeded with all due diligence, time being essence of the contract, on the part of the Contractor. To ensure good progress during the execution of work, the contractor shall be bound, in all cases in which the time allowed for any work exceeds one month (save for special jobs), to complete 1/8th of the whole of the 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 3/4 of such time *** elapsed. If the contractor fails to complete the work in accordance with this time schedule in terms of cost in money, and the delay in execution of work is attributable to the contractor, the contractor shall be liable to pay compensation to the Jaipur Development Authority at every time span as below: -

A.	Time Span of full stipulated period	1/4th	1/2th	3/4th	Full
B.	Work to be completed in terms or money.	(..... days) 1/8th	(..... days) 3/8th	(..... days) 3/4th	(..... days) Full
C.	Compensation payable by the contractor for delay at the stage of :	(Rs.....) 2.5% of Scheduled work remained unexecuted on the last day of (1/4) time span.	(Rs.....) 5% of Scheduled work remained unexecuted on the last day of (1/2) time span.	(Rs.....) 7.5% of Scheduled work remained unexecuted on the last day of (3/4) time span.	(Rs.....) 10% of Scheduled work remained unexecuted on the last day of contracted full period.

Note:- In case delayed period over a particular span is stilt up and is jointly attributable to government and contractor, the competent authority may reduce the compensation in proportion of delay attributable to government over entire delayed over that span after taking up

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delays attributable to government and this reduced compensation would be application over the entire delayed period without paying any escalation. Following illustration is given.

First time span is of 6 months, delay is of 30 days which is split over as under 5 days [attributable to government] + 5 days [attributable to contractor] + 5 days [attributable to government] + 5 days clubbed to 15 days [attributable to government] and 15 days [attributable to contractor]. The normal compensation 30 days as per clause 2 of agreement is 2.5 which can be reduced as 2.5 15/30 1.25 over 30 days without any escalation by competent authority.

The contractor shall, further, be found to carry out the work in accordance with the date and quantity entered the progress statement attached to the bid.

In case the delay in execution of work is attributable to the contractor, then span wise compensation as laid down in this clause shall be mandatory. However, in case the slow progress in one time span is covered up within original stipulated period, then the amount of such compensation levied earlier shall be refunded. The Price escalation, if any, admissible under clause 45 of Conditions of Contract would be admissible only on such rates and cost of work, as would be admissible if work would have been carried out in that particular time span. The Engineer-in-charge shall review the progress achieved in every time span, and grant stage wise extension in case of slow progress with compensation, if the delay is attributable to contractor, otherwise without compensation.

However, if for any special job, a time schedule has been submitted by the Contractor before execution of the agreement and it is entered in agreement as well as same has been accepted by the Engineer-in charge, the Contractor shall complete the work within the said time schedule. In the event of the Contractor failing to comply with this condition, he shall be liable to pay compensation as prescribed in forgoing paragraph of this clause provided that the entire amount of compensation to be levied under the provisions of this Clause shall not exceed 10% of the value of the contract. While granting extension in time attributable to the Jaipur Development Authority reasons shall be recorded for each delay.

Clause 3: Risk & Cost Clause:

The Engineer-in-charge or the Competent Authority defined under rules may, without prejudice to his rights against the Contractor, in respect of any delay or interior workmanship or otherwise, or to any claims for damages in respect of any breaches of the contract and without prejudice to any rights or remedies under any of the provisions of this contract or otherwise, and whether the date for completion has or has not elapsed, by notice in writing, absolutely determine the contract in any of the following cases :-

(i) If Contractor having been given by the Engineer-in-charge, a notice in writing to rectify, reconstruct or replace any defective work or that the work is being performed in any inefficient or otherwise improper of un-workman like manner, shall omit to comply with the requirements of such notice for a period of seven days, thereafter, or if the Contractor shall delay or suspend the execution of the work so that either in the judgment of the Engineer-in-charge (which shall be final and binding) he will be unable to secure completion of the work by the date for completion of he has already, failed to complete the work by that date.

(ii) If the Contractor, being a company, shall pass a resolution or [illegible] an order that the company shall be wound up or if a receiver or a manager, on

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of a creditor, shall be appointed or if circumstances shall arise, which entitle the Court or Creditor to appoint a receiver or a manager or which entitle the Court to make a winding up order.

(iii) If the Contractor commits breach of any of the terms and conditions of this contract.

(iv) If the contractor commits any acts mentioned in clause 19 hereof.

When the contractor has made himself liable for action under any of the cases aforesaid. The Engineer in-charge behalf of the Jaipur Development Commissioner of Jaipur Development Authority shall have powers.

(a) To determine or rescind the contract as aforesaid of which determination or rescission notice in witting to the contractor under the hand of the Engineer in charge shall be conclusive evidence upon such determination or rescission, the earnest money, full security deposit of the contract and performance guarantee of the contractor shall be liable to be forfeited and shall be absolutely at the disposals of Jaipur Development Authority.

(b) To employ labour paid by the department and to supply materials to carry our the work or any part of the work debiting the contractor with the cost of the labour and the price of the material (of the amount of which cost and price certified by the Engineer in charge shall be final and conclusive against the contractor) and crediting him with the value of the work done in all respects in the same manner and at the same rates as if it had been carried out by the contractor under the terms of this contract. The certificate of the divisional officer as to the value of the work done, shall be final and conclusive evidence against the contractor provided always that action under the sub clause shall only be taken after giving notice in writing to the contractor. Provided also that if the expenses incurred the department are less than amount payable to the contractor at his agreement rates the difference shall not be paid to the contractor.

(c) After giving notice to the contractor to measure up the work of the contractor and to take such part thereof as shall be unexecuted out of his hands and to give it to another contractor to complete in which case any expenses which may be incurred in excess of the sum which would have been paid to the original contractor if the whole work had been executed by him (of the amount of which excess the certificate in writing of the Engineer-in-charge shall be final and conclusive) shall be borne and paid by the original contractor and may be deducted from any money due to him by Jaipur Development Authority under this contract or on any other account whatsoever or from his earnest money, security deposit, performance guarantee, enlistment security or the proceeds of sales thereof or a sufficient part thereof as the case may be. In the event of any one or more of the above courses being adopted by the engineer in charge the contractor shall not claim to compensation for any loss sustained by him by reason of his having purchased or procured any materials or entered into any engagements or made any advances on account or with a view to the execution of the work or the performance of contract. And in case action is taken under any of provisions aforesaid the contractor shall not be entitled to recover or be paid any sum for any work thereof or actually performed under this contract unless and until the Engineer in charge has certified in writing the performance of such work and the value payable in respect thereof and he shall only be entitled to be paid the value so certified.

Clause 4: Contractor remains liable to pay compensation, if action not taken under

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clause 3:

(i) In any case in which any of the powers conferred by clause 3 hereof shall have become exercisable and the same shall have not been exercised the non exercise thereof shall not constitute waiver of any of the conditions thereof and such power shall not with starting be exercisable in the event of any future case of default by the contractor for which by any clause or clauses hereof he is declared liable to pay compensation amounting to the whole of his security deposit/performance guarantee/Easiest money/Enlistment security and the liability of the contractor for past and future compensation shall remain unaffected.

Powers to take possession of or require removal sale of contractor plant.

(ii) In the event of the Engineer in charge putting in force powers vested in him under the preceding clause 3, he may, if he so desires, take possession of all or any tools plants materials and stores in or upon the works or the site, thereof, or belonging to the contractor of procured by him and intended to be used for the execution of the work or any part thereof paying or allowing for the same in account at the contract rates or in case of these not being applicable, at current market rates, to be certified by the JDA or duly authorized Engineer (whose certificate thereof shall be final and conclusive) otherwise the Engineer in charge may give notice in writing to the contractor or his clerk of the works foreman or other authorized agent require him to remove such tools, plant, materials or stores from the premises (within a time to be specified in such notice) and in the event of the contractor failing to comply with any requisition, the JDA or other duly authorized Engineer may remove them at the contractors expenses by auction or private sale on account of the contractor and at his risk in all respects, and the certificate of the JDA or other duly authorized Engineers, as to the expense of any such removal, and the amount of the proceeds and expense of any such sale shall be final and conclusive against the contractor.

Clause 5: Extension of Time:

If the contractor desires an extension of time for completion of the work on the ground of his having been unavoidably hindered in its execution or on any other grounds he shall apply in writing to the Engineer in charge within 30 days of the date of the hindrance on account of which he desires such extension as aforesaid and the authority competent to grant extension under the rule/delegation of powers or other duly authorized Engineer shall if in his opinion (which shall be final) reasonable grounds be shown therefore authorize such extension of time if any as may, in his opinion be necessary or proper, if the period of completion of contractor expires before the expiry of the period of one month provided in this clause the application for extension shall be made before the expiry of the period stipulated for completion of contract the competent authority shall grant such extension at each such occasion within a period of 30 days of receipt of application from contractor and shall not wait for finally of work. Such extensions shall be granted in accordance with provisions under clause (2) of this agreement.

Clause 5 A: Monthly returns of extra claims:

Contractor has to submit a return every month for any work claimed as extra. The contractor delivery the return in the office of the executive engineer and obtain receipt number of the receipt register of the day on or before 10th day of every month during the currency of the work covered by this contract a return showing details of any work claimed as extra by the contractor which value shall be based upon the rates and prices mentioned in the con

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or in the schedule of rates in force in the district for the time being. The contractor shall be deemed to have waived all claims not included in such return and will have no right to enforce any such claims not included whatsoever be the circumstance.

Clause 6: Final certificate:

On completion of the work the contractor shall send a registered notice to the Engineer in charge giving the date of completion and sending a copy of it to the officer accepting the contractor on behalf of the J.D.C. and shall request Engineer In-Charge to give him a certificate of completion but no such certificate shall be given nor shall the work be considered to be complete unit the contractor shall have removed from the site on which the work shall be executed all scaffolding surplus materials and rubbish and cleared off the dirt from all wood work doors walls floors or other parts of any building in upon or about which the work is to be executed or of which he may have possession for the execution thereof he had filled up the pits. If the contractor shall fail to comply with the requirements of this clause as to removal of scaffolding surplus materials and rubbish and clearing off dirt and filling of pits on or before the date fixed for completion of the work, the Engineer-in-Charge may, at the expenses of the contractor, remove such scaffolding, surplus materials and the rubbish and dispose of the same, as he thinks fit, and clean off such dirt and fill the pit, as aforesaid and the contractor shall forthwith pay the amount of all expense so incurred and shall have no claim in respect of any such scaffolding or surplus materials as aforesaid except for any sum actually realized by the sale thereof. On completion, the work shall be measured by the Engineer in charge himself or through his subordinates whose measurements shall be binding and conclusive against the contractor. Provided that if subsequent to the taking of measurements by the subordinate as aforesaid, the Engineer in charge had reason to believe that the measurements taken by his subordinates are not correct the engineer in charge shall have the power to cancel the measurements already taken by his subordinates and acknowledged by the contractor and to take measurements again after giving reasonable notice to the contractor and such pre-measurement shall be binding on the contractor.

Within ten/thirty days of the receipt of the notice Engineer in charge shall inspect the work and if there is no visible defects on the face of the work shall give the contractor, a certificate of completion. If the Engineer in charge finds that the work has been fully completed. It shall be mentioned in the certificate so granted. If on the other hand, it is found that there are certain visible defects to be removed the certificate to be granted by Engineer in charge shall specifically mention the details of the visible defects along with the estimate of the cost for removing these defects. The final certificate of work shall be given after the visible defects pointed out as above have been removed. Ten days will apply to works at the headquarters of Engineer-in-charge and thirty days for works at other place.

Clause: 7: Payment on intermediate certificate to be regarded as advance:

No Payment shall be made for works estimated to cost less than rupees twenty five thousand till after the whole of the works shall have been completed and a certificate of completion given. But in the case of works estimated to cost more than Rupees twenty five thousand the contractor for shall on submitting the bill therefore, be entitled to receive a monthly payment proportionate to the part thereof then approved and passed by the engineer in charge, whose certificate of such approval and passing of sum so payable shall be final and conclusive. Running Account bill shall be paid within 15 days from presentation. But [illegible] intermediate payment shall be regarded as payments by way of advance against the

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payment only and not as payments for work actually done and completed and shall not erected or considered as an admission of the due performance of the contract or any part thereof in any respect or the accruing of any claim nor shall it conclude determine or effect in any way the powers of the Engineer -in-charge under these conditions or any of them to final settlement and adjustment of the accounts or otherwise or in any other way vary of effect the contract. The final bill shall be made/submitted by the Contractor within one month of the date fixed for completion of the work otherwise the Engineer-in-charge's certificate of the measurement and of the total amount payable for the work accordingly shall be final and binding on all parties.

Clause 7 A: Time Limit for Payments of Final Bills:

The final bill shall be paid within 3 months on presentation by the contractor after issuance of final completion certificate in accordance with clause 6 of the conditions of contract. If, there shall be any dispute about any item(s) of the work, then the undisputed item(s) only, shall be paid within the said period of 3 months if a final bill (which contains no disputed item or disputed amount of any item) is not paid within the period of 3 months from presentation of final bill or 6 months from the date of receipt of registered notice regarding completion of work in accordance with clause 6 of the conditions of the contract, the defects, if any shall be brought to the notice of the higher authority. The period of 3 months shall commence from the date of rectification of the defects. The higher authority shall ensure that in no case final bill should be left unpaid after 9 months from the receipt of registered notice regarding completion of work. The contractor shall submit a memorandum of the disputed items along with justification in support within 30 days from the disallowance thereof, and if he fail, to do so, his claims shall be deemed to have been fully waived and absolutely extinguished.

Clause 8: Bills to be submitted monthly:

A bill shall be submitted by the Contractor each month on or before the date fixed by the Engineer-in-charge for all work executed in the previous month and the Engineer-in-charge shall take or cause to be taken the requisite measurement for the purpose of having the same verified and the claim, as far as admissible, authorized or paid, if possible, before the expiry of ten days from the presentation of the bill. If the Contractor does not submit the bill within the time fixed, as aforesaid, the Engineer-in-charge may depute a subordinate to measure up to said work in the presence of the Contractor, whose signature in the Measurement Book will be sufficient warrant and the Engineer-in-charge may prepare a bill from such Measurement, Book, which shall be binding on the Contractor in all respects.

Clause 8 A: Contractor to be given time to file objection to the Measurements recorded by the Department: -

Before taking any measurement of any work, as have been referred to in preceding Clauses 6, 7 & 8, the Engineer-in-charge or a subordinate, deputed by him, shall given reasonable notice to the Contractor. If the Contractor fails to be present at the time of taking measurements after such notice or fails to sign or to record the difference within a week from the date of measurement in the manner required by the Engineer-in-charge, then in any such event, the measurements taken by the Engineer-in-charge or by the subordinates deputed by him, as the case may be, shall be final and binding on the Contractor and the Contractor shall have no right to dispute the same.

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Clause 8 B: Recovery of cost of preparation of the Bill:

In case of contractors of class "A" and "AA" do not submit the bill with time fixed, the Engineer-in-charge may prepare the bill as per provision of clause 8 of the conditions of contract but deduction @ 0.5% of amount of such a bill shall be made and credited to the general revenue on account of preparation of bill.

Clause 9: Bills to be on printed forms:

The Contractor shall submit all bills on the printed forms, to be had on application, at the office of the Engineer-in-charge and the charges in the bills shall always be entered at the rates specified in the bid or in the case of any extra work ordered in pursuance of these conditions, and not mentioned or provided for in the bid, at the rates hereinafter provided for such work.

Clause 9 A: Payments of Contractor's Bills to Banks:

Payments due to the Contractor may if so desired by him, be made to his Bank instead of direct to him, provided that the contractor has furnished to the Engineer-in-charge

A. an authorization in the form of a legally valid document, such as a Power of Attorney conferring authority on the Bank to receive payments, and

(ii) his owe acceptance of the correctness of the account made out, as being due, to him, by Government, or his signature on the bill or other claim preferred against Jaipur Development Authority before settlement by the Engineer-in-charge of the account or claim, by payment to the Bank. While the receipt given by such bank shall constitute a full and sufficient discharge for the payment, the Contractor should, whenever possible, present his bill duly receipted and discharged through his Banker. Nothing, herein contained, shall operate to create in favour of the Bank any rights vis-à-vis the Jaipur Development Commissioner of Jaipur Development Authority.

Clause 10: Stores supplied by Jaipur Development Authority: -

If the specification of estimate of the work provides for the use of any special description of material, to be supplied from Engineer-in-charge's stores, or if, it is required that contractor shall use certain stores to be provided by the Engineer-in-charge specified in the schedule or memorandum hereto annexed, the Contractor shall be bound to procure and shall be supplied such materials and stores as are, for time to time, required to be used by him for the purpose of the contract only, and the value of the full quantity of materials and stores, so supplied; at the rate specified in the said schedule or memorandum, may be set off or which may be deducted from any sum, them due or thereafter become due, to the contractor under the contract or otherwise or against or from the performance Guarantee and or Security Deposit or the proceeds of sale, if the same is held in Jaipur Development Authority securities, the same or a sufficient portion thereof being in this case, sold for this purpose. All materials supplied to the Contractor, either from departmental stores or with the assistance of Government, shall remain the absolute property of Government. The Contractor shall be the trustee of the Stores/Materials, so supplied/procured and these shall not, on any account, be removed from the site of work and shall be all times open to inspection by the Engineer-In-charge. Any such material unutilized and in perfectly good condition at the time of completion or determination or rescinding of the contract, shall be returned to the Divisional Officer's Stores. If by a notice in writing under his hand, he shall so require, and if on service of such notice, the contractor fails to return materials so required he shall be liable to pay the price of such materials in accordance with

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provision of Clause 10B in bid. But the Contractor shall not be entitled to return any such materials, unless with such consent, and shall have no claim for compensation on account of any such materials, so supplied to him as a foresaid being unused by him, or for any wastage in or damage to any such materials. For the stores returned by the Contractors, he shall be paid for at the price originally charged excluding storage charges, in case of material supplied from departmental stores and actual cost including freight, cartage, taxes etc. paid by the contractor, in case of supplies received with the assistance of Government, which, however, should in no case exceed market rate prevailing at the time the materials are taken back. The decision of the Engineer-in charge as to the price of the stores returned keeping in view its condition etc, shall be final and conclusive. In the event of breach of the aforesaid condition, the Contractor shall in addition to throwing himself open in account for contravention of the terms of the license or permit and/or for criminal breach of trust, pay to the Government, all advantages or profits resulting, or which in the usual course, would result to him by reason of such breach. Provided that the contractor shall, in no case be entitled to any compensation or damage on account of any delay in supply thereof, all or any such materials and stores.

Clause 10A: Rejection of materials procured by the contractor:

The Engineer-in charge shall have full powers to require the removal from the premises of all materials which in his opinion are not in accordance with the specifications and, in case of default, the Engineer-charge shall be at liberty to employ other person (s) to remove the same without being answerable or accountable for any loss of damage, that may happen or arise to such materials to substituted thereof, and in case of default, Engineer-in charge may cause the same to be supplied and all costs. Which may attend such removal and substitution, are to be born by the contractor.

Clause 10B: Penal rate in case of excess consumption:

The contractor shall also be charged for the materials consumed in excess of the requirements calculated on the basis of standard consumption approved by the department at double of the issue rate including storage and supervision charge or market rate, whichever is higher. A Material supply and consumption statement in prescribed From RPWA 35A shall be submitted with every Running Account Bill, distinguishing material supplied by the Government and the material procured by the Contractor himself. The recovery for such material shall be made from Running Account Bill next after the consumption and shall not be referred certificate of such nature shall be given in each running Account Bill.

Clause 10 C: Hire of Plant and Machinery:

Special Plant and Machinery, required for execution of the work may be issued to the contractor, if available, on the rates of hire charges and other terms and condition as per departmental Rules, as schedule annexed to these conditions. Rates of such Plant & machinery shall be got revised periodically so as to bring them at per with market rate:

Clause 11: Works to be executed in accordance with specifications, Drawings, Orders, etc.

The Contractor shall execute the whole and every part of the work in the most substantial and satisfactory manner and both as regards materials and otherwise in every respect in strict accordance with the Specification. The Contractor shall also conform exactly fully and faithfully to the designs, drawings and instructions in writing relating to the work assigned by the Engineer-in-charge and lodged in his office and to which the contractor shall be entitled to have access at such office or on the site of the work for the purpose of inspection during [illegible] hours and contractor shall, if he so require, be entitled, at his own expense, to make or cause

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be made copies of specifications and of all such designs, drawings and instructions, as aforesaid. A certificate of executing works as per approved design and specifications etc. shall be given on each Running Account.

These specifications of work, material, methodology of execution, drawings and designs shall be signed by the contractor and executive Engineer while executing agreement and shall from part of agreement.

Clause 12:

The Engineer-in-charge shall have power to make any alteration omission or additions to or substitutions for the original specification, drawings, designs and instructions, that may appear to him to be necessary during the progress of the work and the contractor shall carry out the work accordance with any instruction which may be given to him in writing signed by the Engineer-In-Charge and such alterations, omissions, additions or substitutions shall not invalidate the contract and any altered, additional or substituted work, which the contractor may be directed to do in the manner above specified, as part of the work shall be carried out work shall be extended in the proportion that the altered, additional or substituted work bears to the original contract work, and the certificate of the Engineer-in-charge shall be conclusive as to such proportion. The rates for such additional altered or substituted work under this clause shall be worked out in accordance with the following provisions in their respective order.

(i) If the rate for the additional, altered or substituted work are specified in the contract for the work, the contractor is bound to carry out the additional, altered or substituted work at the same rates as are specified in the contract for the work.

(ii) If the rates for the additional, altered or substituted work are not specifically provided in the contract for the work , such rates will be derived from the rates for a similar class of work as are specified in the contract for the work.

(iii) If the rates for the altered, additional or substituted work can not be determined in the manner specified in the sub-clause (i) to (ii) above, then the rates for such composite work items shall be worked out on the basis of the concerned Schedule of Rates of the Districts / Area specified above minus / plus the percentage which the total tendered amount bears to the estimated cost of the entire work put to bid. Provided always that if the rates for a particular part of parts of the item is not in the Schedule of Rates, the rate for such part or parts will be determined by the Engineer-in-Charge on the basis of the prevailing market rates when the work was done.

(iv) If the rate for the altered, additional or substituted work item cannot be determined in the manner specified in sub-clauses (i) to (iii) above, then the contractor shall within 7 days of the date of receipt of order to carry out the work, inform the Engineer-in-Charge of the rates which it is his intention to charge for which class of work supported by analysis of the rate or rates claimed and the Engineer-in-Charge shall determine the rates or rates on the basis of prevailing market rates, and pay the contractor accordingly. However, the Engineer-in-Charge by notice in writing will be at liberty to cancel his order to carry out such class of work and arrange to carry it out in such manner, as he may consider advisable. But under no circumstances, the contractor shall suspend the work on the plea of non-settlement of rates of items failing under the clause.

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(v) Except in case of items relating to foundations, provisions contained sub-clauses (i) to (iv) above shall not apply to contract or substituted items as individually exceed the percentage set out in the bid documents under Clause 12.A.

For the purpose of operation of Clause 12(v) the following works shall be treated as work relating to foundations:-

(a) For buildings, compound wall, plinth level or 1.2 meters (4 ft.) above ground level whichever is lower, excluding items above flooring and D.P.C. but including base concrete below floors.

(b) For abutments, pier, retaining wall of culverts and bridges, walls of water reservoir and the bed of floor level.

(c) For retaining walls, where floor levels is not determinate 1.2 meters above the average ground level or bed level.

(d) For roads, all items of excavation and filling including treatment of sub base and soling work.

(e) For water supply lines, sewer lines underground storm water drains and similar work all items of work below ground level except items of pipe work for proper masonry work.

(f) For open storm water drains, all items of work except lining of drains.

(g) Any other items of similar nature which Engineer-in-charge may decide relating to foundation.

The rate of any such work, except the items relating to foundations, which is in excess of the deviation limit, shall be determined in accordance with the provisions contained in Clause 12A.

Clause 12A:

The quantum of additional work for each item shall not exceed 50% of the original quantity given in the agreement and the total value of additional work shall not exceed 20% of the total contract value, unless otherwise mutually agreed by the Engineer-in-charge and the Contractor. This limit shall not be applicable on items relating to foundation work which shall be executed as per original rates or provision of clause 12(i) to (iv)

In case of contract substituted items or additional items, which results in exceeding the deviation limit laid down in this clause except items relating to foundation work. Which the contractor is required to do under Clause 12 above, the contractor shall within 7 days from the receipt of order, claim revision of the rate supported by proper analysis in respect of such items for quantities in excess of the deviation limit notwithstanding the fact that the rates for such items exist in the bid for the main work or can be derived in accordance with the provision of sub clause (ii) of Clause 12 and the Engineer-in-charge, may revise their rates having derived in according with the provision of sub-clause may revise their rates having regard to prevailing market rates and the contractor shall be paid in accordance with the rates so fixed. The Engineer-in-charge shall be at liberty to cancel his order to carry out such increased quantities of work by giving notice in writing to the contractor and arrange to carry out in such manner as he may consider advisable. But under no circumstances, the contractor shall suspend the work on the plea of non-settlement of rates of items failing under this clause.

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All the provisions of the preceding paragraph shall equally apply to decrease in rates of items for quantities in excess of the deviation limit notwithstanding the fact that the rates for such items exist in the bid for the main work or can be derived in accordance with the provisions of sub-clause (ii) of the preceding clause 12 and the Engineer-in-charge may revise such rates having regard to the prevailing market rates unless otherwise mutually agreed by the engineer-in-charge and the contractor.

Clause 13: No compensation for alteration in or restriction of work to be carried out:

If at any time after the commencement of the work the Jaipur Development Authority shall, for any reason, whatsoever, not require the whole work, thereof, as specified in the bid, to be carried out, the Engineer-in-charge shall give notice, in writing of the fact to the contractor, who shall have no claim to any payments or compensation, whatsoever, on account of any profit or advantage, which he might have derived from the execution of the work in full but which he did not derive in consequence of the full amount of the work not having been carried out. Neither, shall he have any claim for compensation by reason of alterations having been made in the original specifications, drawings and design and instructions, which shall involve any curtailment of the work as originally contemplated. Provided, that the contractor shall be paid the charges for the cartage only, of materials actually brought to the site of the work by him for bonafide use and rendered surplus as a result of the abandonment or curtailment of the work or any portion thereof, and taken them back by the contractor provided, however that the Engineer-in-charge shall have, in all such cases, the option of taking over all or any such materials at their purchase price or at local market rates whichever may be less. In the case the option of taking over all or any such materials at their purchase price or at local market rates whichever may be less. In the case of such stores, having been issued from Jaipur Development Authority stores, charges recovered, including storage charges, shall be refunded after taking into consideration any deduction for claim on account of any deterioration or damage while in the custody of the contractor and in this respect the decision of the Engineer in Charge shall be final.

Clause 14: Action and compensation payable in case of bad work:

If, it shall appear to the JDA or any authorized authority or the Engineer-in-Charge or his subordinates in charge of the work, or to the committee of retired officers / officers appointed by the Jaipur Development Authority for the purpose that any work has been executed with unsound, imperfect or unskillful workmanship, prior with material of any interior description, or that any materials or articles provided by him for the execution of the work are unsound or of a quality inferior to that contracted, or otherwise not in accordance with contract, the contractor shall be demand in writing from the Engineer in charge, specifically the work / materials or articles complained of, notwithstanding that the same may have been inadvertently passed, certified and paid for, will rectify or remove and reconstruct the work, so specified, in whole or in part, has the case may be, remove the materials or articles, so specialties and provide other proper and suitable materials or articles at his own cost and in the event of his failing to do so, within a period to be specified by the Engineer-in-charge in his demand, as aforesaid, then the contractor shall be liable to pay compensation, at the rate of one percent on the bided amount of work for every week not exceeding ten percent, while his failure to do so shall continue, and in the case of any such failure, the Engineer - in - Charge may rectify or remove and re-execute the work or remove and replace within others, the materials or articles complained of as the case may be, at the risk and expense, in all respects of the contract.

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Clause 15: Work to be open to inspection: Contractor or his responsible agent to be present.

All work, under or in course of execution or executed in pursuance of the contract, shall at all times, be open to inspection and supervisor of the Engineer-in-charge and his superior officers e.g. Superintending Engineer, Additional JDA, Chief Technical Engineer, JDA, and his subordinates and any other authorized agency of the Jaipur Development Authority and the contractor shall at all times during the usual working hours, and at all other times at which reasonable notice of the intention of the Engineer in charge in or his subordinate and any other authorized agency of Jaipur Development Authority or committee of retired officers / officers appointed by the Jaipur Development Authority for the purpose to visit the works shall have been given to the Contractor, either himself be present to receive orders and instructions or have a reasonable agent, duly accredited in writing, present for the purpose. Orders given to the Contractor agent shall be considered to have the same force as if they had been given to the contractor himself.

Clause 16: Notice to be given before any work is covered up:

The Contractor shall give not less than 7 days' notice, in writing, to the Engineer-in-Charge of the work, before covering up or otherwise placing beyond the reach of measurement, any work in order that they 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 no cover up or place beyond the reach of measurement any work without the consent in writing of the Engineer-in-charge of the work and if, any work shall be covered up 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 expenses or in default, thereof, no payment or allowance shall be made for such work, or for the materials, with which the same was executed.

Clause 17: Contractor liable for damage done and for imperfections:

If the Contractor of his work people or servants shall break, deface, injure or destroy any part of a building in which they may be working or any building, road, fence, enclosure or cultivated ground continuous to the premises on which the work or any part of it is being executed, or if any damage shall happen to the work. While in progress, from any cause, whatsoever, or any imperfections become apparent in it, within a period specified in clause 37, after a certificate, final or otherwise of its completion, shall have been given by the Engineer-in-charge, may cause the same to be made good by other workmen and deduct the expense (of which the certificate of the Engineer-in-charge shall be final) from any sums that may be then, or at any time thereafter, may become due to the contractor, or from his security deposit, or the proceeds of sale thereof, or of a sufficient portion thereof.

Clause 18: Contractor to supply Plant, Ladders, Scaffolding etc.

The contractor shall arrange and supply, at his own cost, all material (except such special materials, if any, as may, in accordance with the contract, be supplied from the Engineer-in-charge's stores), plants, tools, appliances, implements, ladders, cordage, tackle, scaffolding and temporary works requisite or proper for the proper execution of the work, whether original, altered, or substituted, and whether included in the specification or other documents, forming part of the contract, or referred to in these conditions or not, or which may be necessary for the purpose of satisfying or complying with the requirements of the Engineer-in-charge, as to any matter as to which, under the conditions, he is entitled to be satisfied

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which he is entitled to require, together with carriage thereof, to and from the work. The contractor shall also arrange and supply, without charge, the requisite number of persons with the means and material necessary of the purpose of setting out work and counting, weighing and assisting, in the measurement or examination at any time and from time to time of the work, or materials. Failing his so doing, the same may be provided by the Engineer-in-charge at the expenses of the Contractor, and the expenses maybe deducted from any money due to the Contractor under the contract, or from his performance Guarantee and / or security deposit or the proceeds of sale thereof, or a sufficient portion thereof. The contractor shall also provide all necessary fencing and lights required to protect the public from accident and shall be bound to bear the expenses of difference of every suit, action or other proceeding at law, that may be brought by any person for injury sustained owing to neglect of the above precautions, and to pay any damages and costs, which may be awarded in any such suit, action proceedings to any such person or which may, with the consent of the Contractor be paid to compromise any claim by any such person.

Clause 19: Work not to be sub-let contract may be rescinded and security deposit and performance forfeited for sub-letting, bribing or if contractor becomes insolvent.

The contract shall not be assigned or sublet without the written approval of the JDA, and if the contractor shall assign or sublet his contract or attempt so to do, or become insolvent, or commence any insolvency proceedings or mark any composition with his creditors, or attempt to so to do, or if any bride, gratuity, gift, loan, requisite reward or advantage, pecuniary or otherwise, shall either, directly or indirectly, be given promised or offered by the Contractor or any of his servants or agents, to any public officer or person, in the employ of Government, in any way relating to his office or employment, or if any such officer or person shall become, in any way, directly or indirectly interested in the contract, the JDA may thereupon, by notice, in writing resigned the contract and the performance guarantee and security deposit of the contractor shall, thereupon, stand forfeited and be absolutely at the disposal of Jaipur Development Authority and the same consequences shall ensure as, if the contract had been rescinded under clause 3 thereof, and in addition the contractor shall not be entitled to recover or be paid for any work therefore, actually performed under the contract.

Clause 20: Sums payable by way of compensation to be considered as reasonable compensation without reference to actual loss:

All sums payable by way of compensation under any of these conditions shall be considered as reasonable compensation to be applied to the use of Jaipur Development Authority without reference to the actual loss or damage sustained and whether or not any damage shall have been sustained.

Clause 21: Changes in Constitution of firm:

Where the Contractor is partnership firm, the previous approval, in writing, of the Engineer-in-charge shall be obtained before business any change is made in the constitution of the firm. Where the contractor is an individual or a Hindu undivided family business concern, such approval, as aforesaid, shall likewise be obtained before the contractor enters into any partnership agreement where under the partnership firm would have the right to carry out the work thereby undertaken by the contractor. If, previous approval, as aforesaid is not obtained, the contract shall be deemed to have been assigned in contravention of clause 19 thereof, and the same action may be taken and the same consequence shall ensure, as provided in clause 19.

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Clause 22: Work to be under direction of Engineer-in-charge

All the works, to be executed under the contract, shall be executed under the direction and subject to the approval. In all respect, of the Engineer-in-charge of the Jaipur Development Authority for the time being, who shall be entitled to direct, of what point or points and in what manner, they are to be commenced and from time to time carried on.

Clause 23: Standing committee for Settlement of disputes:

If any question, difference or objection, whatsoever shall arise in any way, in connection with or arising out of this instrument, or the meaning of operation of any part thereof, or the rights, duties or liabilities of either party then, save in so far, as the decision of any such matter, as herein before provided for, and been so decided, every such matter constituting a total claim of Rs.50000/- or above, whether its decision has been otherwise provided for an whether it has been finally decided accordingly, or whether the contract should be terminated or has been rightly terminated and as regards the rights or obligations of the parties, as the result of such termination, shall be referred for decision to the Empowered Standing Committee, which would consist of the followings:-

1. Jaipur Development Commissioner, JDA, Jaipur -Chairman
2. Director Engineering-I, JDA, Jaipur
3. Director (Finance), JDA, Jaipur
4. Director (Law), JDA, Jaipur
5. Superintending Engineer, JDA, Jaipur - Member Secretary

The Engineer-in-charge, on receipt of application along with non-refundable prescribed fee, (the fee would be two percent of the amount in dispute, not exceeding Rs. One Lakh) from the contractor, shall refer the disputes to the committee within a period of three months from the date of receipt of application.

The contractor shall be furnished, free of cost one certified copy of the contract documents except standard specifications. Schedule of Rates and such other printed and published documents, together with all drawings as may be forming part of the Bid Documents. None of these documents shall be used for any purpose other than that of this contract.

Procedure and application form referring cases for settlement by the Standing Committee shall be, as given in form RPWA 90.

Clause 23 A: Contractor to indemnify for infringement of Patent or design.

Contractor shall fully indemnify the Jaipur Development Authority against any action, claim or proceeding, relating to infringement or use of any patent or design or any alleged patent or design, rights, and shall pay any royalties, which may be payable in respect of any articles or part thereof included in the contract, in the event of any, claims made under or action brought against Government. In respect of any such matters, as aforesaid, the contractor shall be immediately, noticed thereof, and the contractor shall be at liberty at his own expense, to settle any dispute or to conduct any litigation, that may arise there from provided that the contractor shall not be liable to indemnify the Jaipur Development Authority, if the infringement of the patent or design or any alleged patent, or design, right is the direct result of an order given to the Engineer-in-charge in his behalf.

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Clause 24: Imported Store articles to be obtained from Government:

The contractor shall obtain form the stores of the Engineer-in-charge, all imported store articles, which may be required for the work or any part thereof, or in making up articles required thereof, or in connection therewith, unless he has obtained permission in writing, from the Engineer-in-charge, to obtain such stores an articles from elsewhere. The value of such stores and articles, as may be supplied to the contractor by the Engineer-in-charge, will be debited to the contractor, in his account, at the rates shown in the schedule attached to the contract, and if they are not entered in the schedule, they will be debited at cost price, which for the purposes of this contract, shall include the cost of carriage and all other expenses, whatsoever, which shall have been incurred in obtaining delivery of the same at the stores aforesaid plus storage charges.

Clause 25: Lump sums in estimates:

When the estimate on which a bid is made includes lump sums, in respect of parts of the work, the contractor shall be entitled to payment in respect of the item of work involved, or the part of the work in question at the same rates, as are payable under the contract for such items or if the part of the work in question is not, in the opinion of the Engineer-in-charge capable of measurement, in Engineer-in-charge may at his discretion pay the lump sum amount entered in the estimate and the certificate in writing of the Engineer-in-charge shall be final and conclusive with regard to any sum or sums payable to him under the provisions of this clause.

Clause 26: Action where no Specification:

In case of any class of work for which there is no such specification as is mentioned in rule 1, such work shall be carried out in accordance with the detailed specification of the department and also in accordance with the instructions and requirement of the Engineer-in-charge.

Clause 27: Definition of work;

The expression "Work" or "Works" where used in these conditions, shall unless there be something either in subject or context, repugnant to such construction, be construed and taken to mean the works by or by virtue of the contract contracted to be executed, whether temporary or permanent, and whether original, altered, substituted or additional.

Clause 27 A: Definition of Engineer-in-charge.

The term :Engineer-in-charge" means the Executive Engineer, who shall supervise, and be in charge of the work, and who shall sign the contract on behalf of the Jaipur Development Commissioner of Jaipur Development Authority.

Clause 28:

It cannot be guaranteed that the work will be started immediately after the bids have been received. No claims for increase of rate will be entered, if the bids for starting work are delayed.

Clause 29: Payments at reduced rates on account of items of work not accepted and not completed to be at the discretion of the Engineer-in-charge.

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The rates for several items of works, estimated to cost more than Rs.1000/- agreed within, will be valid only when the item concerned is accepted, as having been completed fully in accordance with the sanctioned specifications. In cases, where the items of work are not accepted, as so completed, the Engineer-in-charge may make payment on account of such items, at such reduced rates as he considers reasonable, in the preparation of final or on account bills, and his decision in the matter shall be final and binding.

Clause 29A: Payments at part rates:

The rates for several items of works may be paid at his rates provisionally in running bills in proportion to the quantum of items executed at the discretion of Engineer-in-charge. In case of item rates, if the rate quoted for certain items are very high in comparison to the average / overall bid premium, then the payment at running stages shall not be made more than the average sanctioned premium. The deferred payment, will however be released after successful completion of the work.

Clause 30: Contractor's percentage, whether applied to net or gross amount of bills:

The percentage referred to in the "Bid of Works" will be deducted / added from / to the gross amount of the bill before deducting the value of any stock issued.

Clause 31: Contractor to adhere to labour laws / regulation:

The contractor shall adhere to the requirements of the Workmen's Compensation Act and Labour Legislation in force from time to time and be responsible for and shall pay any compensation to his workmen which would be payable for injuries under the workmen Compensation Act, hereinafter called the said Act. If such compensation to his workmen which would be payable for injuries under the Workmen's Compensation Act, hereinafter called the said Act. If such compensation is paid by the State as Principal employer under sub Section (1) of section 12 of the said Act, on behalf of the contractor it shall be recoverable by the State from the Contractor under sub section (2) of the said section. Such compensation shall be recovered in the manner laid down in clause I of the conditions of contract.

Note: All Contractors with Government shall require registration of workers under the Building & other Construction Workers (Regulation of Employment & Conditions of Services) Act, 1996 and extension of benefit to such workers under the Act.

Clause 32: Withdrawal of work from the Contractor:

If the Engineer-in-charge shall at any time and for any reasons, whatsoever, including inability to maintain prorate progress, think any portion of the work should not be executed or should be withdrawn from the contractor, he may, by notice in writing to that effect require the contractor not to execute the portion of the work specified in the notice or may withdraw from the contractor for the portion of work, so specified, and the contractor shall not be entitled to any compensation, by reason of such portion of work having been withdraw from him. The Engineer-in-charge may supplement the work by engaging another agency to execute such portion of the work at the cost of the original contractor, without prejudice to his rights under Clause 2. He shall also be competent to levy compensation for delay in progress. The recovery of excess cost shall be made from next available running bill or any other claim and shall not be deferred.

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Clause 33: The contractor includes clearance, leveling and dressing of site within a distance of 15 meters of the structure / building on all sides except where the building adjoins another building.

Clause 34: Project Works:

The contractor shall arrange to protect, at his own cost, in an adequate manner, all cut stone work and other work requiring protection and to maintain such protection, as long as work is in progress. He shall remove and replace this protection, as required by the Engineer-in-charge, from time to time. Any damage to the work, so protected, no matter how it may be caused, shall be made good by the contractor free of cost.

All templates, forms, moulds, centering, false works and models, which in the opinion of the Engineer-in-charge are necessary for the proper and workman like execution of the work, shall be provided by the Contractor free of cost.

Clause 35: Contractor liable for settlement of claims caused by his delays:

If the progress of the work has fallen so much in arrears as to prevent other contractors on the work, from carrying out their part of the work within the stipulated time, he will be liable for settlement of any claim, put in by any of these contractors for the expenses of keeping their labour unemployed, to the extent considered reasonable by the Engineer-in-charge.

Clause 36A: The liability, if any, on account of quarry fees, royalties, octroi and any other taxes and duties in respect of materials actually consumed on public work, shall be borne by the Contractor.

Clause 36B:

The cost of all water connections, necessary for execution of work, and the cost of water consumed and hire charges of meters and the cost of electricity consumed in connection the execution of work, shall be paid by the Contractor except where other specifically indicated.

Clause 36C: Payment of Sales Tax and any other Taxes:

Royalty or other tax on materials, issued in the process of fulfilling contract payable to the Jaipur Development Authority under rules in force will be paid by the Contractor himself.

Clause 36D:

In respect of goods and materials procured by the Contractor for use in works under the contract, sales tax will be paid by the contractor, himself. But in respect of all such goods manufactured and supplied by the Contractor and works executed under the contract, the responsibility of payment of Sales tax would be that of the Engineer-in-charge.

Clause 37: Refund of Performance Guarantee and Security Deposit:

The performance Guarantee and / or security deposit will be refunded after the expiry of the period, as prescribed below:-

(a) In case of contracts relating to hiring of trucks and other 'T'&P' transportation including loading, unloading of materials, the amount of performance guarantee / security deposi is refundable along with the final bill.

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(b) Supplies of material: As per provision of the G.F. & A.R.

(c) Ordinary repair: 3 months after completion of the work provided the final bill has been paid.

(d) Original works / special repairs / renewal works: Six months after completion except in case of works, such as building works, bridge works, cross drainage work, Dams, canals water supply and sewerage schemes (except where provided otherwise in any specified case) etc., the Performance Guarantee / Security Deposit will be refunded 6 months after completion or expiry of one full rainy season, or after expiry of defect liability period as defined in the special condition of agreement whichever is later, provided the final bill has been paid. (Regarding "refund of performance guarantee and security deposit").

"In case of road, bridge and CD works (original/special, repairs/renewals). The defect Liability period shall be three years after completion of works".

(e) **(i) For construction phase** the Security Deposit amount shall become due and shall be paid to the contractor after expiry of Defect Liability Period

(f) The Security Deposit will be released in the following stages after satisfactory performance certificate issued by Engineer-In-Charge **:--**

1	After completion of one year	20 % of SD Amount
2	After completion of two years	20 % of SD Amount
3	After completion of three years	Remaining 60% of SD Amount

(g) **(ii) SD for O&M period** shall be deducted as 10% per running bill from running bills and shall be refunded after completion of O&M period of 10 years

Clause 38: Fair Wage Clause:

(a) The Contractor shall pay not less than fair wages / minimum wages to laborious engaged by him on the work as revised from time to time by the Jaipur Development Authority but the Jaipur Development Authority shall not be liable to pay anything extra for it except as stipulated escalation clause (clause 45) of the agreement.

Explanation: Fair wage means minimum wages for time or piece work, fixed or revised, by the State Govt. the Minimum Wages Act. 1948.

(b) The Contractor shall, notwithstanding the provisions of any contract to the country, cause to be paid fair wages to labourers indirectly engaged on the work, including any labour engaged by his sub-contractors in connection with the said work as if the labourers have been immediately or directly employed by him.

(c) In respect of all labourers immediately or directly employed on the work, for the purpose of the contractor's part of this agreement, the (Contractor shall comply with or cause to be complied with the Public Works Department Contractors Labour Regulations made, or that may be made by the Government, from time to time. With regard to payment of wages, wages period, deductions from wages,

(d) recovery of wages not paid, and unauthorized deductions, maintenance of wages register, wages card, publication of scale of wages and notice for employment, inspection and submission of periodical returns and other of a like nature.

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(e) The Engineer-in-charge 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 reasons of non-fulfillment of the conditions of the contract, for the benefit of the worker or workers, non-payment of wages or of deductions made there from, which are not justified by the terms of the contract, or as a result of non - observance of the aforesaid regulations.

(f) Vis-à-vis the Jaipur Development Authority of Rajasthan, the Contractor shall be primarily liable for all payments to be made and for the observance of the regulations aforesaid, without prejudice to his right to claim indemnify from his sub-contractors.

(g) The regulations, aforesaid, shall be deemed to be part of this contract and any breach, thereof, shall be deemed to be breach of the contract.

Clause 39: Contractor to engage technical staff:

The contractor shall engage the technical staff as follows, on the contract works at his own cost for which nothing extra will be payable.

(a) **For work costing Rs. 100 Lakh and above :- One Graduate Engineer** .

(b) **For work costing between Rs. 50 Lakh to Rs. 100 Lakh :- One qualified Diploma holder having experience of not less than three years** .

(c) **For work costing between Rs. 15 Lakh to Rs. 50 Lakh :- One qualified Diploma holder**

The technical staff should be available at site, whenever required by Engineer-in-charge to take instructions.

Clause 39A: The contractor shall comply with the provisions of the Apprenticeship Act, 1961, and the Rules and orders issued, there-under, from time to time. If he fails to do so, his failure will be a breach of contract. The contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provisions of said Act.

Clause 40: Safety of Works : The Contractor shall follow the safety code. The contractor shall be fully responsible for safety of works at site taking note of all the necessary provisions as per Employer's conditions of contract for safety, Health and Environment Manual (SHE Manual) available at Section 7,which shall be binding on the contractor. The contractor's price shall be inclusive of all the necessary costs to meet the prescribed safety standards. In the case the contractor fails in the above, the Employer may provide necessary arrangements and recover the cost from contractor.

Clause 41: Near Relatives barred from tendering: The contractor shall not be permitted to bid for works, in same Circle, in which his near relative is posted as Accountant or as an officer in any capacity between the grades of the Superintending Engineer and Assistant Engineer (both inclusive). He shall also intimate the names of persons, who are working with him in any capacity or are subsequently employed by him and who are near relative to any gazetted officer in the organization / Department. Any breach of this condition by the contractor would render him liable to be removed from the approved list of contractors of the Department. If it is noticed (a) before sanction of bid, his offer shall be declared invalid and earnest money

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be forfeited, (b) after sanction of the bid then bid sanctioning authority may at his discretion forfeit his earnest money, performance guarantee, security deposit and enlistment deposit and the work / remaining work may allot to any registered contractor on the same rates as per rules.

Note : By the term 'near relative' is meant wife, husband, parents and grandparents, children and grand children, brothers and sisters, uncles and cousins and their corresponding in laws.

Clause 42: Retired Gazetted Officers barred for 2 years: No Engineer of Gazetted rank or other Gazetted officer, employed in Engineering or Administrative duties in an Engineering Department of the Jaipur Development Authority, is allowed to work as a contractor for a period of 2 years, of his retirement from Jaipur Development Authority Service without the previous permission of Jaipur Development Authority. The contract is liable to be cancelled, if either the contractor or any of his employee found, at any time, to be such a person, who had not obtained the permission from as aforesaid before submission of the bid or engagement in the contractors service as the case may be.

Clause 43: Quality Control

The Jaipur Development Authority shall have right to exercise proper quality Control measures.

Clause 43A:

The work whether fully constructed or not and all materials machinery tools and plant scaffolding temporary buildings and other things connected therewith shall be at the risk of the contractor until the work has been delivered to the Engineer in charge and a certificate from him to effect obtained.

Clause 44: death of Contractor:

Without prejudice to any of the rights or remedies under the contract, if the contractor dies, the legal heirs of the contractor or the JDA or duly authorized Engineer shall have the option of terminating the contract without any compensation.

Clause 45 & 45A: Price variations Clause: Deleted

Clause 46 Force Majeure:

Neither party shall be liable to each other for any loss or damage occasioned by or arising out of acts of God such as unprecedented floods volcanic eruptions earthquake or other invasion of nature and other acts.

Clause 47: General discrepancies and errors:

In case of percentage rate bids if there is any typographical or clerical error in the rates shown by the Department in the "G" schedule the rates as given in the basic schedule of Rates of the Department of the area shall be taken as correct.

Clause 48: Post payment audit & technical examination:

The Jaipur Development Authority shall have right to cause an audit and technical examination of the works, and the final bills of the contractor, including all supporting vouchers, abstracts etc., to be made within 2 years after payment of the final bill and if as a result of audit and technical examination any sum is found to have been over paid in respect of any

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done by the contractor under the contract or any work claimed by him to have been done by him under the contract and found not to have been executed below specifications, the contractor shall be liable to refund the amount of over payment and it shall be lawful for Department in recover the same from him in the manner prescribed in clause 50 or in any other manner legally permissible and if it is found that the contract was paid less than what due to him under the contract in respect of any work executed by him under it the amount of such under payment shall be duly paid by the Jaipur Development Authority to the contractor.

Clause 48A: Pre check or post check of Bills:

The Jaipur Development Authority shall have right to provide a system of pre-check of contractor bills by specified organisation and payment by an Engineer or an accounts officer/Sr. Accounts Officer/Chief Accounts Officer/ Financial advisor as the Jaipur Development Authority may in its absolute discretion prescribe any overpayments/excess payments detected as a result of such pre-check or post check of contractor's bills can be recovered from the contractor's bills in the manner herein before provided and the contractor will refund such over/excess payments.

Clause 48 B: Check Measurements:

The department reserves to itself the right to prescribe a scale of check measurement of work in general or specific scale for specific works or by other special orders (about which the decision of the department shall be final) checking of measurement by superior officer shall supersede measurements by the subordinate officer and the former will become the basis of the payment. Any over/excess payment detected as a result of such check measurement or otherwise at any stage upto the date completion and the defect removal period specified elsewhere in this contract shall be recoverable from the contractor as any other dues payable to the government.

Clause 49: Dismantled Materials:

The Contractor in course of the work should understand that all materials e.g. bricks still and other obtainable in the work by dismantling etc. will be considered as the property of the Jaipur Development Authority and will be disposed off to the best advantage of the Jaipur Development Authority as per directions of the Engineer in-charge.

Clause 50: Recovery from contractors:

Whenever any claim against the contractor for the payment of a sum of money arises out of or under the contract the Department shall be entitled to recover such sum by appropriating in part or whole of the performance guarantee and/or security deposit. Security Deposit at the time of enlistment of the contractor. In the event of the security being insufficient or if no security has been taken then the balance or the total sum recoverable, as the case may be shall be deducted from any sum then due or which at any time thereafter may become due to the contractor, under this or any other contract with the Jaipur Development Commissioner of Jaipur Development Authority of Rajasthan should this sum be not sufficient to cover the full amount recoverable the contractor shall pay to the department on demand the balance remaining dues.

The department shall further have the right to affect such recoveries under public Demands recovery Act.

Clause 51: Jurisdiction Court:

In the event of any dispute arising between the parties hereto in respect of any of the matters comprised in this agreement the same shall be settled by a competent court [illegible]

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jurisdiction over the place where agreement is executed and by no other court after completion of proceeding under clause 23 of this contract.

Schedule of Material to be supplied by the Department if available

(Referred is in Clause 10)

S.No.	Particulars	Quantity	Rates		Place of Delivery
			Unit	Rupees	
1	NIL	NIL		NIL	

Schedule of Machinery /T&P to be supplied by the Department:

The following Machinery/ T & P shall be supplied by the Department if available to the contractor on hire as per rules of the Department for supply for machinery /T& P to the contractors on hire charges (Referred to in Clause 10 C)

S.No.	Item	Rate (Rs.)	Place of Delivery Return
1	**NIL**	**NIL**	

Progress Statements referred to in clause 2 of conditions of contract.

Name of work	Date from which the work should be commenced	Date by which the work should be completed	Monthly rate of progress
1	**2**	**3**	**4**

The contractor has been informed that his bid has been accepted.

Dated …….Signature Dated……..Signature of Contractor

Signature valid
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Notes: For Filling in the Progress Statement Form

1. Columns 2.3 and 4 must be initialed and dated by the contractor

2. Column 4 must be initialed and dated by the JDA or other duly authorised Engineer also.

3. The date in column 2 correspond to the date on which the order to commence work is given to the contractor read with clause 2 of the conditions of contract.

4. The date in column 3 must correspond to the period stated in sub clause (e) of the Memorandum below bid for works:

5. Column 4 this will ordinarily be worked out proportionately thus for example if ` 240000/- is the cost of whole or portion of work bided for and six months period of completion then the monthly rate of progress should be Rs. 4000. If necessary quantities may also be specified in this column at the discretion of the JDA.

6. The certificate as to intimation of acceptance of bid printed at the foot of the form must be signed and dated both by the Director Engineering-III or other duly authorized Engineer and the contractor.

Signature valid
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ANNEXURE TO APPENDIX XI

RAJASTHAN PUBLIC WORKS DEPARTMENT CONTRACTORS

LABOUR REGULATIONS

1. **Short Title**: These Regulations may be called "The Rajasthan Public Works Department Contractor's-Labour Regulations."

2. **Definition** : In these Regulations unless otherwise expressed or indicated, the following works and expressions shall have the meaning hereby assigned to them respectively, that is to say –

   (i) **"Labour"** means works employed by a Rajasthan P.W. Department contractor directly or indirectly through a sub-contractor or other person by an agent on his behalf.

   (ii) **"Fair Wage"** means minimum wages for time or piece work fixed or revised by the State Government under the Minimum Wages Act, 1948.

   (iii) **"Contractor"** shall include every person whether sub-contractor or headman or Agent employing labour on the work taken on contract.

   (iv) **"Wages"** shall have the same meaning as defined in the Payment of Wages Act and includes time and piece, rate wages.

3. **Display of Notice regarding wages etc.**: The contractor shall (a) before he commences his work on contract, display and inconspicuous place on the work notices in English and the correctly maintain in Hindi by the majority of the workers giving the rate of wages which have been certified by the Executive, Engineer, the Superintending Engineer, the Chief Engineer or Labour Commissioner as fair wages and the hours of works for which such wages are earned, and (b) such a copy of such notices to the Certifying Officers.

4. **Payment of Wages :**

   (i) Wages due to every worker shall be paid to him direct.

   (ii) All wages shall be paid in current coin or currency or in both.

5. **Fixation of wage periods** :

(i) The contractor shall fix the wage periods in respect of which the wages shall be payable.

(ii) No wage period shall exceed one month.

(iii) Wages of every workman employed on the contract shall be paid before the expiry of ten days after the last day of the wage period in respect of which the wages are payable.

(iv) When the employment of any worker is terminated by or on behalf or the contractor, the wages earned by him shall be paid before the expiry of the day succeeding the one on which his employment is terminated.

(v) All payments of the wages shall be made on a working day except when the work is completed before the expiry of the wage period, in which case, final payments shall be made within 48 hours of the last working day.

Note: The term "working day" means a day on which labour is employed in progress.

6. **Wage Book and Wage Slips etc.**

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(i) The contractor shall maintain a Wage Book of each worker in such form as may be convenient but the same shall include the following particulars :-

(a) Rate of daily or monthly wages.

(b) Nature of work on which employed.

(c) Total number of days worked during each wage period.

(d) Total amount payable for the work during each wage period.

(e) All deductions made from the wages with an indication in each case of the ground for which the deduction in made.

(f) Wages actually paid for each wage period.

(ii) The contractor shall also maintain a wage slip for each worker employed on the work.

(iii) The Executive Engineer may grant an exemption from the maintenance of the wage books and wages slips to a contractor who, in his opinion, may not directly or indirectly employ more than 50 persons on the work.

7. Fines and deductions which may be made from wages:

(i) The wages of a worker shall be paid to him without any deductions of any kind except those authorized, namely the following:

(a) Fines

(b) Deductions for absence from duty i.e. from the place or places where, by the terms of his employment, he is required to work. The amount of deduction shall be in proportion to the period for which he was absent.

(c) Deductions for damages to or loss of goods expressly entrusted to the employed person for custody or for loss or any other deductions of money, which he is required to account where such damages or losses are directly attributable to his neglect or default.

(i) The Rajasthan Government may, from time to time, allow deductions other than those specified in clause I above.

(ii) No fines shall be imposed on a worker and on deduction for damage or loss shall be made until worker has been given an opportunity or showing cause against each fine or deductions.

(i) The total amount of fines, which may be imposed in any one wage period on a worker, shall not exceed an amount equal to three paise in rupee of the wage payable to him in respect of that wage period.

(ii) No fine imposed on any worker shall be recovered from him by installments or after expiry of 60 days from the date on which it was imposed.

8. Register of fines etc.: The contractor shall maintain a register of fines and of all deductions for damage or loss. Such register shall mention the reasons for which fine was imposed of deduction for damage or loss was made. The Contractor shall maintain both in English and local Indian Language a list approved by the labour Commissioner clearly stating the acts and omission for which penalty or fine may be imposed on workman and display it in a good condition in conspicuous place of the work.

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9. **Preservation of Register**: The wage register, the wage card and the register of fines deduction required to be maintained under these regulations, shall be preserved for 12 months after the date or the 1st entry made in them.

10. **Powers of Labour Welfare Officer to make investigation of enquiry**: The Labour Welfare Officer or any other person, authorized by the State Government on their behalf shall have power to make enquiries with a view to ascertaining and enforcing due and proper observance of the fair wage clauses and provisions of the regulations. He shall investigate into any complaint regarding default made by the Contractor of Sub-Contractor in regard to such provisions.

11. **Report of Labour Welfare Officer**: The Labour Welfare Officer or other person, authorized as a aforesaid, shall submit a report of the result of his investigation or enquiry to the Executive Engineer concerned indicating the extent, if any to which the defaults has been committed with a note that necessary deductions from the contractors bill be made and the wage and other dues be paid to the labour concerned in case an appeal is made by contractor under clause 12 of these regulations, actual payment to Labours will be made by the Executive Engineer after the Labour Commissioner had given decision on such appeal.

12. **Appeal against the decision of labour Welfare Officers**: Any person aggrieved by the decision and recommendation of the Labour Officer or other persons, so authorised, and may appeal against. Such decision to the Labour Commissioner within 30 days from the date do decision forwarding simultaneously a copy of his appeal to Executive Engineer concerned but subject to such appeal the decision of the Officer shall be final and binding upon the contractor.

12-A. No Party shall be allowed to be represented by a lawyer during any investigation enquiry appeal or any other proceedings

13. **Inspection of Wage Books and Slips:** The contractor shall allow inspection of the wage books and wage slips and register of fines and deductions to any of his workers or to his agent at a convenient time and place after due notice is received or to the Labour Welfare Officer or any other person authorised by the State Government on his behalf.

14. **Submission of Returns**: The contractor shall submit periodical returns as may be specified from time to time.

15. **Amendments**: The Jaipur Development Authority may from time to time add to or amend these regulations and on any questions as to the application interpretation effect of these regulations the decision of the Labour commissioner to the Jaipur Development Authority or any other person authorised by the State Jaipur Development Authority in that behalf shall be final.Progress Statement referred to in Clause 3 of Conditions of Contract.

Name of works	Date from which the work should be commenced	Date by which the work should be completed	Monthly rate of progress
1	2	3	4

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The contractor has been informed that this bid has been accepted.

Date : **Date:**

Sig. Engineer in charge **Sig. Contractor**

Signature valid

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NOTES FOR FILLING IN THE PROGRESS STATEMENT FROM THE LAST PAGE

1. Columns 2,3 and 4 must be signed and dated by the contractor,
2. Column 4 must be signed and dated by the Director (Engineering) or other duly authorized Engineer also.
3. The date in column 2 should correspond to the date on which the order to commence works is given to the contractor specified in line 3 clause 2 page 3 of the conditions or contract.
4. The date in column 3 must correspond to the period stated in clause (f) page 2 of the bid.
5. Column 4. This will ordinarily be worked out proportionately thus, for example, if 240000/- is the cost of the whole or portion of work bided for and six months period of completion then the monthly rate of progress should be Rs. 4000. If necessary, quantities may also be specified in this column at the discretion of the JDA.
6. The certificate as to intimation acceptance of bid printed at the foot of the form must be signed and dated both by the JDA or other duly authorized Engineer and the Contractor.

(Signature of contractor) **(Signature of Engineer)**

Signature valid
Digitally signed by Dilip Lamba
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SCHEDULE OF FAIR WAGE TO BE GIVEN BY EXECUTIVE ENGINEER LIST OF ACTS AND COMMISSION FOR WHICH FINE CAN BE IMPOSED

(1) Without insubordination or disobediences whether alone or combination with another.

(2) The fraud or dishonesty in connection with the contractors business or property of the Rajasthan P.W.D./ JDA.

(3) Taking or giving bribes or any illegal gratification

(4) Labour late attendance

(5) Drunkenness fighting not or disorderly or indecent behavior

(6) Habitual negligence

(7) Smoking near or around the area where combustible or other materials are stocked

(8) Habitual indiscipline

(9) Causing damage work in progress or to property of the Rajasthan P.W.D./ JDA or the contractor

(10) Sleeping on duty

(11) Malingering or sowing down work.

(12) Giving of information regarding name age father's name

(13) Habitual loss of wage cards supplied by the employers

(14) Un-authorised use of employer's property or manufacturing or making of unauthorized articles at the work place.

(15)Bad workmanship in construction and maintenance by skilled workers is not approved by the department and for which contractors are compelled to undertake rectification.

(16) Making false complains and/or misleading statement

(17) Engaging in trade within the premises of the establishment

(18) Any delinquency of business affairs of the employers

(19) Collection or canvassing for the collection of any money within the premises of an establishment unlessauthorized by the employer.

(20) Holding meeting inside the premises without previous sanction have the employer

(21) Threatening or intimidating any workman or employee during the working hours Within the premises.

(Signature of contractor) (Signature of Engineer)

Signature valid
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STATEMENT OF PAYMENT & RECOVERIES TO BE ATTACHED WITH THE AGREEMENT OF WORKS

			Recoveries									Net Amt.	C.B. Vr. No. & Date	Date rates of	
S. No.	Gross amt. of Bill	Progressive total amt. of Bills	Materials T&P	Quantity Hours	Amount	S.D.	Income tax deduction	Sales Tax	Royalty	Other Recoveries	Total Recoveries			D.A.O	E.E.
1	2	3	4(a)	4(b)	4(c)	4(d)	4(e)	4(f)	4(i)	4(j)	4(j)	5	6	7	8

Signature of Bidder

Signature valid

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SECTION – 3

(OTHER CONDITIONS OF CONTRACT)

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SECTION - 3

OTHER CONDITIONS OF CONTRACT

3.1 GENERAL

3.1.1 **These OTHER Conditions of Contract' (OCC) shall be applicable to this bid in amplification/modification of the 'General Conditions of Contract'(GCC).**

3.1.2 In case any clause provided in GCC is modified/amplified in OCC, then provision in OCC will be binding and will prevail over the corresponding provisions in GCC.

3.1.3 The Contractor shall carry out the Works based on the following:

(i) Rajasthan PWD/Jaipur JDA Standard Specifications (Civil works)/RUIDP BSR

(ii) MORT&H/IRC Specifications (latest revision) wherever applicable

The attention of the contractor is drawn to those clauses of codes, which require supporting specification either by the engineer or by mutual agreement between the Contractor and Employer. In such cases, it is the responsibility of the Contractor to seek clarification on any uncertainty and obtain prior approval of the Engineer before taking up the supply/construction. In absence of such prior clarification, the Engineer's choice/design will be final and binding on the Contractor without involving separately any additional payment.

The latest edition of all Specifications / Standards till 30 (Thirty) days before the final date of submission of the bid, shall be adopted.

3.2 SCOPE OF WORK AND DEVIATIONS

3.2.1 Scope of work would be as specified under technical specification of work

3.2.2 The Contractor is not to vary or deviate from the drawings/specifications/stipulations as submitted by contractor and finally approved by Jaipur Development Authority(JDA) for execution, conditions of bid documents or instructions to execute work of any kind, whatsoever, unless so authorized by the Engineer-in-charge (E.I.C.) in writing. If, compliance with the E.I.C's aforesaid order involves extra work and/or expense beyond that is involved in the execution of the contract work, then unless the same were issued in consequence of some breach of this contract on part of the Contractor(s), the latter shall be entitled to be paid the price of the said work to be valued as provided in 'GCC'.

3.2.3 The several documents forming the contract are to be taken as mutually explanatory to one another, detailed drawings being followed in preference to small scale drawings and figured dimensions in preference to the measured ones.

3.2.4 The right to carry out the work either in conformity with or in a manner entirely different from the terms of these Bid Documents that may be considered the most suitable before or subsequent to the receipt of bids due to exigencies of work is reserved with the EIC.

3.2.5 It shall be the responsibility of the Contractor to promptly bring to the notice of E.I.C. any error or discrepancy in the Contract Documents and obtain his orders thereon. Only stated dimensions are to be taken and not those obtained by scaling drawings. In case any feature of the work is not fully described and set forth in the drawings and specifications, the Contractor shall forthwith apply to the EIC for further instructions and drawings and specifications.

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3.2.6 In case of errors, omission and/or disagreement between written and scaled dimension in the drawings and between the drawings and specifications, the following principles shall be followed.

a) As between the written description or written dimension in the drawing and the corresponding one in the specification, the former shall apply.

b) The drawing on a large scale shall take precedence over that on a smaller scale, and

c) Drawing approved as construction drawing from time to time shall supersede corresponding drawing previously approved.

3.3 RATES AND OTHER FINANCIAL CONDITIONS

3.3.1 The rate quoted in the bid must be for the finished work as per the drawings and specifications and unless clearly specified otherwise, shall be inclusive of all expenses for the proper and entire completion of work and shall be inclusive of all labour, material and other inputs, taxes, duties and levies including sales tax, municipal taxes, local taxes, octroi, all royalties, patent rights, other incidental charges etc. The rate offered shall be final and no claim whatsoever on any account shall be entertained.

3.3.2 GST registration

3.3.2.1 GST registration required for payment to the contractor.

3.3.3 Insurance

3.3.3.1 Requirements

Before commencing execution of works, it shall be mandatory for the contractor to obtain at his own cost insurance cover to meet the cost of compensation to be paid by the contractor for any accidents/incidents pertaining to J.D.A staff, site execution staff, labour, materials, plant and third party damages etc., under the following requirements:

a. Contractor's all risk and Third Party Cover.

b. Liability under the Workmen's Compensation Act, 1923, Minimum Wages Act, 1948, and Contract Labour (Regulation and Abolition) Act 1970.

c. Accidents to staff, Engineer, Supervisors and others who are not governed by Workmen's Compensation Act.

d. Damage to Material, Machinery and works due to fire, theft etc.

e. Any other risk may be specified in the Special Conditions of Contract.

3.3.3.2 Insurance policy in joint names of Contractor and Employer

The policy referred to under sub-clause 3.3.3.1 above shall be obtained in the joint names of the contractor and the employer and shall inter-alia provide coverage against the following, arising out or in connection with execution of works, their maintenance and performance of the contract.

- Loss of life or injury involving public, employee of the contractor, or that of Employer or Engineer, labour etc.
- Injury, loss or damages to works or property belonging to public, Government Bodies, Local Authorities, utility organizations, contractors, employers or others etc.

3.3.3.3 Currency of Insurance Policy

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The policies shall remain in force throughout the period of execution of the works and till the expiry of the maintenance period. The contractor shall, submit to the Engineer or his representative the copies of various insurance policies obtained by him as also the rates of premium and the receipts for premium paid by him to ensure that the policies indeed continue to be in force.

3.3.3.4 Deduction of Income Tax (TDS)

Deduction towards income tax and any other tax shall be made at source from each on account bill by the employer as per rules of Central Govt./ State Govt.

3.3.4 Release of Security Deposit

The Security Deposit wil l be release as per provisions of Clause 37 of GCC after passing of Final Bill after satisfactory performance certificate issued by Engineer-In-Charge or as per order issued by JDA D-29 dated 11.03.2016.

Provided always that, no 'Security Deposit' amount shall become due nor payable to the contractor unless all the stipulations of the contract have been fulfilled by the contractor and all claims and demands made by the employer for and in respect of damage or loss by, from or in consequence of the works have been finally satisfied.

3.4 SETTING OUT

3.4.1 The Contractor(s) is/are to set out the whole of the work in conjunction with an officer to be deputed by the EIC and during the progress of the work to amend on the requisition of the EIC any errors which may arise therein and provide all the necessary labour materials and equipment's for so doing. The contractor(s) is/are to provide all tools, plant, machinery, labour and materials (with the exceptions noted in the relevant clauses for issue of departmental materials as per schedule attached) which may be necessary and required for the work. All materials and workmanship shall conform to the relevant specifications mentioned in the bid documents.

3.5 SITE, TRANSPORTATIONS AND CONTRACTOR'S OFFICE

3.5.1 The Contractor shall set up an office in Jaipur in case he does not have one already, for planning and co-ordination of the present bid/contract. He shall furnish to the Employer postal address of the same.

3.5.1.2 The contractor shall provide and maintain at the work site, an air conditioned site office for Employer's engineering staff, of floor area not less than 35 Sq M with two rooms of adequate size reasonably furnished with furniture , computer with operating system software and latest (authenticated) working software like Auto Cad, Primavera / MS project MS word, MS Excel, etc, and coloured multi-functional printer (MFP) A-3 size printer. The site office shall also be equipped with broadband connection (speed not less than 2.0 mpbs), with attached toilet and watch and ward and one attendant. The contractor shall also arrange all necessary IRC codes, IS codes MoRTH Specifications and other technical literature, etc as directed by EIC of latest version in soft copies as well as hard copies, in the site office. The contractor shall bear the monthly cost of electricity, water consumption, broadband, stationary and other consumables of the site office. Nothing extra shall be payable on this account and the bided cost of contract shall be deemed to include in the cost for the main works. In case of non-satisfaction of the services being provided or maintained a maximum deduction of Rs. 10,000/- per month will be made by the EIC.

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3.5.1.3 Any notice or instructions to be given to the Contractor under the terms of the contract shall be deemed to have been served on him if it has been delivered to his authorised agent or representative at site, or if it has been sent by registered post to the site office or to the address of the firm last provided by the Contractor.

3.5.2 Use and Care of Site

3.5.2.1 The Contractor shall not demolish, remove or alter structure or other facilities on the site without prior approval of the EIC.

3.5.2.2 All garbage shall be burnt or removed from the site as it accumulates. All surface and sub soil drains shall be maintained in clean, sound and satisfactory state of performance.

3.5.3 Materials, tools and plants.

3.5.3.1 The Contractor shall supply at his own cost all materials, plants, tools, appliances, implements, ladders, tackle, scaffolding and temporary works or any other item required for the proper execution of the work, whether original, altered or substituted and whether included in the specification or other documents forming part of the contract referred to in these conditions or not, which may be necessary for the purpose of satisfying or complying with the requirements of the EIC to any matter as to which under these conditions he is entitled to be satisfied or which he is entitled to require together with carriage thereof to and from the work. Materials so supplied shall have the approval of EIC before being used on the works. All the rejected materials shall be removed at once from the site of work at the Contractor's own cost.

3.5.4 Storage of Materials

3.5.4.1 Materials required for the work whether purchased by the contractor or supplied by the Employer shall be stored by the Contractor only at places, in standard profiles and in the manner approved by the EIC. The Contractor shall construct suitable godown at the site of work for safety against damage due to sun, rain, dampness, fire, theft etc. Storage of cement at site of work shall be at Contractor's expense and risk. In the event of any damage occurring to cement due to faulty storage in Contractor's sheds, or on account of negligence on his part, such damage shall be the liability of the Contractor.

3.5.4.2 Safety of materials

Storage and safe custody of materials shall be the responsibility of the Contractor. He shall employ necessary watch and ward establishment for that purpose and no extra claim whatsoever shall be entertained on this account.

3.5.5 Supply of water and electric power

3.5.5.1 The contractor shall have to make his own arrangement for water supply and electric power necessary for the work. Any recommendatory letters to the concerned department shall be issued by the JDA for this purpose if requested by the contractor. However, JDA shall not be responsible for any delay in getting the required supply and no claim on this account will be acceptable by JDA.

3.5.5.2 Electric supply, charges and precautions

The electric connections shall be obtained by the contractor for use for the work under the contract subject to following conditions:-

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a) The charges pertaining to electric supply including installation of temporary connection including the cost of making electric sub-station if needed, laying cables wherever necessary upto the meter from the relevant electricity supply authority pole and from meter upto actual consumption point and the cost of electricity shall be borne by the Contractor. The Contractor shall also bear the entire cost of connection charges in case electric connection is discontinued by the electric supply authority.

b) It will be the responsibility of the Contractor to make necessary arrangements for the illumination to be provided on the main road in the work area. The Contractor shall make his own arrangement for any further requirements in respect of illumination at site of work. No claim whatsoever on this ground shall be entertained and the Contractor shall bear the full expenses in respect of the same.

c) The Contractor shall at all times observe the Indian Electricity Rules and any other rules/bye laws applicable at the time and any damage/penalty on account of violation of any of the rules/bye laws shall be responsibility of the Contractor.

d) The Employer shall in no way be responsible for any delay in getting the electric connection and no claim on this account whatsoever, shall be entertained. It should be clearly understood that the Contractor has to make his own arrangement for use before the electric connection is made available and also to be used as a stand-by arrangement in case of power failure etc. or in the case of disconnection of electric supply by electric supply authority for any reason.

e) It shall be mandatory for contractor to provide safety light during night for safe movement of traffic and provide follow safety instruction provided in IRC code for safety in construction zone.

3.6 ACCESS ROADS AND HAUL ROADS

3.6.1 Existing public roads may be used by the Contractor to carry out construction activities with prior approval of the competent authority. The Contractor shall pay all statutory vehicle licenses and permit fees for the use of public roads.

3.6.2 The Contractor shall indemnify the Employer against all claims for damage to any road or bridge caused by movement of his traffic, including such claims as may be made directly against the Employer and shall negotiate and pay all claims arising out of such damage.

3.6.3 No extra payment will be made for construction and maintenance of any temporary haul roads including any special protection or strengthening required and all cost of such works shall be deemed to have been included in the cost quoted by the Contractor.

3.7 SAFETY, LIGHTING AND FIRE PREVENTION

Safety of Workers

1.7.1 The Safety Code annexed to the General Conditions of Contract supplemented by the other instructions by the EIC and Conditions of Contract for Safety, Health and Environment (SHE) as per Section7, shall be strictly followed. All the safety procedures as per law of the land shall be binding on the Contractor.

1.7.2 Over and above the provisions made in Safety Code included in GCC and Conditions of Contract for Safety, Health and Environment (SHE) the following will also be applicable.

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1.7.3 In respect of all workmen directly employed on the work for the performance of the Contractor's part of this agreement, the Contractor shall at his expense arrange for the safety provisions as per Indian Standard Safety Codes given below and shall at his own expense provide for all facilities in connection therewith. In case the Contractor fails to make arrangements, and provide necessary facilities as aforesaid, he shall be liable to pay penalty prescribed under relevant clauses of these bid documents for each default and in addition the EIC shall be at liberty to make arrangement and provide facilities as aforesaid and recover the cost incurred on that account from the contractor and no claims whatsoever shall be entertained.

1. IS 3696 (Part I); Safety Code for Scaffolds and Ladders.
2. IS 3696 (Part II); Safety Code for Scaffolds and Ladders Part II.
3. IS 3764, Safety Code for excavation work.
4. IS 4081 , Safety Code for blasting and drilling operations
5. IS 4138, Safety Code for working in compressed air.
6. IS 5121; Safety Code for piling and other deep foundations.
7. IS 5121, Safety Code construction involving use of hot bituminous materials.
8. IS 7293, Safety Code for working with construction machinery.
9. IS 7969, Safety Code for storage and handling of building materials.
10. IRC safety code for construction zone IRC(SP) 55 2001
11. Any other code and/or as per directions of EIC.
12. The contractor shall be responsible for providing following services/ measures for which no extra payment shall be made as per directions of Engineer In charge.

(a) The contractor shall take all necessary precautions for excavation of required depth up to 6.0 m for construction and simultaneously to maintain the service road carriageway uninterrupted for all direction traffic throughout construction period. He should also give his methodology of carrying out the construction, list of equipment and procedure to be followed without delaying the project. The methodology shall only be adopted after approval from Engineer In charge. The contractor should cover all the expenses due to methodology adopted and construction difficulties in the quoted rates.

(b) Contractor has to divert and manage traffic by deploying marshals with reflective shirts, torch/reflective sticks. In the absence of marshals JDA shall deploy the marshals at market rate and recovery from the contractor will be done at double the rate paid from his running payments. The open excavation shall be done taking proper care for land sliding as per IS Code 3764 and other. Slope shall be limited to space available at site at least 2 lanes should be available for either side traffic such arrangement as approved by Engineer In charge shall be done by contractor at his own cost.

(c) In case of any lapse , if found in barricading the site of work then, agency will be liable for penalty @ Rs. 5000/-per day (Rs. Five Thousand per day) till the rectification of the same as per directions of Engineer In charge in construction area. The contractor shall enclose the area completely. The steel plates should have the Name of Agency, Name of Client and "Construction in Progress" duly written as approved by Engineer In charge.

(d) The contractor shall construct and maintain the 2 lane diversion road with bituminous surface road for bridge work for smooth movement of all traffic till the construction period. No cost will be payable for this diversion work.

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(e)The contractor shall be responsible for immediately removing the accident vehicle/ material by mobile crane for least hindrance to the traffic in construction area and to arrange the ambulance as per requirement immediately.

(f) The contractor shall take all necessary measures for the safety of traffic and the workers during construction and provide, erect and maintain such barricades including signs, markings, flags, lights and flagmen as necessary, all around the excavation/construction area and at such intermediate points, as directed by the EIC including the proper identification of the construction areas. He shall be responsible for all damages and accidents on account of construction and other relevant activities. Nothing extra shall be paid on account of above.

The temporary warning signs/lamps shall be installed at all barricades during the hours of darkness and kept lit there at all times during these hours and nothing shall be paid extra on this account. However, traffic police signals shall not be the responsibility of the contractor.

(g)The contractor will be responsible for following all the norms, instructions mentioned in Safety Codes of IS/ BS or other for every construction activity, heavy machines including operator and technical staff. In case of any casualty JDA will not be responsible for negligence of contractor. He will appoint safety induction officer having minimum qualification, Diploma in such field with minimum 5 years experience in similar nature of works.

(h)Nothing extra will be paid on account of Dewatering.

1.7.4 NIGHT WORK:- Normally No work during night work shall be allowed .In any special situation permission from EIC is required to execute the work during the night.

1.7.5 SECURITY MEASURES

Security arrangement for the work shall be adequate conforming to IS Codes, applicable rules and laws of the land. The contractor shall be held responsible for the action or inaction on the part of his staff and employees and also those of any approved sub-contractor. The Contractor shall also provide and maintain adequate security personnel on continuous basis for ensuring security of the works for duration of contract.

The requirement of security measures to be taken by the Contractor shall include, but not be limited to maintenance of law and order at site, provision of all lighting, guards, flagmen and all other measures necessary for protection of works within the colonies, camps and elsewhere at site, all materials delivered to the site and all persons employed in connection with the work continuously throughout working and non-working periods including nights, Sundays and holidays for the duration of the contract. In close proximity of traffic corridors where public are likely to come close to the work area, suitable barriers/fencing as directed by EIC shall be provided.

1.7.6 **ANCILLARY AND TEMPORARY WORKS**

i. The contractor's proposals for execution of all ancillary and temporary works shall be in conformity with the proposals submitted along with the Tender and modification thereto as approved by the EIC.

ii. The Contractor shall submit drawings, supporting design calculations and other relevant details of all such work to the EIC for approval by the EIC and other relevant details of all such work to the EIC for approval of all

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before he desires to commence such works. Approval by the EIC of any such proposal shall not relieve the Contractor of his responsibility.

iii. No extra payment shall be made for complying with the provisions of this clause. The cost of the same shall be deemed to be included in the Tendered Cost as accepted by the Employer.

iv. No separate payment shall be made for complying with provisions of this clause and all costs shall be deemed to have been included in the Tendered Cost as accepted by the Employer.

v. The Contractor shall make his own arrangement for the disposal of the spoils from the works to such place where the same shall not cause nuisance and shall be acceptable to the authorities concerned.

1.7.7 SERVICES

i Underground and overhead services are likely to be met with during construction. These are to be protected against damage by the Contractor at his own cost.

ii The contractor shall not have any claim in case of delay in shifting of services or removal of obstructions. However, suitable extension of time shall be granted by Engineer-in-charge for such delays proportionately. Shifting charges shall be met by the Employer.

iii No extra payment will be made to the contractor for damage caused by rains, floods, earthquake, fire, accidents and other natural calamities during the execution of work.

1.7.8 PROGRESS & PROJECT MONITORING

(Amplification of clause 2 of GCC)

i After the work order issued by JDA, the contractor shall submit within 10 days the complete detailed work programme mentioning Key Dates for the mile stones and got it approved by JDA, failing which JDA may fix key dates at its own which shall be binding to the contractor and shall be applicable for deduction of liquidated damages. The contractor shall also submit monthly programme in the first week of every month to the EIC an up to dateprimavera/ MS project hard copy detail showing changes and covering backlog of previous month, if any, in planning or scheduling and reflecting the project status as at the end of previous month. If the contractor fails to submit the proper work program within first week of the month, penal deduction of Rs. 5,000.00 (Rupees Five Thousand) per day will be made..

ii Whenever the contractor proposes to change the construction programme he shall immediately advise the EIC in writing and, if the EIC considers the change a major one, the contractor shall submit a revised programme for approval.

iii If the contractor falls behind the approved construction programme, he shall, within fourteen days of the date of such default, submit for approval a revision of the construction programme showing the proposed measures, including augmentation of plant, labour and material resources to complete the works on time.

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iv The Employer or the EIC will hold periodical Progress Status Review Meeting. The Contractor shall depute his Engineers/Managers at appropriate level as decided by the EIC to attend the Review Meeting.

v Progress photographs of the major events shall be submitted by the Contractor along with the Progress Reports. No extra payment will be made for supply of progress photographs.

vi No separate payment shall be made for the requirement under this clause and the same shall be deemed to be included in the Tendered Cost as accepted by the Employer.

1.7.9 RIGHT OF WAY

i Right of way to the work site will be provided to the contractor. The contractor shall prepare at his own cost approach road to the site of work. The Employer reserves the right to make use of the service road for themselves, all other connected agencies in the area as and when necessary without any payment to the contractor. If the contractor wishes to use the existing roads, he may do so after taking permission from competent authority and after due strengthening of such roads to take any anticipated heaviest traffic at their own cost as may be required by the authority.

ii The contractor shall plan transportation of construction materials, components and equipment's over public roads in accordance with traffic regulations as applicable at the time and without causing any obstruction to other traffic or causing accident. No claim whatsoever will be entertained on this account.

iii All arrangements for maintenance of traffic diversion including traffic signals/regulations during construction and maintenance period shall be considered as incidental to the work and contractor's responsibility and nothing extra shall be payable in this respect.

iv The contractor shall take all necessary measures for the safety of traffic and the workers during construction and provide, erect and maintain such barricades including signs, markings, flags, lights and flagmen as necessary, all around the excavation/construction area and at such intermediate points, as directed by the EIC including the proper identification of the construction areas. He shall be responsible for all damages and accidents on account of construction and other relevant activities. Nothing extra shall be paid on account of above.

v The temporary warning signs/lamps shall be installed at all barricades during the hours of darkness and kept lit there at all times during these hours and nothing shall be paid extra on this account. However, traffic police signals shall not be the responsibility of the contractor.

3.8 TIME MANAGEMENT

3.8.1 Commencement of Work

The Contractor shall commence the Works on the date specified in the Letter of Acceptance or if no date is specified in the Letter of Acceptance, on the date specified in an instruction in writing to that effect from the Engineer. Thereafter the Contractor shall proceed with due diligence, without delay, and in accordance with the programme or any revised or modified programme of the Works. Time is

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the essence of Contract and time for Completion shall run from the date the Contractor is to commence the Works under this Clause.

3.8.4.1 Access for Engineer

The Contractor shall allow the Engineer or the Engineer's Representative, at all times access to the Site, and to any place where work in connection with the Contract is being carried out or is intended to be carried out and to any place where Materials or plant are being manufactured, fabricated and/or assembled for the Works. The Contractor shall ensure that sub Contracts if any shall contain provisions entitling the Engineer or any person authorised by him to have such access.

3.8.4.2 Access Road and Way Leaves

Providing access roads/ way leaves to the Site will be Contractor's responsibility.

3.9 Time for Completion

Time is the essence of Contract and will remain so at all times during the pendency of the Contract including the extended period of Contract. The Contractor shall ensure defect free completion of the whole of the Works and/or parts thereof before the same is taken over by the Employer.

3.10 Delay

3.10.1 Failure or delay by the Employer or the Engineer, to hand over to the Contractor the Site necessary for execution of Works, or any part of the Works, or to give necessary notice to commence the Works, or to provide necessary Drawings or instructions or clarifications or to supply any material, plant or machinery, which under the Contract, is the responsibility of the Employer, shall in no way affect or vitiate the Contract or alter the character thereof; or entitle the Contractor to damages or compensation thereof but in any such case, the Engineer shall extend the time period for the completion of the Contract, as in his opinion is / are reasonable.

3.10.2 In case of delay on the part of the Contractor, the Contractor shall be liable to pay liquidated damages in addition to any other compensation for the damages suffered by the Employer. This is without prejudice to the right of the Employer to rescind the Contract.

3.11 Extension of Time for Completion not on Contractor's fault

The time within which, the Works or any phase or part of the work is to be completed, may be extended by the Engineer by such further period of time as may reasonably reflect delay in completion of Works notwithstanding due diligence and the taking of all reasonable steps by the Contractor to avoid or reduce such delay, caused by any of the following events

i. "Force Majeure" referred to in **Clause 46.0**
ii. The issue of any instruction or major Variation by the Engineer
iii. The Contractor not being given possession of or access to the Site or any part thereof in accordance with the Contract
iv. Instruction of the Engineer to suspend the Works and the Contractor not being in default as to reasons of suspension

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v. Acts or omissions of Other Contractors in executing work not forming part of this Contract and on whose performance, the performance of the Contractor necessarily depends.

vi. Any act of prevention or Breach of Contract by the Employer and not mentioned in this Clause

vii. Any order of Court restraining the performance of the Contract in full or in any part thereof

viii. Any other event or occurrence which, according to the Employer is not due to the Contractor's failure or fault, and is beyond his control

However, the Contractor shall not be entitled to any extension of time where the instructions or acts of the Employer or the Engineer are necessitated by or intended to cure any default of or breach of Contract by the Contractor. If the Contractor considers himself to be entitled to an extension of time for Completion, he shall give notice to the Engineer of such intention as soon as possible and in any event within 28 days of the start of the event giving rise to the delay, together with any notice required by the Contract and relevant to such Clause.

3.12 Extension of Time for Delay due to Contractor and Liquidated Damage

3.12.1 Extension of Time for Delays due to Contractor

If the delay in the completion of the whole Works or a portion of the Works, for which an earlier completion period is stipulated, is due to the Contractor's failure or fault, and the Engineer is of the view that the remaining Works or the portions of Works can be completed by the Contractor in a reasonable and acceptable short time, then, the Engineer may allow the Contractor extension or further extension of time at its discretion with or without liquidated damages, for completion, as he may decide.

3.12.2 Liquidated Damages

3.12.2.1 In case the Engineer decides to extend the Contract with liquidated damages for delays due to Contractor, in that case without prejudice to any other right or remedy available to the Employer, the liquidated damages shall be levied as per clause 3.12.2.2.

The decision of the Engineer as to the Liquidated Damages payable by the Contractor under this Clause shall be final and binding. For submission of detailed work programme, key dates etc.

3.12.2.2 These liquidated damages shall not relieve the contractor from his obligation to complete the works or from any other of his obligations and liabilities under this contract. These liquidated damages levied shall be in addition to all other penalties/ compensations/ liquidated damages.

3.14 Suspension

3.14 .1 Suspension of Work:- The Engineer may at any time instruct the Contractor to suspend progress of part or all of the Works. During suspension, the Contractor will protect, store and secure such part or whole of the Works against any deterioration, loss or damage.

3.14.2 Consequences of Suspension:- The Contractor shall not be entitled to extra cost (if any), incurred by him, during the period of suspension of Work, if such suspension is

a. Provided for in the Contract, or

b. Necessary for proper execution of Woks or by reasons of weather conditions, or by some default on the part of the Contractor, or

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c. Necessary for the safety of Works or any part thereof or

d. Necessary for the safety of adjoining public or other property or safety of the public or workmen or those who have to be at the Site or

e. To ensure safety and to avoid disruption of traffic and utilities, as also to permit fast repairs and restoration of any damaged utilities.

3.15 TERMINATION OF CONTRACT

3.15.1 Termination for Employer's Convenience

(i) The Employer may terminate the Contract by giving notice to the Contractor with effect from the date stated in the notice, for its convenience and without need to give reasons.

(ii) The Contractor must comply with the instructions of the Employer to wind down and stop work and the Contractor must leave the Site by the date stated in the termination notice and remove all Temporary Works it has brought on to the Site except for those items identified in the termination notice as to be retained on the Site.

(iii) After termination under **Clause 3.15.1**, subject to its other rights under the Contract, the Employer must pay to the Contractor:

a. the value of approved Materials actually brought to the Site and reasonably required to execute the Works during next three months, as per approved programme, and

b. Value of Work completed up-to-date by the Contractor at rates specified in the Contract, after taking into account any deductions, retentions, setoff

c. In addition, a sum not exceeding 2% (two percent) of the value of the work remaining incomplete on the date of Termination notice taking effect.

(iv) The payment as above are full compensation for termination under this clause and the Contractor has no claim for damages or other entitlements whether under the Contract or otherwise.

(v) Any remaining tools, plants, equipment's and surplus Materials of Employer with Contractor will be returned to the Employer at Employer's depot at Contractor's cost. In case of failure of the Contractor to do so, the Employer will be entitled to recover their cost from the Contractor from the amount becoming due to the Contractor or from any other money due in any other Contracts. The decision of the Engineer of amount to be recovered will be final decision and full credit at rates initially charged to the Contractor shall be allowed for such Materials. Similarly the Employer shall be entitled to recover the cost of unreturned material, plant, equipment and tools from the Contractor where such Materials have been supplied free of cost and plant, equipment and tools free of cost or on lease basis to the Contractor as stipulated in the Special Conditions of Contract.

(vi) Provided further, that any diminution of quantities against individual items of the Contract, merely as a variation when the work is completed, shall not constitute foreclosure of Contract in terms of this clause, and no compensation or payment whatsoever as per this clause will be due or payable to the Contractor on that account.

3.15.3 Rescission of Contract Due To Death of Contractor / Partner

If the Contractor is an individual or a sole proprietary concern and the Contractor dies, or if the Contractor is a partnership concern and one of the partners dies, in that case unless the Employer is satisfied that the legal representative of the individual Contractor or of the sole proprietor concern in the case of a partnership firm, all surviving partners, are capable of carrying out and completing the Contract, the Employer shall be entitled to rescind the Contract

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as to its incomplete part. The Engineer's decision in this regard will be final and binding on the parties. In that event, the Employer shall not be liable to pay any compensation to the legal heirs of the deceased Contractor and / or to the surviving partners of the Contractor's firm, on account of such cancellation of Contract. Provided further that the legal representatives of the Deceased Contractor the surviving partners, shall also not be liable to pay any damages, to the Employer, in respect of incomplete part of the Contract. Any liability incurred by the deceased Contractor, or by the deceased partner of the Contracting firm, shall be recovered from the legal representatives of the deceased Contractor or from the surviving partners of the said Contracting firm as the case may be.

3.15.4 Termination of Contract Due To Contractor's Default

3.15.4.1 Notice to Correct

If the Contractor fails to carry out any obligation under the Contract, the Engineer may by notice require the Contractor to make good the failure and remedy it within a specified reasonable time as the Engineer may deem reasonable.

3.15.4.2 Conditions Leading To termination Of Contract

The Employer shall be entitled to terminate the Contract if the Contractor or any one of its constituents,

a) fails to comply with a notice under Sub clause 3.15.4.1
b) abandons or repudiates the Contract
c) without reasonable excuse fails to commence the Works in accordance with the Contract
d) sub Contracts the whole of the Works or assigns the Contract without Approval of the Employer
e) becomes bankrupt or insolvent or goes into liquidation except voluntary liquidation for the purpose of amalgamation or reconstruction
f) persistently disregards instructions of the Engineer or contravenes any provisions of the Contract, or
g) fails to adhere to the agreed programme of work by margin of 10% of the stipulated period or 21 days, whichever is earlier, or fails to complete the Works or parts of the Works within the stipulated or extended period of completion, or is unlikely to complete the whole Work or part thereof within time because of poor record of progress; or
h) fails to remove Materials from the Site, or pull down and replace work, after receiving notice from the Engineer to the effect that the said Materials or Works have been condemned or rejected, or
i) fails to take steps to employ competent and/or additional staff and labour, or
j) fails to afford the Engineer or his representative proper facilities for inspecting the Works or any part thereof, or
k) indulges in corrupt or fraudulent practices as explained in Clause 3.16.1 (a) (ii)

In any one these events or circumstances, the Employer may upon giving 14 days' notice to the Contractor, terminate the Contract and expel the Contractor from the Site. The Employer shall give a 2 days' notice to the Contractor towards the end of this 14 day period following which the Contractor shall remove all his plants and Machinery from the Site within these two days failing which Liquidated Damages shall be levied on the Contractor. However, in case of sub-paragraph (e) or (i), the Employer may by notice terminate the Contract immediately.

The Employer's election to terminate the Contract shall not prejudice any other rights of the Employer under the Contract.

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After termination, the Employer may complete the Works and/ arrange for any other entities to do so at the risk and cost of the Contractor. The Employer and his entities may then use, the roads, the Contractor's documents and his design document made by or on behalf of the Contractor.

On termination of Contract due to Contractor's default, the Employer shall be entitled to

a. forfeit the whole or such portion of the Performance Security amount as he may consider fit, and

b. Recover from the Contractor the cost of carrying out the balance work in excess of the sum which he would have been paid according to the certificate of the Engineer, if the Works had been carried out and completed by the Contractor under the terms of Contract. Such certificate shall be final and binding upon the Contractor. The amount to be recovered may be deducted by the Employer from any monies then due or which, at any time thereafter, may become due to the Contractor alone or jointly under this or any other Contract or otherwise.

3.15.4.3 Non-exercise of power not to constitute waiver

Provided always that in case any of the powers conferred upon the Employer by **Sub-clause 3.15.4.1** and **Sub-clause 3.15.4.2** above, shall have become exercisable, and the same may not have been exercised, the non-exercise thereof shall not constitute waiver of any of the conditions thereof.

3.16 CORRUPT OR FRAUDULENT PRACTICES

3.16.1 The Employer requires that the Bidders/Contractors observe the highest standards of ethics during

Tendering and execution of this Contract.In pursuance with this policy, the Employer:

a. defines, for the purpose of these provisions, the terms set forth below as follows:

(i) "corrupt practice" means the offering, giving, receiving or soliciting of anything of value to Employer, Engineer or any of their employees, influence in the procurement process or in Contract execution; and

(ii) "fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a Contract to the detriment of the Employer, and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.

b. Will reject the Tender for the work or rescinds the Contract if the Employer determines that the Bidder/Contractor has engaged in corrupt or fraudulent practices.

c. Will declare a Contractor ineligible, either indefinitely or for a stated period of time, to be awarded a Contract/s if he at any time determines that the Contractor has engaged in corrupt or fraudulent practices in competing for, or in executing the Contract.

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SECTION – 4

(FORM OF AGREEMENT)

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Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.:
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SECTION -5

FORM OF AGREEMENT

This AGREEMENT is made on …… day of …….. 2022 between (Name of Employer ……..) (Mailing Address of Employer ……..) hereinafter called "the Employer", of the one part (Name of Contractor …….. …… (hereinafter called "the Contractor) of the other part.

Whereas the Employer is desirous that certain works should be executed viz. (brief description work)…….. and has by Letter of Acceptance dated (Date of letter of acceptance) …… accepted Bid by the Contractor for the execution completion and maintenance of such works. NOW THIS AGREEMENT WITNESSED AS FALLOWS.

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.

The following documents shall be deemed to form and be read and construed as parts of the agreement viz:.

The Letter of Acceptance.

NIT, Technical Bid, Bid declaration form, other information, Special Conditions, RTPP Annexures.

Instructions to Bidders (Section -1).

General Conditions of Contract (Section – 2).

Other Conditions of Contract (Section - 3).

Technical Specification (Appendix-A) (Section – 4).

Form of Agreement (Section – 5)

Bank Guarantee (Section – 6)

The aforesaid documents shall be taken as complementary and mutually explanatory of one another.

In consideration of the payment to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute, complete and maintain the works in conformity in all respects with the provisions of the Contract.

The employer thereby covenants to pay the Contractor in consideration of the execution, completion and maintenance of the work of Contract Price at the time and in the manner prescribed by the Contract.

IN WITNESS whereof the parties have caused their respective Common Seals to be hereunto affixed (or have hereunto set their respective hands and seals) the day and year first above written, SIGNED SEALED AND DELIVERED by the.

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Designation : Executive Engineer
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Said ……. Said ……..

(Name ……..) (Name ……..)

on behalf of the Contractor on behalf of the Contractor

In the presence of : In the presence of :

Name: Name:

Address Address

This form is included in the bid documents only for the information of the bidders. Only the successful bids will in due course be required to complete the form.

Signature valid
Digitally signed by Dilip Lamba
Designation : Executive Engineer
Date: 2025.11.14 10:25:31 IST
Reason: Approved

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SECTION – 5

(Form of Bank Guarantee)

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Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

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Section - 6

Form of (Bank Guarantee) -En cashable at branch of the bank in Jaipur City.

To

Secretary,

Jaipur Development Authority,

Jaipur

Sub:

Bank Guarantee No. _____ dated _____ for [amount of Security in figures] [in words] on behalf of _____ [Name of the Bidder] against the Bid Security for Bid for **Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur..**

WHEREAS, _____ [name of Bidder with address] (hereinafter called "the Bidder") has submitted his Bid dated ..... for the work of **Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur.**

(hereinafter called "the Bid").

KNOW ALL PEOPLE by these presents that we _____

_____ (Name of Bank) of having our registered office at _____[name of country] having our registered office at _____ (hereinafter called "the Bank") are bound unto Secretary, Jaipur Development Authority. (Hereinafter called "the Employer") in the sum of Rupees _____ [Amount of Security in figures] _____ (in words) only for which payment will and truly to be made to the said Employer, the Bank binds itself, its successors, and assigns by these presents.

That on demand of JDA, this Bank Guarantee is encashable at following branch in Jaipur City.

SEALED with the Common Seal of the said Bank this _____ day of _____ of 20____

THE CONDITIONS of this obligation are:

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Designation : Executive Engineer
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If the Bidder withdraws his Bid during the period of Bid validity specified in the Form of Bid;

If the Bidder refuses to accept the correction of errors in his bid;

If the Bidder, having been notified of the acceptance of his Bid by the Employer during the period of Bid validity;

Fails or refuses to execute the Form of Agreement in accordance with the

Instructions to Bidders, or

Fails or refuses to furnish the Performance Security, in accordance with the Instructions to Bidders;

We undertake to pay to the Employer up to the above amount upon receipt of his first written demand, without the Employer having to substantiate his demand, provided that in his demand the Employer will note that the amount claimed by him is due to him owing to the occurrence of one or more of the above conditions, specifying the occurred condition or conditions.

This Guarantee will remain in force up to and including the date 30 days after the date of expiration of the Bid Validity, as stated in the Instructions to Bidders, or any such extension thereto as may be agreed by the Bidder, notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this Guarantee should reach the Bank not later than the above date.

The amount covered under the above Bank Guarantee shall be automatically be credited in the accounts of JDA in ICICI Bank, JDA Campus, Jaipur through IFSC code No ICIC 0006754. Bank Account No. 675401700518 on the date of expiry or its validity, unless the agencies get it re-validated well before its expiry date or produce NOC from JDA in written for its release.

Date _____ Signature of the Bank_____

Witness_____ Seal _____

[Signature, Name and Address]

[Note: To be furnished on appropriate non-judicial stamps.]

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SECTION – 6

(SAFETY, HEALTH and ENVIRONMENT MANAGEMENT CLAUSE)

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LABOUR SAFETY PROVISIONS

1.0 Suitable scaffolds should be provided for workmen for all works that cannot safely be done from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable footholds and hand holds shall be provided on the ladder and the ladder shall be given an inclination not steeper than ¼ to 1 (1/4 horizontal and 1 vertical).

2.0 Scaffolding or staging more than 3.6m (12 feet) above the ground or floor, swung or suspended from an overhead support or erected with stationery support shall have a guard rail properly attached or bolted, braced and otherwise secured at least 90 cm. (3 feet) high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such opening as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

3.0 Working platforms, gangways, and stairways should be so constructed that they should not sag unduly or unequally, and if the height of the platform or the gangway or the stairway is more that 3.6m (12 feet) above ground level or floor level, they should be closely boarded, should have adequate width & should be suitable fastened as described in (2.0) above.

4.0 Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 90 cm (3 feet).

5.0 Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9m. (30 feet) in length while the width between side rails in rung ladder shall in no case be less than 29 cm. (11.5”) for ladder up to and including 3m (10 feet) in length. For longer ladders this width should be increased at least 1/4" for each additional 30 cm (1 ft.) of length. Uniform step spacing shall not exceed 30 cm (12"). Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites of the work shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The contractor shall provide all necessary fencing and lights to protect the public from accident, and shall be bound to bear the expenses of defense of every suit, action or other proceeding at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and cost which may be awarded in any such suit, action or proceedings to any such person or which may, with the consent of the Contractor, be paid to compensate any claim by any such person.

6.0 EXCAVATION AND TRENCHING

All trenches, 1.2mts. (four feet) or more in depth, shall at all times be supplied with at least one ladder for each 30m. (100 feet) in length or fraction thereof, ladder shall be extended from bottom of the trench to at least 90cm (3feet) above the surface of the ground. The side of the trenches, which are 1.5 m. (5feet) or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger or sides to collapsing. The excavated materials shall not be placed within 1.5m (5 feet) of the edges of the trench or half of the depth of the trench whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done.

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7.0 Demolition - Before any demolition work is commenced and also during the progress of the work following precautions shall be observed:

7.1 All roads and open areas adjacent to the work site shall either be closed or suitably protected.

7.2 No electric cable or apparatus which is likely to be a source of danger or a cable or apparatus used by the operator shall remain electrically charged.

7.3 All practical steps shall be taken to prevent danger to persons employed from risk or fire or explosion or flooding. No floor, roof or other part of the building shall be overloaded with debris or materials as to render it unsafe.

8.0 All necessary personal safety equipments as considered adequate by the Engineer-in-charge should be kept available for the use of persons employed on the site and maintained in a condition suitable for immediate use, and the contractor should take adequate step to ensure proper use of equipment by those concerned. The following safety equipment shall be invariably provided.

8.1 Workers employed on mixing asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective goggles.

8.2 Those engaged in white washing and mixing or stacking of cement bags or any materials which are injurious to the eye shall be provided with protective goggles.

8.3 Those engaged in welding works shall be provided with welders protective eye shields.

8.4 Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe interval.

8.5 When workers are employed for works in sewers and manholes, which are in active use, the Contractors shall ensure that the manhole covers are opened and ventilated at-least for an hour before the workers are allowed to get into the manholes, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident the public. In addition, the contractor shall ensure that the following safety measures are adhered to:

a. Entry for workers into the sewer line shall not be allowed except under supervision of the JE or any other higher officer.

b. At least 5 to 6 manholes upstream and downstream should be kept open for at least 2 to 3 hours before any man is allowed to enter into the manholes for working inside.

c. Before entry, presence of Toxic gases should be tested by inserting wet lead acetate paper which changes color in the presence of such gases and gives indication of their presence.

d. Presence of Oxygen should be verified by lowering a detector lamp into the manhole. In case, no Oxygen is found inside the sewer line, workers should be sent only with Oxygen kit.

e. Safety belt with rope should be provided to the workers. While working inside the manholes such rope should be handled by two men standing outside to enable him to be pulled out during emergency.

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f. The area should be barricaded or cordoned off by suitable means to avoid mishaps of any kind. Proper warning signs should be displayed for the safety of the public whenever cleaning works are undertaken during night or day.

g. No smoking or open flames shall be allowed near the blocked manhole being cleaned.

h. The malba obtained on account of cleaning of blocked manholes and sewer lines should be immediately removed to avoid accidents on account of slippery nature of the malba.

i. Workers should not be allowed to work inside the manhole continuously.

He should be given rest intermittently. The Engineer-In-charge may decide the time up to which a worker may be allowed to work continuously inside the manhole.

j. Gas masks with Oxygen Cylinder should be kept at site for use in emergency.

k. Air-blowers should be used for flow of fresh air through the manholes.Whenever called for, portable air-blowers are recommended for ventilating the manholes. The Motors for these shall be vapour proof and of totally enclosed type. Non sparking gas engines also could be used but they should be placed at-least 2 metres away from the opening and on the leeward side protected from wind so that they will not be a source of friction on any inflammable gas that might be present.

l. The workers engaged for cleaning the manholes / sewers should be properly trained before allowing to work in the manhole.

m. The workers shall be provided with Gumboots or non-sparking shoes, bump helmets and gloves non sparking tools, safety lights and gas masks and portable air blowers (when necessary). They must be supplied with barrier cream for anointing the limbs before working inside the sewer lines.

n. Workmen descending a manhole shall try each ladder step or rung carefully before putting his full weight on it to guard against insecure fastening due to corrosion of the rung fixed to manhole well.

o. If a man has received a physical injury, he should be brought out of the sewer immediately and adequate medical aid should be provided to him.

p. The extent to which these precautions are to be taken depend on individual situation but the decision of the Engineer-In-charge regarding the steps to be taken in this regard in an individual case will be final.

8.6 The Contractor shall not employ men and women below the age of 18 years on the work of painting with products containing lead in any form wherever men above the age of 18 are employed on the work of lead painting the following precautions should be taken.

8.6.1 No paint containing lead or lead products shall be used except in the form of paste or readymade paint.

8.6.2 Suitable face masks should be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint is dry rubbed and scrapped.

8.6.3 Overalls shall be supplied by the Contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.

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8.6.4.1a) White lead, sulphate or lead work products containing those pigments shall not be used in painting operation except in the form of paste or of paints ready for use.

b) Measures shall be taken whenever required in order to prevent danger arising from the application of paint in the form of spray.

c) Measures shall be taken, whenever practicable to prevent danger arising out of dust caused by dry rubbing down and scrapping.

8.6.4.2a) adequate facilities shall be provided to enable working painter to wash during and on cessation of work.

b) Suitable arrangements shall be made to prevent clothing put off during working hours being spoiled by painting materials.

8.6.4.3a) Cases of lead poisoning and of suspected lead poisoning shall be notified and shall be subsequently verified by a medical man appointed by the competent authorities of J.D.A.

b) The J.D.A may require when necessary a medical examination of workers.

c) Instructions with regard to the special hygienic precautions to be taken in the painting trade shall be distributed to working painters.

9.0 When the work is done near any place where there is risk of drowning, all necessary equipments should be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provisions should be made for prompt first aid treatment for all injuries likely to be sustained during the course of the work.

10.0 Use of hoisting machines and tackle including their attachment encourage and supports shall conform to the following standard of conditions.

10.1 a) these shall be of good mechanical construction, sound material and adequate strength and free from patent, defects and shall be kept in good working order.

b) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from patent defects.

10.2 Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years should be in-charge of any hoisting machine including any scaffolding, winch or giving signals to operator.

10.3 In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or as means of suspension the safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with the safe working load. In case of a hoisting machine having a variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this clause shall be loaded beyond the safe working load except for the purpose of testing.

10.4 In case of J.D.A machines, the safe working load shall be notified by the Engineer-in-Charge. As regards Contractor's machines the Contractor shall notify the safe working load of the machine to the Engineer-in-charge whenever he brings any machinery to site of work and get verified by the Engineer-in-Charge.

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11.0 Motors gearing, transmission electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguard. Hoisting appliances should be provided with such means as will reduce to the minimum the risk of accidental descent of the load. Adequate precautions should be taken to reduce the minimum the risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already energized, insulating mats, wearing apparel, such as gloves sleeves and boots as may be necessary be provided. The worker should not wear any rings, watches and carry keys or other materials, which are good conductors of electricity.

12.0 All scaffold, ladders, and other safety devices mentioned or described herein shall be maintained in safe condition and no scaffold ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near places of work.

13.0 These safety provisions should be brought to the notice of all concerned by display on a notice board at a prominent place of work spot. The person responsible for compliance of the safety codes shall be named therein by the contractor.

14.0 To ensure effective enforcement of the rules and regulations relating to safety precautions the arrangements made by the Contractor shall be open to inspection by J.D.A Official or their representatives.

15.0 Notwithstanding the above Clauses from (i) to (xiv) there is nothing in these to exempt the contractor from the operations of any other Act or Rule in force in the Republic of India.

MODEL RULES FOR THE PROTECTION OF HEALTH AND SANITARY ARRANGEMENTS FOR WORKERS

1.0 APPLICATION

These rules shall apply to all building and construction works in which 20 (twenty) or more workers are ordinarily employed or are proposed to be employed in any day during the period during which the contractor work is in progress.

2.0 DEFINITION

Work place means a place where twenty or more workers are ordinarily employed or are proposed to be employed in connection with construction work on any day during the period during which the contract work is in progress.

3.0 FIRST-AID FACILITIES

3.1 At every work place first aid facilities shall be provided and maintained, so as to be easily accessible during working hours, First-Aid boxes at the rate of not less than one box per 150 contract labour or part thereof ordinarily employed.

3.2 The First-Aid boxes shall be distinctly marked with a red cross on white background and shall contain the following equipments:

3.2.1 a) For work places in which number of contract labour employed does not exceed 50, Each First-Aid box shall contain the following equipments:

i. Small sterilized dressings.
ii. Medium size sterilized dressings.
iii. Large size sterilized dressings.
iv. Large sterilized burn dressings.

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v. 1 (30 ml) bottle containing a two percent alcoholic solution of iodine.
vi. 1 (30 ml) bottle containing salvolatile having the dose and mode of administration indicated on the label.
vii. 1 snakebite lancet.
viii. 1 (30 gms) bottle of potassium permanganate crystals.
ix. 1 pair of scissors.
x. 1 copy of the First-Aid leaf-let issued by the Director General, FactoryAdvise Service & Labour Institute, Government of India.
xi. 1 bottle containing 100 tablets (each of 5 grams) of aspirin.
xii. Ointment for burns.
xiii. A bottle of suitable surgical antiseptic solution.

3.2.2 For work places in which the number of contract labour exceed 50. Each First- Aid box shall contain the following equipments:
i) 12 small sterilized dressings.
ii) 6 medium size sterilized dressings.
iii) 6 large size sterilized dressings.
iv) 6 large size sterilized burn dressings.
v) 6 (15 gms) packet sterilized cotton wool.
vi) 1 (60 ml.) bottle containing a two percent iodine alcoholic solution.
vii) 1 (60 ml.) bottle containing salvolatile having the dose and mode of administration indicated on the label.
viii) 1 - roll of adhesive plaster.
ix) 1 snake - bite lancet.
x) 1 (30 gms.) Bottle of potassium permanganate crystals.
xi) 1 pair of scissors.
xii) 1 copy of the First-Aid leaf-let issued by the Director General, FactoryAdvice Service and Labour Institutes, Government of India.
xiii) A bottle containing 100 tablets (each of 5 grams) of aspirin.
xiv) Ointment for burns.
xv) A bottle of suitable surgical antiseptic solution.

3.3 Adequate arrangements shall be made for immediate recoupment of the equipment when necessary.

3.4 Nothing except the prescribed contents shall be kept in the First Aid box.

3.5 The First Aid box shall be kept in charge of a responsible person who shall always be readily available during the working hours of the work place.

3.6 A person in charge of the First-Aid box shall be a person trained in First-Aid treatment in work places where the number of labour employed is 150 or more.

3.7 In work places where the number of labour employed is 500 or more and hospital facilities are not available within easy distance of the works, first- Aid Posts shall be established and run by a trained Compounder. The Compounder shall be on duty and shall be available at all hours when the workers are at work.

3.8 Where work places are situated in places, which are not towns of cities, a suitable motor transport shall be kept readily available to carry injured person or persons suddenly taken ill to the nearest hospital.

4.0 DRINKING WATER

4.1 In every work place, there shall be provided and maintained at suitable places, easily accessible to labour, a sufficient supply of cold water fit for drinking.

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4.2 Where drinking water is obtained from an intermittent public water supply, each work place shall be provided with storage where such drinking water shall be stored.

4.3 Every water supply of storage shall be at a distance of not less than 50 feet from any latrines drain or other source of pollution, where water has to be drawn from an existing well which is within such proximity of latrine, drain or any other source of pollution, the well shall be properly chlorinated before water is drawn from it for drinking. All such wells shall be entirely closed in and be provided with a trap-door which shall be dust and water-proof.

4.4 A reliable pump shall be fitted to each covered well, trap-door shall be kept locked and opened only for cleaning or inspection which shall be done at least once a month.

5.0 WASHING FACILITIES

5.1 In every work place adequate and suitable facilities for washing shall be provided and maintained for the use of labour employed herein.

5.2 Separate and adequate screening facilities shall be provided for the use of male and female workers.

5.3 Such facilities shall be conveniently accessible and shall be kept clean and hygienic condition.

6.0 LATRINES AND URINALS

6.1 Latrines shall be provided in every work place on the following scale, namely:

a) Where females are employed there shall be at least one latrine for every25 females.

b) Where males are employed, there shall be at least one latrine for every 25 males.

Provided that where the number of males or females exceeds 100, it shall be sufficient if there is one latrine for 25 males or females, as the case may be, upto the first 100, and one for every 50 thereafter.

6.2 Every latrine shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings.

6.3 Construction of Latrines: The inside walls shall be constructed of masonry or some suitable heat resisting non-absorbent materials and shall be cement washed inside and outside at least once a year. Latrine shall not be a standard lower than bore-hole system.

6.4 (a) Where workers of both sexes are employed, there shall be displayed outside each block of latrine and urinal, a notice in the language understood by the majority of the workers "For Men only" or "For Women only" as the case may be.

(b) The notice shall also bear the figure of man or of a woman, as the case may be.

6.5 There shall be at least one urinal for male workers up to 50 and one for female workers up to 50 employed at a time. Provided that where the number of male or female workmen, as the case may be, exceeds 500, it shall be sufficient if there is one urinal for every 50 males or females up to the first 500 and one for every 100 or part thereof, thereafter.

6.6 a) The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times.

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b) Latrines and urinals other than those connected with a flush sewerage system shall comply with the requirements of the Public Health Authorities.

6.7 Water shall be provided by means of a tap or otherwise so as to be conveniently accessible in or near the latrines and urinals.

6.8 Disposal of Excreta

Unless otherwise arranged for by the local sanitary authority arrangements for proper disposal of excreta by incineration at the work place shall be made by means of a suitable incinerator. Alternatively, excreta may be disposed off by putting a layer of night soil at the bottom of a pucca tank prepared for the purpose and covering it with a 15 cm layer of waste or for refuse and then covering it with a layer of earth for fortnight (when it will turn into manure).

6.9 The Contractor shall, at his own expense, carry out all instruction issued to him by the Engineer-in-Charge to effect proper disposal of night soil and other conservancy work in respect of the Contractor's workmen or employees on the site. The Contractor shall be responsible for payment of any charges which may be levied by Municipal or Cantonment Authority for execution of such work on his behalf.

7.0 PROVISION OF SHELTER DURING REST

At every place, there shall be provided, free of cost, four suitable sheds, two for males and the other two for rest separately for the women labour. The height of each shelter shall not be less than 3 meters from the floor level to the lowest part of the roof. These shall be kept clean and the space provided shall be on the basis of 0.6 sqm. per head.

Provided that the Engineer-in-Charges may permit, subject to his satisfaction, a portion of the building under construction or other alternative accommodation to be used for the purpose.

8.0 CRECHES

8.1 A every work place, at which 20 or more women workers are ordinarily employed, there shall be provided two rooms of reasonable dimensions for the use of their children under the age of six years. One room shall be used as a play room for the children and the other as their bedrooms.

The rooms shall be constructed on standard not lower than the following:

i) Thatched roof

ii) Mud floor and walls.

iii) Planks spread over the mud floor and covered with matting

8.2 The rooms shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provision of sweepers to keep the places clean.

8.3 The Contractor shall supply adequate number of toys and games in the playroom and sufficient number of cots and beddings in the bed-room.

8.4 The Contractor shall provide one Ayaa to look after the children in the crèche when the number of women workers does not exceed 50; and two when, the number of women workers exceed 50.

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8.5 The use of the rooms/earmarked as creches shall be restricted to children, their attendant and mother of the children.

9.0 CANTEENS

9.1 In every work place where the work regarding the employment of contract labour is likely to continue for six months and wherein contract labour numbering one hundred or more are ordinarily employed, an adequate canteen shall be provided by the Contractor for the use of such labour.

9.2 The canteen shall be maintained by the Contractor in an efficient manner.

9.3 The canteen shall consist of at least a dining hall, kitchen, and storeroom, pantry and washing places separately for workers and utensils.

9.4 The canteen shall be sufficiently lighted at all times when any person has access to it.

9.5 The floor shall be made of smooth and impervious material and inside walls shall be lime washed or colour washed at least once in each year.

Provided that the inside walls of the kitchen shall be lime-washed every four months.

9.6 The premises of the canteen shall be maintained in a clean and sanitary condition.

9.7 Waste Water shall be carried away in suitable covered drains and shall not be allowed to accumulate so as to cause a nuisance.

9.8 Suitable arrangements shall be made for the collection and disposal of garbage.

9.9 The dining hall shall accommodate at a time 30 persons of the labour working at time.

9.10 The floor area of the dining hall, excluding the area occupied by the service counter and any furniture except tables and chair shall not be less than one square metre per dinner to be accommodated.

9.11 a) A portion of the dining hall, and service counter shall be partitioned off and reserved for women workers in proportion to their number.

b) Washing places for women shall be separate and screened to secure privacy.

9.12 Sufficient tables, stool, chairs or benches shall be available for the number of dinners to be accommodated.

9.13.1 a) There shall be provided and maintained sufficient utensils, crockery, furniture and any other equipment necessary for the efficient running of the canteen.

b) The furniture, utensils and other equipment shall be maintained in a clean and hygienic condition.

9.13.2 a) Suitable clean clothes for the employees serving in the canteen shall be provided and maintained.

b) A service counter, if provided, shall have top of smooth and impervious material.

c) Suitable facilities including an adequate supply of hot water shall be provided for the cleaning of utensils and equipment.

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9.14 The food stuffs and other items to be served in the canteen shall be in conformity with the normal habits of the labour.

9.15 The charge for food stuffs, beverages and any other items served in the canteen shall be based on 'No profit' No loss' and shall be conspicuously displayed in the canteen.

9.16 In arriving at price of food stuffs, and other articles served in the canteen, the following items shall not be taken into consideration as expenditure, namely:

a) The rent of land building;

b) The depreciation and maintenance charges for the building and equipment provided for the canteen;

c) The cost of purchase, repair and replacement of equipment including furniture, crockery, cutlery and utensils;

d) The water charges and other charges incurred for lighting and ventilation;

e) The interest and amounts spent on the provision and maintenance and equipment provided for in the canteen;

9.17 The accounts pertaining to the canteen shall be audited once every 12 months by registered accountants and auditors.

10.0 ANTI MALARIAL PRECAUTIONS

The Contractor shall at his own expense, conform to all anti-malarial instructions given to him by the Engineer-in-Charge including the filling up of any borrows pits which may have been dug by him.

11.0 AMENDMENTS

J.D.A may from time to time, add to or amend these rules and issue such directions as it may consider necessary for the purpose of removing any difficulty which may arise in the administration hereof.

CONTRACTOR'S LABOUR REGULATIONS

1.0 SHORT TITLE

These regulations may be called the Contractor "Labour Regulations".

2.0 Definitions

2.1 "Workman" means any person employed by the J.D.A or its Contractor directly or indirectly through a sub-contractor, with or without the knowledge, of the J.D.A to do any skilled, semi-skilled, un-skilled, manual, supervisory, technical or clerical work for hire or reward whether, the terms of employment are expressed or implied but does not include any person-

a)	Who is employed mainly in a managerial or administrative capacity; or

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b)	Who being employed in a supervisory capacity draws wages exceeding Rupees Two Thousand Five hundred per person or exercises either by the nature of the duties attached to the office or by reason of powers vested to him, functions mainly of managerial nature.
c)	Who is an out worker, that is to say, a person to whom any articles or materials are given out by or on behalf of the principal employer to be made up cleaned, washed, altered, ornamental finished, repaired, adopted or otherwise processed for sale for the purpose of the trade or business of the principal employer and the process is to be carried out either in the home of the out worker or in some other premises, not being premises under the control and management of the principal

2.2 "Fair Wages" means wages whether for time or piece work fixed and notified under the provisions of the minimum Wages Act from time to time.

2.3 "Contractor" shall include every person who undertake to produce a given result other than a mere supply of goods or articles of manufacture through labour or who supplies labour for any work and includes a sub-contractor.

2.4 "Wages" shall have the same meaning as defined in the Payment of Wages Act.

2.4.1 Normally working hours of an adult employee should not exceed 9 hours a day. The working day shall be so arranged that inclusive of interval for rest, if any, it shall not spread over more than 12 hours on any day.

2.4.2 When an adult worker is made to work for more than 9 hours on any day or for more than 48 hours in any week he shall be paid overtime for the extra hours put in by him at double the ordinary rate of wages.

2.4.3.1 Every worker shall be given a weekly holiday on a Sunday, in accordance with the provisions of the Minimum Wages (Central) Rules 1960 as amended from time to time, irrespective of whether such worker is governed by the Minimum Wages Act or not.

2.4.3.2 Whether the Minimum Wages prescribed by the Government under the Minimum Wages Act are not inclusive of the wages for the weekly day of rest, the worker shall be entitled to rest day wages at the rate applicable to the next preceding day, provided he has worked under the same contractor for a continuous period of not less than 6 days.

2.4.3.3 Where a contractor is permitted by the Engineer-in-Charge to allow a worker to work on a normal weekly holiday, he shall grant a substitute holiday to him for the whole day on one of the five days immediately before or after the normal weekly holidays and pay wages to such worker for the work performed on the normal weekly holiday at overtime rate.

3.0 DISPLAY OF NOTICE REGARDING-WAGES, ETC.

The contractor shall before he commences his work on contract, display and correctly maintain and continue to display and correctly maintain in a clean and legible condition in conspicuous places on the work, notices in English and in the local Indian languages spoken by the majority of the workers, giving the minimum rates of wages fixed under the Minimum Wages Act, the actual wages being paid, the hours of work for which such wages are earned, wage period, dates of payment of wages and other relevant information as per Appendix 'A'.

4.0 PAYMENT OF WAGES

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4.1 The contractor shall fix wage periods in respect of which wages shall be payable.

4.2 No wage period shall exceed one month.

4.3 The wages of every person employed as labour in an establishment or by a contractor where less than one thousand, such persons are employed shall be paid before the expiry of the seventh day and in other cases before the expiry of tenth day after the last day of the wage period in respect of which the wages are payable.

4.4 Where the employment of any worker is terminated by or on behalf of the contractor the wages earned by him shall be paid before the expiry of the second working day from the date on which his employment is terminated.

4.5 All payments of wages shall be made on a working day at the work premises and during the working time and on a date notified in advance and in case the work is completed before the expiry of the wage period, final payment shall be made within 48 hours of the last working day.

4.6 Wages due to every worker shall be paid to him direct or to other person authorized by him in this behalf.

4.7 All wages shall be paid in current coin or currency or in both.

4.8 Wages shall be paid without any deductions of any kind except those specified by the Central Government by general or special order in this behalf or permissible under the Payment of Wages Act 1956.

4.9 A notice showing the wage period and the place and time of disbursement of wages shall be displayed at the place of work and a copy sent by the contractor to the Engineer-in-Charge under acknowledgment.

4.10 It shall be the duty of the contractor to ensure the disbursement of wages in the presence of the Engineer or any other authorized representatives of the Engineer-in-Charge who will be required to be present at the place and time of disbursement of wages by the contractor to workmen.

4.11 The contractor shall obtain from the Engineer or any other authorized representative of the Engineer-in-Charge as the case may be, a certificate under his signature at the end of the entries in the "Register of Wages" or the "Wage-cum-Muster Roll" as the case may be in the following form:

"Certified that the amount shown in column No. 14(net Amount paid) has been paid to the workmen concerned in my presence on..... at .....".

5.0 FINES AND DEDUCTIONS, WHICH MAY BE MADE FROM WAGES

5.1 The wages of a worker shall be paid to him without any deduction of any kind except the following –

a)	Fines
b)	Deductions for absence from duty i.e. from the place or the place where by the terms of his employment he is required to work. The amount of deduction shall be in proportion to the period for which he was absent.

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c)	Deduction for damage to or loss of goods expressly entrusted to the employed persons for custody, or from loss of money or any other deduction which he is required to account where such damage or loss is directly attributable to his neglect or default.
d)	Deduction for recovery of advances or for adjustment of over payment of wages, advances granted shall be entered in a register.
e)	Any other deduction, which the Central Government may from time to time allow.

5.2 No fines should be imposed on any worker save in respect of such acts and omissions on his part as have been approved by the Chief Labour Commissioner.

NOTE: An approved list of Acts and Omissions for which fines can be imposed is enclosed at Appendix-I.

5.3 No fine shall be imposed on a worker and no deduction for damage or loss shall be made from his wages until the worker has been given an opportunity of showing cause against such fines or deductions.

5.4 The total amount of fine which may be imposed in any one wage period on a worker shall not exceed an amount equal to three paisa in a Rupee of the total wages, payable to him in respect of that wage period.

5.5 No fine imposed on any worker shall be recovered from him in installment, or after the expiry of sixty days from the date on which it was imposed.

5.6 Every fine shall be deemed to have been imposed on the day of the act or omission in respect of which it was imposed.

6.0 LABOUR RECORDS

6.1 The contractor shall maintain a "Register of persons employed" on work on contract in form XIII of the CL (R&A) Central Rules 1971 (Appendix-B).

6.2 The contractor shall maintain a "Muster Roll" register in respect of all workmen employed by him on the work under contract in from XVI of the CL (R&A) Rules 1971 (Appendix-C).

6.3 The contractor shall maintain a "Wage Register" in respect of all workmen employed by him on the work in form (Appendix-D).

6.4 Register of accidents - The contractor shall maintain a register of accidents in such form as may be convenient at the work place but the same shall include the following particulars:

a) Full particulars of the labourers who met with accident.
b) Rate of wages
c) Sex
d) Age
e) Nature of accident and cause of accident.
f) Time and date of accident.
g) Date and time when he/she admitted in Hospital
h) Date of discharge from the Hospital
i) Period of treatment and result of treatment
j) Percentage of loss of earning capacity and disability as assessed by Medical Officer
k) Claim required to be paid under Workmen's Compensation Act.

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l) Date of payment of compensation.
m) Amount paid with details of the person to whom the same was paid.
n) Authority by whom the compensation was assessed.
o) Remarks.

6.5 Register of Fines - The contractor shall maintain a "Register of Fines" in the form (Appendix-H).

The contractor shall display in a good condition and in a conspicuous place of work the approved list of Acts and Omission for which fines can be imposed (Appendix-I).

6.6 Register of Deductions –

The contractor shall maintaina Register of Deductions" for damage or loss in form (Appendix-J).

6.7 Register of Advances – The contractor shall maintain

Advances" in form (Appendix-K).

6.8 Register of Overtime - The contractor shall maintain a "Register of

Overtime" in form (Appendix-L).

7.0 ATTENDANCE CARD-CUM WAGE SLIP:

7.1 The contractor shall issue an attendance card-cum-wage slip to each workman employed by him in the specimen form at (Appendix-E).

7.2 The card shall be valid for each wage period.

7.3 The contractor shall mark the attendance of each workman on the card twice each day, once at the commencement of the day and again after the rest interval, before he actually starts work.

7.4 The card shall remain in possession of the worker during the wage period under reference.

7.5 The contractor shall complete the wage slip portion on the reverse of the card at least a day prior to the disbursement of wages in respect of the wage period under reference.

7.6 The contractor shall obtain the signature or thump impression of the worker on the wage slip at the time of disbursement of wages and retain the card with himself.

8.0 EMPLOYMENT CARD

The contractor shall issue an Employment Card in form to each worker within three days of the employment of the worker (Appendix-F).

9.0 SERVICE CERTIFICATE

On termination of employment for any reason whatsoever the contractor shall issue to the workman whose services have been terminated, a service certificate in from Appendix-G.

10.0 PRESERVATION OF LABOUR RECORDS

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All records required to be maintained under Regulations Nos. 6 and 7 shall be preserved in original for a period of three years from the date of last entries made in them and shall be made available for inspection by the Engineer-in-Charge, Labour Officer.

11.0 POWER OF LABOUR OFFICERS TO MAKE INVESTIGATIONS INQUIRY

The Labour Officer or any other person authorized by J.D.A on its behalf shall have power to make inquire with a view to ascertaining and enforcing due and proper observance of the Fair Wage Clauses and the Provisions of Regulations. He shall investigate into any complaint regarding the default made by the contractor or sub-contractor in regard to such provision.

12.0 INSPECTION OF BOOK AND SLIPS

The contractor shall allow inspection of all the prescribed labour records to any of his workers or to his agent at a convenient time and place after due notice is received or to the Labour officer or any other person, authorized by the Central Government on his behalf.

13.0 SUBMISSION OF RETURNS

The contractor shall submit periodical returns as may be specified from time to time.

14.0 AMENDMENTS

The J.D.A may from to time, add or amend the regulations and on any question as to the application, interpretation or effect of these regulations the decision of the Zonal Chief concerned shall be final.

PENALTY

1.0 Charges to be recovered from contractor for unsafe act or condition

1.1 JDA has built an image of safety conscious organisation meticulously over a period of many years. Any reportable accident (fatality / injury) results in loss of life and/or property damage. These accidents not only result in loss of life but also damage the reputation of JDA. Most of the accidents are avoidable and caused preliminary due to contractors' negligence. Hence JDA shall recover the cost of damages from the contractors for every reportable incident (fatality / injury).

1.2 In addition every JDA work site is exposed to public scrutiny as the work is executed just on the right-of-way. Any unsafe act / unsafe condition observed by public further damage our reputation. Because of the non-voluntary compliance of contractors to the condition of contract on SHE and project SHE manual, JDA has been forced to establish safety-enforcing organization. The cost of established such organization is to be recovered from contractors for all observed safety violations at sites.

1.3 The following table indicates the Safety, Health and Environment violation (unsafe act / unsafe condition) and charges to be recovered from contractors subject to a maximum limit @ 0.1% of the contract value in addition to all other penalties / compensation./ liquidated damages.

S.N.	TOPIC	UNSAFE ACT/UNSAFE CONDITION	DEDUCTABLE AMOUNT
	Injury and Incidence reporting	Fatal accidents Injury accident Abnormal delay in reporting accidents or will full suppression of information about any accidents / dangerous occurrence	Rs. 1,00,000 for every fatality Rs. 25,000 for serious grievous injury and Rs. 5,000 for

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			subsequent grievously injured person Rs.75,000 for first violation and Rs.1,00,000 for subsequent violations
	Housekeeping	Housekeeping maintenance register not properly maintained up to date Surrounding areas of drinking water tanks / taps not hygienically cleaned / maintained Office, stores, toilet / urinals not properly cleaned and maintained. Required dustbins at appropriate places not provided / not cleaned. Stairways, gangways, passageways blocked. Lumber with protruding nails left as such Openings unprotected Excavated earth not removed within a reasonable time. Truck carrying excavated earth not covered / tyres not cleaned. Vehicles / equipments parked / placed on roads obstructing free flow of traffic Unused surplus cables / steel scraps lying scattered Wooden scraps, empty wooden cable drums lying scattered Water stagnation leading to mosquito breeding	Rs.2,000 per single violation.
	Working at Height / Ladders and Scaffolds	Not using or anchoring Safety Belt Not using Safety Net Absence of life line or anchorage point to anchor safety belt Using Bamboo ladders Painting of ladders Improper usage (less than 1m extension above landing point, not maintaining 1:4 ratio) Aluminium ladders without base rubber bush Usage of broken / week ladders Usage of re-bar welded ladders Improper guardrail, toe board, barriers and other means of collective protection Improper working platform Working at unprotected fragile surface Working at unprotected edges	Rs.5,000 per single violation.
	Lifting appliances and gear	Non availability of fitness certificate. Documents not displayed on the machine or not available with the operator. Maximum Safe Working Load not written on the machine. Automatic safe load indicator not provided or not in working condition. Age of the operator less than 21 years or without any license. Person riding on crane. Creating more noise and smoke	Rs.5,000 per single violation.

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		Absence of portable fire extinguisher in driver cabin Fail to guard hoist platform No fencing of hoist rope movement area. Hoist platform not in the horizontal position.	
	Site Electrical safety	Exposed electric lines (fermentative damage) and circuits in the workplace. Inserting of bare wires into the socket Improper grounding for the electrical appliances Electrical cables running on the ground	Rs.5,000 per single violation.
	Gas Cutting	Wrong colour coding of cylinder. Cylinders not stored in upright position. Fail to put cylinders in a cylinder trolley. Damaged hose. Using domestic LPG cylinders Fail to store cylinder 6.6m away from fire prone materials Fail to use hose clamps Fire extinguisher not placed in the vicinity during operation	Rs.5,000 per single violation.
	Welding	Voltmeter and Ammeter not working Improper grounding and return path. Damaged welding cable Bare openings in the cable. Non-availability of separate switch in the transformer Non-availability of main switch control to switch off power to the welding unit. Usage of reinforcement rod as return conductor Damaged holder Fire extinguisher not placed in the vicinity during operation	Rs.5,000 per single violation.
	Fire precaution	Smoking and open flames in fire prone area Using more than 24V portable electrical appliances in the fire prone area Not proper ventilation in cylinder storage area. Absence of fire extinguishers Fire extinguishers not refilled once in a year. Fire extinguisher placed in a not easily accessible location	Rs.2,000 per single violation.
	Traffic Management	a) Barricades Not Cleaned Not in alignment Not numbered Not painted Red lights / reflectors not working Damages not repaired Not secured properly Barricade inspector not employed Protruding parts / portions repaired Barricades maintaining register not properly maintained up to date	Rs.2,000 per single violation.

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		b) Contractor Vehicles Over loading of vehicles Unfit drivers or operators Unlicensed vehicles Absence of traffic marshals Absence of reversing alarm Absence of fog light (at winter) Power / hand brakes not in working condition.	Rs.2000 per single violation.
	PPE	Not having Not wearing (or) using and kept it elsewhere Using damaged one Using wrong type Using wrong color helmet or helmet without logo Using for other operation (e.g. Using safety helmet for storing materials or carrying water from one place to other)	Rs.500 per single violation
	Occupational Health	Fail to conduct Medical examination to workers Workers not having ID card Inadequate number of toilets Toilets not cleaned properly Absence of water facilities for toilets and washing places Absence of drinking water Absence of first-aid person in work site. Absence or inadequacy of first-aid box. Smoking inside the construction site Drink and drive or work Excessive noise and vibration	Rs.1,000 per single violation.

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Appendix - 'A'

LABOUR BOARD

Name of work

Name of Contractor Address of Contractor Name and Address of Unit

Name of Labour Enforcement Officer

Address of Labour Enforcement Officer

Date:

S. No.	Category	Minimum wage fixed	Actual wages paid	Number present	Remarks

Weekly Holiday

Wage Period

Date of Payment of wages

Working hours

Rest interval

Signature valid

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Appendix - 'B'

FORM 13

See rule 75

REGISTER OF WORK MEN EMPLOYED BY CONTRACTOR

Name and Address of Contractor

Name and Address of Establishment in under which contract is carried on

Nature and location of work

Name & Address of Principal Employer

Sl. No.	Name and surname of workman	Age & sex	Father's Husbands Name	Nature of employment / designation	Permanent home address of the workman (village and Tehsil Taluk and District)	Local address
1.	2.	3.	4.	5.	6.	7.

ate of commencement of Employment	Signature or thumb impression of the workman	Date of termination of employment	Reasons for termination	Remarks
1.	2.	3.	4.	5.

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FORM XVI

(See Rule 78(2) (193)

MUSTER ROLL

Name and address of contractor

Name and address of establishment in/under which contract is carried on

Nature and location of work

Name and Address of Principal Employer

For the month / fortnight

Appendix - 'C'

S. No.	Name of the workman	Sex	Father's/ Husband's Name	Dates					Remarks
1.	2.	3.	4.	5.					6.
				1	2	3	4	5	

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Appendix - 'D'
FORM XVII (See Rule)

78(2) (03) REGISTER OF WAGES
Name and address of contractor

Name and address of establishment in/under which contract is carried on

Nature and location of work

Name and Address of Principal Employer

Wage period: per month/ fortnightl

S. No.	Name of Workman	Serial No. in the register of workman	Designation nature of work done	Nos. of days worked	Units of work done	Daily rate of wages/ piece rate	Basic Wages
1.	2.	3.	4.	5.	6.	7.	8.

Dearness allowance	Overtime	Other cash payments (Nature of payments to be indicated)	Total	Deduction if any (indicate nature)	Net Amt paid	Signature thumb impression of the workman	Initial contractor or his representative
9.	10.	11.	12.	13.	14.	15.	16.

Signature valid
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Appendix - 'E'

FORM XIX

[SEE RULE 78 (2) (B)]

W A G E S L I P

Name and address of contractor

Name and Father's/Husband/s Name of workman

Nature and location of work

For the Week/Fortnight/Month ending

1. No. of days worked

2. No. of Units worked in case of piece rate workers

3. Rate of daily wags/piece rate

4. Amount of overtime wages

5. Gross wages payable

6. Deductions if any

7. Net amount of wages paid

Sign of the Contractor

Signature valid
Digitally signed by Dilip Lamba
Designation : Executive Engineer
Date: 2025.11.14 10:25:31 IST
Reason: Approved

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Appendix - 'F'

WAGE CARD

Wage Card No.

Name and address of Contractor Date of Issue Nature of work with location
Designation Name of workman Month/Fortnight Rate of Wages

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 2526 27 28 29 30 31

Morning Rate Evening
Amount Initial

Received from the sum of Rs. On account

of my wagon.

Signature

The wage card is valid for one month from the date of issue.

Signature valid
Digitally signed by Dilip Lamba
Designation : Executive Engineer
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Appendix 'F'

FORM XIV

(See Rule 76)

EMPLOYMENT CARD

Name and address of contractor

Name and address of establishment under which

The contract is carried out

Nature and location of work

Name and address of Principal Employer

1. Name of the workman
2. S. Name in the register of workman employed
3. Nature of Employment/Designation
4. Wage rate (with particulars of unit in case of piece work)
5. Wage Period
6. Tenure of employment
7. Remarks

Signature of Contractor

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Appendix - 'G'

Form XV

(See Rule 77)

(SERVICE CERTIFICATE)

Name and address of contractor Nature and location of work Name and address of workman Age or date of birth Identification Marks Father's/Husbands Name

Name and address of establishment in under which contract is carried on

Name and address of Principal Employer

	Total period of which employed				
S. No.	From	To	Nature of work	Rate of wages (with particular s of unit In case of piece work)	Remarks
1.	2.	3.	4.	5.	6.

Signature

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Appendix 'H

Form XII

[See Rule 78 (2) (d)]

REGISTER OF FINES

Name and address of contractor

Name and address of establishment in/ under which contract is carried on

Nature and location of work

Name and address of workman

Name and address of Principal Employer

S. No.	Name of workman	Father's/Husband Name	Designation/nature of employment	Act/Omission for which	Date of offence

Whether workman showed cause against fine	Name of person in whose presence employees explanation was heard	Wage period and wages payable	Amount of fine Imposed	Date on which fine realized	Remarks

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APPENDIX-'I'

LIST OF ACTS AND OMISSIONS FOR WHICH FINES CAN BE IMPOSED

In accordance with rule of Labour Regulations, to be displayed prominently at the site of work both in English and local language.

1. Willful insubordination or disobedience, whether alone or in combination with other.
2 Theft, fraud or dishonestly in connection with contractors beside a business or property of J.D.A
3 Taking or giving bribes or any illegal gratifications
4 Habitual late attendance.
5 Drunk-ness fighting riotous or disorderly or indifferent behaviour.
6 Habitual negligence.
7 Smoking near or around the area where combustible or other materials are locked.
8 Habitual indiscipline.
9 Causing damage to work in the progress or to property of the J.D.A or of the contractor.
10 Sleeping on duty.
11 Malingering or slowing down work.
12 Giving the false information regarding name, age, fathers name etc.
13 Habitual loss of wage cards supplied by the employer.
14 Unauthorized use of employers properly of manufacturing or making of unauthorized articles at the work place.
15 Bad workmanship in construction and maintenance by skilled workers, which is not approved by the J.D.A for which the contractors are compelled to rectifications.
16 Making false complaints and/or misleading statements.
17 Engaging on trade within the premises of the establishment.
18 Any unauthorized divulgence of business affairs of the employees.
19 Collection or canvassing for the collection of any money within the premises of an establishment unless authorized by the employer.
20. Holding meeting inside the premises without previous sanction of the employers.
21 Threatening or intimidating any workman or employee during the working hours within the premises

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Appendix - 'J'

Form

XX

[See Rule 78 (2)

(d)]

REGISTER OF DEDUCTION FOR DAMAGES OR LOSS

Name and address of contractor

Name and address of establishment in/ under which contract is carried on

Nature and location of work

Name and address of Principal Employer

S. No.	Name of workman	Father's/Husband Name	Designation/ nature of employment	Particulars of damage of loss	Date of damage/loss

				Date of recovery		
Whether workman showed cause against deductions	Name of person in whose presence employees explanation was heard	Amount of deduction Imposed	No. of installment	First insta-llment	Last Insta-llment	Remarks

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Appendix - 'K'

Form XXII

(See Rule 78(2))

REGISTER OF ADVANCES

Name and address of contractor

Name and address of establishment in/ under which contract is carried on

Nature and location of work

Name and address of Principal Employer

S. No.	Name of workman	Father's/ Husband's Name	Designation/ nature of employment	Wages period and wages payable	Date and amount of advance given

Purpose / for which advance made	No. of installments by which advance is to be paid	Date and amount of each installment repaid	Date on which last installment was repaid	Remarks

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Appendix - 'L'

Form XXIII [See Rule 78(2) (e)]

REGISTER OF OVERTIME

Name and address of contractor

Name and address of establishment in/ under which contract is carried on

Nature and location of work

Name and address of Principal Employer

S. No.	Name of workman	Father's/ Husband's Name	Sex	Designation/ nature of employment	Date on which overtime worked

Total overtime worked or production in case of piece rated	Normal rate of wages	Overtime rate of wages	Overtime earning	Rate on which overtime wages paid	Remarks
7	8	9	10	11	12

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Jaipur Development Authority Jaipur

Name of Work: Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur.

VOLUME - II

SCOPE OF WORK & TECHNICAL SPECIFICATIONS

Executive Engineer –(PHE-I)

Jaipur Development Authority

Jaipur

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Reason: Approved

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SECTION – I

SCOPE OF WORK & TECHNICAL SPECIFICATIONS

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1.0 **(A) SCOPE OF WORK: Design, construction, supply, installation, testing & commissioning**

1.0 PREAMBLE1

1.1 Background of the Project

Jaipur, the resonant capital of Rajasthan is also known as the "Pink City" because of the color of the buildings in the old city. Built on a dry lakebed it is a city of forts, palaces, golden sands, warm people and rich culture. The altitude of Jaipur is 486 m. The climate in summer is hot with a mean high of 45.0° C and a mean low of 25.8° C, while in winter the mean high is 22.0° C and mean low is 8.3° C. The main languages in Jaipur are Hindi, Rajasthani, English, Urdu and Sindhi.

The city is surrounded by the Nahargarh hills in the north and Jhalana in the east, which is a part of Aravalli hills - ranges. To the south and the west of the city are also prevailing hillocks but they are isolated and discontinuous in formation. The southern end of the city is open to plain and stretches far and wide towards Sanganer and beyond.

Jaipur has a convenient external transport, with developed highways, railways, and aviation net work. The city lies on Delhi-Ahmedabad rail route of Western Railway. The NH-8 and NH-11 intersect at Jaipur and NH-12 leading to Jabalpur starts from Jaipur. Jaipur lies at a distance of about 260 km from Delhi, 135 km from Ajmer, 225 km from Agra and 245 km from Kota. Jaipur receives over 650 millimeters (26 inches) of rainfall annually. Most rains occur in the monsoon months between June and September when there are frequent, heavy rains and thunderstorms, but flooding is not common. Temperatures remain relatively high throughout the year. The population of Jaipur City is 30,46,163 as per 2011 census.

1.2 Location of Plant

The proposed STP site is located near Chandlai Lake having GPS co-ordinates as 26°40'36.4"N 75°52'40.9"E. The Scope of Work includes but not limited to the following Units:

- **Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur. The scope of work includes 3 months trial run & 1 year O&M.**
- Raw Sewage Pumping comprising Connection of incoming sewer to Receiving Chamber, Receiving Chamber, Coarse Screen Channels, Degritting Chamber, Wet Well along with Pumping Main at STP area.
- Primary Treatment Units comprising of Inlet Chamber, Fine Screen Channels and Grit Chambers.
- Biological Treatment Units based on Sequential Batch Reactor (SBR) technology.
- Disinfection Units comprising of Chlorine disinfection system, chlorine contact tank along with parshall flume for flow measurement at outlet.
- Disposal of treated sewage into nearby channel/ Nallah leading to waterbody. The work of outfall treated water line of 1600mm dia & approx. 1500mtr length from the STP to the channel/ Nallah leading to water body shall be in the scope of contractor.
- Sludge Handling Units comprising COTDM Feed Sump & Pump House, COTDM House and Dewatering Polymer Dosing System.
- Buildings including SBR Air Blower cum Admin cum MCC & Control Building, HT Panel Room, Metering Room, Transformer Yard, DG Platform etc.

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- 2 nos. of rainwater harvesting system within STP premises.
- Other Ancillary Structures including Approach road from Main road to the proposed STP, Roads & Pathways, Plant Drains & Storm Water Drains, Boundary Wall/ around 1000.00 m length with fencing having entry gate with guard room.
- Rest room for contractor use-4 Nos.
- RCC Overhead Tank- 5 Lacs Litre capacity with 22 m staging height.
- Tube well- 2 Nos each of 200 mm dia with suitable submersible motor pumps & water distribution network.
- Online Continuous Effluent Monitoring System (OCEMS) shall be provided at the Inlet & Outlet of STP. Parameters such as Flow, pH, BOD, COD & TSS shall be monitored continuously. The OCEMS suppliers have to provide central server at cloud operational on 24x7 basis and to provide online data connectivity with CPCB and RSSPCB servers.
- Street lighting around the road & pathways shall be provided with solar LED (24 Watt) lights.
- Landscaping / plantation for entire plot of the STP (area apprx. 40,000.00 Sqm).
- Installation of DG Set and its O&M including diesel cost: Each load center shall be provided with a silent DG Set as a standby power backup for 100% load. DG sets up to 1000 KVA capacity are required to be supplied with acoustic enclosure as per CPCB norms. Cost of diesel will be borne by agency it self.
- O & M of 120 months***(after satisfactory commissioning, 03months trial run and successful completion of O&M for 1 year)*** including defect liability period of 36 months.
- The contractor will provide 1 no. AC SUV vehicle along with driver for use of JDA supervisory staff on full time basis from the stipulated date of commencement mentioned in work order upto issuance of commissioning certificate on completion of construction phase (upto 3000 km running per month). All expenses towards fuel, maintenance, toll fee payment etc. during this period shall be in contractor's scope.

- The Bidders are to adopt the same nomenclature used for various treatment units in their design report as used in the Tender documents.

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, Raw Sewage Pumping Station of 40 MLD Capacity in STP area.

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

- Design, construction, supplying, erection, testing and commissioning Raw Sewage Pumping Station for STP of 40 MLD Capacity average flow. **The scope of work includes 3 months trial run & 1 year O&M**.

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- Topographical and Geotechnical Survey including Subsoil Investigation for Water Table and Safe Allowable Bearing Capacity. Subsoil Investigation shall be carried out by the Contractor through a reputed and specialist firm approved by Executive Engineer for confirmation of Geotechnical data.
- Site Development including but not be limited to the following works:

1. 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 Employer.
2. Shifting of Pipe Lines, Cables and Poles etc. if required.
3. Site filling by means of suitable earth, as per site condition if required.
4. Levelling and grading to improve the aesthetics and to facilitate the vehicular movement.
5. Construction of Site Offices (One for Employer's Staff and one for Contractor's Staff) with required Furniture, Air-conditioners, Personal Computers and Printers, Telecom facility etc.
6. Arranging Construction Power & Water during construction period. Employer will provide power for Trial run, Commissioning period & O&M period up to guaranteed power consumptions free of cost.
7. Pilling work if any.
8. 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. All the process design, structural designs and drawings shall be vetted by a reputed and specialist institutions NIT/IIT and cost for the same shall be borne by the contractor.
- Construction of Civil Engineering Works for all the Process Units, Buildings, Approach Road, Roads & Pathways, Plant Drains, Storm Water Drains, Boundary walls around 1000 m length etc. as detailed in Civil Specifications. Layout shall be made in such way that all Process Units and Buildings are interconnected and can be accessed from one Point.
- Providing Plinth Protection 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 Water Proof Cement Paint to all Process Units.
- Providing Internal Acrylic Washable Paint and External Acrylic Smooth Exterior Paint to all Buildings.
- Bypasses shall be provided around all flow meters such that the instrument can be isolated and removed for calibration and maintenance without interrupting the flow.
- Providing Rolling Shutters, Doors, Windows and Ventilators in all Buildings.
- Providing lift for buildings of G+2 structure & above.
- Providing External Epoxy Paint to all Steels Works made of MS or GI.
- Providing SS Hand Railing (min. 2 Rows) along all the Stairs and Walkways of all Process Units.
- Providing DI dismantling joint for pipe above 150 mm size.
- Providing false flooring/false ceiling wherever required.
- Supply, Erection, Testing & Commissioning of all the Mechanical Equipment as detailed in Mechanical Specifications.
- Incoming HT Power Supply from State Electricity Authority (Jaipur Vidyut Vitaran Nigam LTD.) from nearby Source to the STP Site shall be arranged by Employer. Permanent power connection shall be obtained in the name of Secretary, JDA-Jaipur.
- 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.
- Providing PTZ - CCTV cameras at all critical process units and remote screen which shall be placed in Plant Control room for monitoring of process units.
- 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 detection &Extinguishers, Fire Alarms etc.

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- Providing Laboratory with required Laboratory Equipments, Instruments, Chemicals & Reagents and Furniture.
- Planting of Trees and Plants / Landscaping.
- Trial Run of the constructed & hydraulically tested Plant along for a period of 03months & commissioning and Operation & Maintenance (O&M) of Pumping Stations & STP for 10 years after successful completion of 1 year O&M, 03 months Trial Run& commissioning as per Tender specifications.
- Supply of all mandatory Spares, Tools & Tackles required during 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 Employer's personnel.
- Defects Liability Period of 36 months from the date of successful completion of Performance Run.
- Preparation and submission of As-Built Drawings and Operation & Maintenance Manuals for Mechanical, Electrical & Instrumentation Items.
- All the statutory approval, permission from forest dept. or any other agency for tree cutting etc., is to be obtained by the contractor. Contractor will pursue various agencies for this purpose. The contractor shall be responsible to take all necessary approvals and NOCs from various departments such as Electricity Department, Pollution Control Board, Fire Department, Environmental Clearance or any other department related to this project. JDA will assist the contractor by issuing necessary letters certifying the requirements and shall provide the necessary documentation and reimburse the statutory fee paid by the contractor for taking such approvals. No extra claim other than reimbursement of fees paid on actual basis will be entertained by JDA on this account.

Preparation and making of Physical 3D model of high class for the project having minimum size of 1.5 x 2.5 Mtr. installed on MS frame stand and encased with minimum 3mm transparent PVC sheet. The materials and techniques adopted for making the model shall be as –

- High Intense poly styrene sheets, acrylic sheets, plastic sheets, PVC sheets, MDF, HDF sheets (pine), wood boards, etc.
- Use of high intense poly styrene and Acrylic sheets for block models,
- Use of dot sprayer and engraving technique for textures and paints,
- Use of UV flatbed printing for details as per requirement,
- Paint-Use of Nitro Cellulose based primer for base coatings; Use of Auto Lacquer Duco Paints forelements;
- Use of emulsion colors for buildings for final coating according to the color code provided, with the primer Coating,
- Use of 3 axis CNC carving for required shapes,
- Embossed texture paint if required,
- Colors used as provided in the reference pictures or color code of actual from shade card of any paint brand,
- Screen Printing And Sand Blasting used for required pattern,
- Vacuum Forming used for required shapes; mostly for fluidic forms, in which die made in wood craved or pop carved.
- Use of SMD lights with 12v and 5v,
- The bidder has to account for cost of model in the bid, No additional cost shall be paid by JDA

Any other Items which have not been specifically mentioned in specifications but are necessary for construction of the Plant as per good engineering practices, safety norms and successful operation and guaranteed performance of the entire Plant shall be deemed to be included within Scope of Work. Any additional item which

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is not specified in above scope of work and if that item is required to be executed with due permission of Employer then it shall be paid to the contractor as per prevailing RUIDP BSR.

The Bidders are advised to visit the STP site & asses the actual site conditions before quoting for the proposed STP. No extra cost/claims in this regard shall be paid to the contractor.

The above works shall be completed within 24 months (including Monsoons) from the commencement date and followed by 03 months trial run & commissioning period followed by performance guarantee test (O&M for 1 year) and Operation & Maintenance (O&M) for 120 months their after.

2.2 PROPOSED TREATMENT SCHEME R

Raw sewage pumping station of 40 MLD capacity

Receiving of Raw Sewage

The raw sewage shall discharge into receiving chamber of pumping station. From Receiving Chamber it will be taken into downstream screens. The function of the Receiving Chamber is to reduce the incoming velocity. Receiving Chamber shall be of adequate size to meet the requirements of workability inside it. The Receiving Chamber shall be water tight to prevent seepage of the sewage out of the Receiving Chamber. Connection of incoming sewer within plant battery limits shall be in the scope of bidder.

Coarse Screening

Coarse screens are to be provided up stream of Wet well for removal of floating and oversized material coming with the sewage. The coarse screens should be capable to screen out most of the medium & large floating and oversized material such as plastic rags, debris, weeds, paper, cloth, rags etc. which could clog the waste water pump impellers. The coarse screen shall be inclined bar screen(Single or multi rake). It should be of sturdy design to take care of all sorts of materials envisaged in the gravity sewer. The screenings shall be dropped in bin above the top of the screen channel. The screening material as collected will drop into a wheelbarrows for its disposal.

Raw Sewage Sump/Wet Well

Screened sewage after coarse screening enters into wet well of the pumping station. Wet well is to be provided with two compartments so that grit/sand coming along with sewage can be settled in the first compartment, necessary arrangement such as screw conveyor, portable sand dredging pump (with cutter) etc. for removal of grit/sand from well with motor and other accessories for periodical clearing should be provided with standby arrangement. The capacity of the wet well should be kept such that adequate detention time is available during average and peak flow conditions. The effective liquid volume shall be provided below the invert level of the incoming sewer after leaving provision for freeboard. 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. In addition to the above liquid depth, an additional depression shall be provided to ensure adequate submergence of the pump as per the manufacturer's recommendations.

Suitable combination of submersible pumps is to be provided in the sumps to cater the pumping requirements at average and peak flow conditions. Based on incoming flow conditions, adequate no. of pumps shall operate automatically to cater the pumping requirements.

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Suitable arrangement shall be provided for lifting of pumps. Electrical panel of the Pumps, screens shall be placed in such a manner to avoid corrosion from gases. Either, it can be clubbed with MCC panel or necessary protection can be given.

The pumped flow from the pumping station shall be taken to the elevated head works Inlet chamber of the STP by means of rising main from where sewage will gravitate to fine screen channels.

Sewage treatment plant of 40 MLD capacity

Inlet Chamber

Inlet Chamber of STP shall receive the average flow of 40 MLD from Raw Sewage Pumping Station of 40 MLD Capacity located in STP area by means of rising main. From Inlet Chamber it will be taken into downstream Fine Screen Channels. 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.

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 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 5 year.

De-gritting

Screened sewage shall gravitate to Grit Separator Tanks for removal of grit and small inorganic particulate matter of specific gravity above 1.8 and particle size above 100 microns with minimum 85% efficiency. The Grit Separator Tanks shall be of RCC complete with grit washing mechanism, etc. The grit separated shall be properly collected in grit washer and transferred for disposal, residual organics shall be transferred back to inlet of grit chamber.

Flow Measurement

Bidder shall provide ultrasonic flow meter on common header of raw sewage pumping transfer pumps in order to measure the flow. Flow measurement before the distribution box for SBR shall also be measured through parshall flume fitted with suitable sensors.

Sequential Batch Reactor (SBR) Units

Preliminary 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.

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

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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 from 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.

Chlorine Contact Tank and Chlorine House & Tonner yard

Treated sewage from SBR Basins shall be taken to Chlorine Contact 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. Chlorinated effluent from Chlorination Tank shall be collect in treated water tank. Overflow from treated water tank shall be discharged into nearby water body by RCC Pipe / Channel through gravity& part of the treated water from treated water tank will be pumped into Overhead tank from where water will be reused for various non potable applications such as gardening, horticulture, washing, construction purposes, etc.

Sludge Handling Units

COTDM Feed Sump

Excess Sludge from SBR Basins shall be withdrawn through Sludge Withdrawal System and shall be collected in the COTDM Feed Sump. Sludge Sump shall be equipped with suitable submersible mixers to ensure homogeneous mixing.

Combined Thickening & Dewatering Machine (COTDM)

Sludge from sump shall be transferred to the COTDM for mechanical thickening &dewatering to achieve the solids consistency of 20% or more. 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 COTDM shall be collected & transferred in suitable vehicle to the designated site of disposal. Whereas centrate shall be transferred back to the system.

Interconnection of various Units shall be made through RCC Pipes of Class NP3/NP4 or RCC Channels. RCC Pipes shall be preferred over RCC Channels wherever possible but the Executive Engineer reserves the right to select any option.

Indicative Process Flow Diagram, Hydraulic Flow Diagram and Equipment Layout for the proposed STP are attached at the end of Section – II. These Drawings are indicative and for tendering purpose only. Bidders need to develop their own drawings based on his design and site conditions, conforming to the specifications given in the Tender documents.

The process selected is a well-established process for treatment of sewage. The Bidders are to adopt the same nomenclature used for various Treatment Units in their design documents as used in the Tender documents.

2.3 Detailed SCOPE OF WORK

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2.3.1 Design Basis:

Sr. No.	Design Parameters	Capacity
1	Average Flow	40 MLD
2	Peak Factor	2.25
3	Peak Flow	90.0 MLD
4	Invert Level of incoming Sewer	324.98 m
5	Ground Level (AGL) at Site	327.58 m
6	Finished Ground Level (FGL) at Site	328 m
7	HFL of nearby Nallah/drain	325 m
8	Approximate length & Dia. of Disposal Pipe	1500.0 m & 1600 mm dia RCC NP-4
9	Ground Water Table	35.0 m below AGL
10	Soil bearing capacity (Indicative)	20 tonne/m2 at 2 m below NGL

Note: Above data is indicative only. Assessment of Length of disposal pipe and Subsoil Investigation shall be carried out by the bidder at minimum two locations through NABL accredited laboratory. No extra cost shall be paid on account of change in length of disposal pipe, site topography and any change in foundation philosophy thereof during construction stage. Bearing capacity of soil for design purpose shall be as per site data assessed by the bidder subject to maximum 20 tonne/m2 at 2 m below NGL.

2.3.2 Raw Sewage Quality:

An abstract of Raw Sewage Characteristics is indicated in the following Table:

Sr. No.	Parameters	Values	UOM
1	pH	6.5 to 8.0	
2	Biochemical Oxygen Demand (BOD5)	600	mg/l
3	Chemical Oxygen Demand (COD)	1100	mg/l
4	Total Suspended Solids (TSS)	600	mg/l
6	Total Kjeldahl Nitrogen (TKN)	70	mg/l

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7	Total Phosphorous (TP)	5	mg/l
8	Fecal Coliform	1 x 106	MPN/100 ml
9	Total Coliform	1 x 107	MPN/100 ml
10	Sewage Temperature to design biological system	Min. 18 0C & Max. 30 0C.	

The Bidder shall carry out the sampling tests of raw sewage by themselves to ascertain the raw sewage quality for treatment process. The Employer 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.

Note:

1. The estimated Raw Sewage Characteristics/parameters of inflow sewer are given above. These characteristics are indicative based on general observed in sewerage flow of Jaipur City. In case the characteristics/parameters such as BOD/COD/TSS are more than those given in above table than bidder has to made treatment arrangements at his own level to achieved parameters as per NGT/RSPCB norms at his own cost. No extra cost/payment shall be paid to successful bidder.
2. The bidder is requested to visit the site and analysis the raw sewerage parameters of nearby area. It is the sole responsibility of bidder to achieve the treated water parameters as per NGT/RSPCB guidelines. If any additional unit is required to achieve these parameters than bidder may include it in designed & quote the price of work accordingly. No additional payments shall be made by JDA.

2.3.3 Treated Sewage Quality:

The Contractor shall design the process in such a way that the treated sewage quality attains the following limits or even better:

2.3.3.1 Treated Sewage Quality:

Sr. No.	Parameters / Pollutants		Values
1	pH	:	6.0 to 8.0
2	Biochemical Oxygen Demand (BOD5)	:	≤10 mg/l
3	Chemical Oxygen Demand (COD)	:	≤ 50 mg/l
4	Total Suspended Solids (TSS)	:	≤20 mg/l
5	Total Phosphorous (TP)	:	≤1 mg/l
6	Total Nitrogen (TN)	:	≤ 10 mg/l
7	Fecal Coliform	:	≤ 100 MPN/100 ml

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2.3.4 Technical Specification

B. Raw Sewage Pumping Station

Receiving Chamber

The sewage will discharge 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 CI sluice gates with actuators on upstream 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 receiving chamber. The receiving 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 receiving chamber. The entire construction is in M30 grade concrete and as per IS 3370. RCC access platform minimum 1200 mm wide with railing as per specifications shall be provided on one side of the chamber:

Total Average flow	:	40 MLD
Peak factor	:	2.25
Design Flow	:	90.0 MLD
Number of Units	:	1 (One)
Detention period	:	30 Sec at Peak Flow
Min Free board	:	0.50 m above FGL

Coarse Screen Channels

Min. two mechanical screen working and one mechanical screen standby of 20 mm clear spacing and each screen shall be provided of 50% peak flow capacity.

The mechanical bar screens shall be made of 10 mm thick Stainless Steel (SS 304) flats respectively. The mechanical coarse screens shall be of Inclined Rake Type of 20 mm opening as per the specifications detailed elsewhere in the tender. Bin and chute arrangement shall be provided to take the screenings to the screenings dropped from chute will be collected in a wheel burrow. Motorised operated CI gates are provided at the upstream to regulate the flow.

Adequate RCC Platforms shall be provided at the upper level to enable operation. Railings shall be provided around the entire periphery of the platform. The entire structure is to be M30 concrete and as per IS 3370 including the platform. RCC staircase 1000 mm wide shall be provided for access from the ground level to the top of the unit & to the operating platform.

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Total Average flow	:	40 MLD
Peak factor	:	2.25
Design Flow	:	90.0 MLD
Number of Units	:	2 Mechanical (Working) + 1 Mechanical (Standby) each of 50% Peak Flow capacity
Approach Velocity at Average Flow (m/sec)	:	0.3
Velocity through Screen at Average Flow	:	0.6 maximum(m/sec)
Velocity through Screen at Peak Flow (m/sec)	:	1.2 maximum
Min Free board	:	0.50 m above FGL
Wheeled Trolley	:	1 No.

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

Raw Sewage Pumping Station

3.1 Sump and Pumps

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 an average flow of 40 MLD. The capacity of the wet well should be kept such that the detention time in the wet well shall be minimum 5 minutes of peak flow and the maximum detention time shall not exceed 30 minutes at average flow. The entire structure is to be M30 concrete and as per IS 3370 including the platform. 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 manufactures recommendations Pumping station should have a room adequate for installing electrical panels. Suitable arrangement should be provided for lifting of pumps.

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5. The effective liquid volume shall be provided below the invert level of the screen chamber after leaving provision for a minimum of 0.1 m.

6. Wet well shall be provided with suitable no of exhaust fan for removal of foul gases.

7. All valves in raw sewage transfer pumps shall be motorized.

Wet well shall be provided with two compartment i.e. baffle wall in order to prevent sand/grit deposit near the pump. Necessary bypass arrangement shall be provided from sump to the disposal point catering to peak flows during the shutdown of the plant.

IS: 3370 and IS: 4111 (part 4) shall be followed for the design and construction of wet well.

Pumping machinery shall be designed for 40 MLD average flow and a peak factor of 2.25. The pumps shall be Submersible raw sewage pumps with centrifugal, non-clog type design. The speed of pump shall not be more than 1500 rpm. Each pump shall be provided with variable frequency drives. The impeller should be of a non-clog design with smooth passage and solid handling capability of 100 mm size.

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. Vibration shall be limited as per BS 4675 Part I.

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. Complete rotor shall be balanced dynamically.

Design Flow : 40 MLD

Minimum Retention Time : 5 minutes minimum at peak flow.

No. of Pumps for present

Flow : 1250 m3/hr with Suitable Head (2 working + 2Standby)

: 625 m3/hr with Suitable Head (1 working + 1 Standby)

Type of Pumps : Submersible type non-clog design with VFD

Solid passage size : 100 mm max.

Through Pumps

Insulation : Class F

Protection : IP-68

Wet well Specific Requirement, Material of Construction and Accessories:

i. Number of Units : (1) One designed for peak flow

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ii. Pumping Station Material of Construction RCCWet well / Sump

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

Electrical panel of the Pumps, screens shall be placed in such a manner to avoid corrosion from gases. Either, it can be clubbed with MCC panel or necessary protection can be given.

Electrical Hoist shall be provided comprising of I-Girder and a 1½ ton or more chain pulley (the chain pulley block capacity to be 1½ Ton or 1.5 times the maximum single unit/ weight that may be required to be removed for maintenance) with horizontal travel on the I-beam.

Pumps Configuration : As mentioned above

Liquid : Raw Sewage

Specific gravity : 1.05

Temperature : Min. 20° C

Efficiency : more than 70%

Installation : Fixed.

Casing : Cast Iron IS 210 Gr. FG 260

Impeller : SS 304

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 : Cast Iron IS 210 Gr. FG 260

Duck foot bend : Cast Iron IS 210 Gr. FG 260

Guide Pipe : SS 304

Lifting chain : SS 304

Fasteners : Suitable harden steel (anticorrosive)

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Testing of Pumps at Manufacturers Premises:

a) Hydrostatic Testing: All pressure parts of pumps prior to assembly, shall be subjected to hydrostatic tests to the satisfaction of Executive Engineer at 1.5 times the maximum pressure obtained with the delivery valve closed and suction pressure at maximum, or twice the working pressure whichever is higher for a duration of 10 minutes.

b) Balancing Test: Impeller and pump rotating assembly shall be dynamically balanced.

c) Performance Test: Each pump shall be tested for full operating range individually to BS: 5316: Part 2. Test shall be carried out for performance at rated speed with minimum NPSH as available at site.

d) Pump performance shall be within the tolerance limits specified in BS: 5316: Part 2.

3.2 Pumped Waste Water Conveyance

The pumped flow from the pumping station to the elevated head works inlet chamber of the plant shall be taken through a DIDF – K-9 pipeline.

(a) The pipeline shall be adequately sized to have a minimum velocity of at least 1.2 m/s at minimum flow conditions and not more than 2.5 m/sec at pumped peak flow.

(b) The pump head shall be adequately sized considering static head, frictional losses & adequate margin on frictional losses.

A suitable pumping bypass along with electrically actuated valve arrangement shall be provided from the pumping station to divert sewage in case of emergency. The pumping bypass of DIDF K-9 class shall collect in a chamber after chlorination/treated water tank which will leads to the final disposal point.

B. Sewage Treatment Plant

1.0 Primary Treatment Units

Primary Treatment Units comprising Inlet Chamber, Fine Screen Channels and Grit Chambers shall be designed for Peak Flow. Area below primary treatment units shall be provided with min. 100 mm thick ballast/grit/pebbles.

1.1 Inlet Chamber

Inlet Chamber of STP shall receive the flow from Raw Sewage Pumping Station, located in STP area. 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.

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Average Flow : 40 MLD

Peak Factor : 2.25

Peak Flow : 90.0 MLD

Number of Units : 1 No.

Hydraulic Retention Time : 30 Sec at Peak Flow

Free Board : 0.50 m min.

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

1.2 Fine Screen Channels

Min. two Mechanical Fine Screens (Working) and one Mechanical Fine Screen (Standby) shall be provided in Fine Screen Channels. Each Fine Screen 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.

The clear opening shall be 6 mm for Mechanical Fine Screen. The Mechanical Screens shall be made of SS 304 flats(2-3 mm for Mechanical). Chute arrangement shall be provided to take the screenings. Screenings dropped from Chute on the belt conveyor &shall be collected in a wheel Burrow at the ground level. Manually operated CI Sluice Gates shall be provided at the upstream and downstream ends to regulate the flow.

Average Flow : 40 MLD

Peak Factor : 2.25

Peak Flow : 90.0 MLD

Number of Units : 2 Mechanical (Working) + 1 Mechanical(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.

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

1.3 Grit Chambers

Two Mechanical Grit Chambers (Working) along with one Manual Bypass Channel (Standby) shall be provided after Fine Screen Channels. Each Grit Chamber shall be designed for 50% of Peak Flow whereas 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 SS304 Hand Railing as per specifications shall be provided. RCC Staircase, minimum 1.20 m wide with SS304 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 a 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 + One Organic Wash Pump.

Motorised 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 : 40.0 MLD

Peak Factor : 2.25

Peak Flow : 90.0 MLD

No. of Units : 2 Mechanical (Working) each of 50% of Peak Flow capacity

Type : Mechanical

Size of grit particle : 0.10 mm and above

Specific gravity of grit : 1.80

Maximum Surface Overflow Rate : 250 m3/m2/day

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Free Board : 0.5 m min.

Side Water Depth : 0.8 m min.

Wheel Barrow : 4 Nos. minimum

Grit removal efficiency : more than 85% for particle size 100 micron & above and

: more than 95% for particle size 150 micron & above

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

Flow Measurement

Flow measurement shall be done online using an electromagnetic(full bore type) flow measurement device. The flow meter shall be installed on common header of raw sewage transfer pumps.

A suitable bypass shall be provided after Grit chambers to divert sewage in case of emergency. The bypass arrangement shall be of RCC NP-4 class pipe which shall collect in a chamber after chlorination/treated water tank which will leads to the final disposal point.

2.0 Sequential Batch Reactor (SBR) Units

2.1 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.

It shall be mandatory for the bidders to submit a MOU/Technology tie up agreement duly signed and notarized on a Rs.500.00 non judicial stamp paper with a technology provider who must have a registered company in India fully equipped with trained manpower to extend services as and when required. The technology provider shall have experience of providing SBR technology and technology equipment for at One (1) no STP of 32 MLD capacity or Two (2) STPs each of 20 MLD capacity in India during last seven years and are working satisfactorily for at least three years as on Date and meeting outlet quality as required for proposed STP. The SBR Technology provider shall submit evidence / certificate signed by client, not below the rank of Executive Engineer.

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MOU/Technology tie up agreement shall be uploaded as a part of technical bid. Technical bid without MOU/Technology tie up agreement shall be rejected. Date of signing of agreement shall be after the date of publishing of tender notice. 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.

2.2 Process Design

Sequential Batch Reactor (SBR) Units shall be installed and equipped for average flow of 40 MLD.

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. The SBR sizing and design shall be such that the proposed cycle times, number of cycles per day, and phase times within each cycle shall all remain fixed up to the specified design peak day flow i.e. SBR to be designed for peak flow requirement without advancing time / no. of cycles.

No acceleration or premature advancing of cycles shall be allowed up to the peak day flow.

Minimum 4 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.

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A minimum total SRT of 10 days shall be maintained to ensure digested sludge.

Provision for transfer of MLSS from one basin to adjacent shall be made in SBR system.

2.3 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.

There should be maximum one (1) Decanter per Basin.

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 floatables 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.

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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 1.3m/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 Technology provider has provided specified type of decanters in at least 10 Number of STP's in India on his own design, and successful operation for at least 1 year as on date.

2.4 Aeration System

The aeration facility shall be installed for 40 MLD 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. Minimum turndown of 50% shall be achieved at lowest operating pressure as per process requirement.

Air Blowers shall have dedicated 50% standby capacity (4W + 2S). All Air Blowers shall operate via VFD.

Air Blower shall be Single Stage, Direct Drive, CE/UL certified, Centrifugal type Turbo Blower consisting of Air Bearings, Impeller, high-speed PMSM Motor, Inverter, Controller and Cooling System. Blower RPM shall be

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minimum 20,000. It shall be able to operate under varying pressure and flow conditions as per process requirement. The maximum idle time between OFF and ON shall not exceed 30 seconds.

It shall be composed of Casing, Suction Filter, Reducer, Acoustic Hood, Blow-Off Valve, Inverter, Electrical Panel and Controller etc. Noise level should be less than 85 dBA at 1.00 m from Blower whereas Vibration level should be less than 2 mm/sec.

Casing shall be of high-quality Aluminium Alloy and able to resist thermal expansion, vibration and air leakage.

Air Bearings shall be non-contact type, bump type foil air bearings with oil free lubrication, low noise and no vibration. The wearing surfaces shall be made of Inconel. Air Bearings should be able to withstand minimum of 20,000 On/Off in its life time.

The bearing consists of top foil and bump foil. Top foil material is nickel alloy coated with Teflon and bump foil is nickel alloy. It is designed to maintain high load bearing capability to sustain the weight of the rotating assembly.

Impeller shall be of high strength Aluminium Alloy (AL7075). It shall have high compression efficiency, high surge stability and wide flow range. It shall be capable to keep dynamic balance in high speed revolution and shall be suitable for transmission of power and safety factor at critical speed. It shall be directly connected with the motor shaft without any coupling. The inlet to the Impeller Compartment shall be open without any restrictions like fins etc.

Integral Variable Frequency Drive shall be air cooled.

Control panel for air blower shall be separate from blower assembly and be placed in separate air-conditioned room.

Motor shall be high-speed Permanent Magnet Synchronous Motor (PMSM). The Shaft of the Motor shall be of Titanium and shall be directly connected to the Impeller.

Motor, being high-speed, shall be provided with the best suited Cooling System to ensure consistent motor output and longevity. All motors shall be air cooled, with an insulation class-H.

Blower shall be equipped with Blow-Off Valve with Silencer.

Controller shall have 16-bit color touch screen with convenient user interface to support various operation modes such as Auto Flow Mode, Auto power mode, Auto RPM Mode, Auto Pressure Mode, Proportional Mode, DO-Link Mode and Failure, Check and Reset Option. Following measurements and operating data are shown on the Controller Screen:

Operating State of the Turbo Blower:

Ready

Run

Stop

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Wait

Error

Measurement and Display Data:

Suction Filter Differential Pressure

Suction Temperature

Discharge Temperature

Discharge Pressure

Suction Flow Rate

Revolution per Minute

Power

(c) Warning and Error Message:

Filter differential Pressure Over

Motor overheating

Compressor Surge

Discharge under pressure

Discharge Over pressure

Suction Over temperature

Inverter Error

Material of construction of various parts of Blowers shall be as follows:

Bearing	:	Inconel
Casing	:	Aluminium Alloy
Impeller	:	Aluminium Alloy (AL7075)
Shaft	:	Titanium Alloy
Blower &Control panel	:	SPHC

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Enclosure

PLC Hardware : Conformal Coated

Head for blowers shall be decided on the basis of S.O.R. of diffusers and maximum liquid depth in Basin duly considering the losses governing point of delivery (diffusers) and the blowers

The operation of Aeration System shall include PLC based control. The operation and speed of Air Blowers shall be automatically adjusted using parameters like Oxygen Uptake Rate, Dissolved Oxygen and Temperature and Liquid Level in the Basin such that the DO is supplied as per demand and power utilization for operation of Air Blowers is optimized.

The main Air Header/Ring Main shall be in MS as per relevant IS Code, painted with corrosion resistant paint as per Manufacture's recommendations. The Air Header/Ring Main shall be supported on saddles at suitable intervals or shall be protected against external corrosion in case laid below ground. The Sub-header shall have Auto Valves to facilitate switch over of Aeration Cycle from one Basin to other by PLC. The Sub-header shall supply air to fixed type Diffuser Grid through vertical Air Supply Pipes. These Air Supply Pipes above water level shall be in MS, painted with corrosion resistant paint and below water shall be in SS 304. All under water Lateral Pipes shall be of UPVC. Junctions between horizontal Sub-header and vertical Air Supply Pipes shall be suitably protected against corrosion due to dissimilar materials.

The Air Blower House shall have perforated Rolling Shutter, Windows with aluminium louvers covered with Velcro net, Exhaust Fans, Safety Equipment with sufficient Ventilation, Lighting and Working Space. It shall be equipped with Forklift of suitable capacity or Electrical Hoist with Travelling Trolley to facilitate lifting / removal / transportation of Air Blower for repair and maintenance, if required.

All other accessories, whether specified or not, but required for completeness shall form part of Contractors scope

2.5 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)

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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

2.6 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

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3.0 DISINFECTION (CHLORINATION) UNITS

The secondary treated sewage shall be led to Chlorination system for disinfection. Chlorination Units shall consist of Chlorine Contact Tank and Chlorine House & Tonner Room.

3.1 Chlorine Contact Tank and Chlorine House & Tonner yard.

Treated sewage from SBR Basins shall be taken to Chlorine Contact Tank by RCC Channel/RCC Pipe of Class NP4. 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.

Chlorination Tank shall be designed and sized to allow draining of the structure with the largest volume from full to empty within six (6) hours by pumping. Draining arrangement shall be connected to disposal pipe.

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 : 0.5 m min.

Chlorinated effluent from Chlorination Tank shall be collect in treated water tank. Overflow from treated water tank shall be discharged into nearby water body by RCC Pipe / Channel through gravity& part of the treated water from treated water tank will be pumped into Overhead tank from where water will be reused for various non potable applications such as gardening, horticulture, washing, construction purposes, etc.

A Chlorinator cum Chlorine Tonner House shall be provided nearby to house Chlorination Systems. It shall be RCC (M25) Frame cum Brick Masonry Structure with Rolling Shutter, Windows & Ventilators, Electrical Hoist with 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 Equipment 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.

Service water pumps of suitable capacity shall be provided for filling OHSR for flushing, cleaning & gardening, reuse purposes.

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:

The Gas Chlorination System shall consist of Vacuum Chlorinators (01 Nos. working + 01 nos. Standby), Water Feed Pumps (01 Nos. working + 01 nos. Standby) Interconnecting Piping and Appurtenances, Chlorine Gas

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Detector with alarm, Empty Chlorine Tonners (Suitable for 30 days' Storage) with Toners, 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.

Chlorine tonners are to be provided from authorised agency with valid filling license copy & valid hydrotest certificate.

Design Flow : Average Flow or Decant Flow whichever is more

Type : Vacuum Type

Chlorine Dosing : Suitable to maintain free residual chlorine in between 0.5 to 1.

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.

3.3 Treated Water Tank & pumps:

Chlorinated sewage from Chlorination tank shall be taken to Treated water Tank. Chlorinated effluent from Chlorination Tank shall be collect in treated water tank. Treated water tank shall be provided with level sensor & auto on/off separation of pumps. Overflow from treated water tank shall be discharged into nearby water body by RCC Pipe NP-4 class / Channel through gravity& part of the treated water from treated water tank will be pumped into Overhead tank from where water will be reused for various non potable applications such as gardening, horticulture, washing, construction purposes, etc.

Design Capacity : Average Flow or Decant Flow whichever is more

Number of Units : 1 No.

Hydraulic Retention Time : 5 min.

Free Board :0.50 m min.

Pumps :Capacity of Pumps- 50 m3/hr @ Suitable Head (1 working + 1 standby)

Flow Measurement

Flow measurement shall be done online using an electromagnetic (full bore type) flow measurement device. The flow meter shall be installed on common header of treated water pumps.

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Suitable arrangement for flow measurement in the form of parshall flume shall be provided at downstream of treated water tank.

4.0 Sludge Handling Units

Sludge Handling Units comprising of COTDM Feed Sump & Pump House, COTDM House and Dewatering Polymer Dosing System shall be designed for sludge production of Average Flow.

4.1 COTDM Feed Sump & Pump House

A Sludge Sump shall be provided to hold biological sludge from SBR basins. Suitable nos of Submersible SS 304mixers shall be provided to facilitate mixing of contents of sludge sump. It shall be constructed in M30 grade reinforced cement concrete and as per IS 3370.

Design Capacity : Biological Sludge from SBR basins

Number of Units : 1 No.

Hydraulic Retention Time : 12 hrs. min. of Average Daily Sludge Production

Free Board : 0.50 m min.

A Pump House shall be provided near Sump to house COTDM 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.

COTDM Feed Sump Mixers & COTDM Feed Pumps

Submersible mixer shall be provided inside the 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.

COTDM Feed Pumps shall be of positive displacement type Screw Pumps suitable for handling biological sludge of 0.8 – 1% solids consistency.

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Capacity and Head : Biological Sludge from SBR basins

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 : Working as per requirement + Min. 50% Standby

All other accessories, whether specified or not, but required for complete shall form part of contractors scope.

4.2 COTDM&COTDM House

A combination of sludge thickener mechanism and mechanical sludge dewatering using belt filter press shall be provided for sludge dewatering.

(i) Sludge Dewatering Units using COTDM

The dewatering facility shall comprise of: Mechanical Belt Thickener + Belt Filter Press Machine or Volute Press +Polyelectrolyte Dosing System Sludge flow from the sludge sump is directed to the combined thickening and dewatering unit. The machine has a simple structure with easy maintenance and high output solids content rate. The sludge will be dewatered from inlet consistency of 0.8% solids to 20% solids in the belt press. The filtrate from belt press will be sent to terminal sewage pumping station and dewatered sludge shall be used for many different purposes (as manure). A standby unit will be provided. The poly dosing system shall also be there to enhance the thickening and dewatering process.

Mechanical Dewatering of the sludge is contemplated after sludge thickening. Belt Filter Press or Volute Press machine has to be provided for Mechanical Sludge Dewatering.

Thickened sludge from the thickener flows to the Belt filter press or Volute Press Dewatering polyelectrolyte solution of strength minimum 0.1% W/V is added to the incoming sludge. By chemical conditioning, the sludge is dewatered at a desired consistency of about 20%. The BFP/Volute Press shall be housed in an elevated building so that the dewatered sludge is collected directly in a container from where it is removed periodically and carted away for further processing and disposal or reuse.

The building shall also house the ancillary equipment for BFP such as DWPE dosing system. The filtrate from BFP shall be directed to the filtrate sump. The filtrate along with the supernatant from thickener cum sludge holding tank shall be recirculated to supernatant sump and then to SBR distribution channel.

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The dewatering system should be so located that the dewatered sludge can be loaded into trolleys/ drums/ bins directly – preferably the dewatering unit shall be so located that the dewatered sludge falls into the containers/ bins without requirement of another material handling unit.

The dewatered sludge should be truck-able & be suitable for disposal by open body truck and should have a minimum solid concentration of 20% w/w (measured as dry solids w/w basis). The dewatering unit should have a 95% solid recovery.

S. No.	Design Criteria	
1	Nos. of COTDM MACHINES	Working as per requirement + Min. 50% Standby
2	Size or Capacity	As per Bidder's Design
3	Maximum Operation Hours per day	12 hours (7 days a week)

Material of Construction

Main Components	SS 304 wetted parts

Mixing arrangement of

Polyelectrolyte and sludge : online-mixing.

Dewatering polyelectrolyte dosing system is to be provided to dose poly electrolyte solution to the incoming sludge at entrance to the COTDM.

A COTDM house shall be provided near COTDM feed pump house to house COTDM. it shall be a G(stilt) + 1 type RCC (m25) frame structure. COTDM 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.

4.3 Polyelectrolyte Dosing System

Polyelectrolyte shall be dosed online at the inlet of COTDM. Minimum dosage of polyelectrolyte shall be 2 – 3 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

Number of Units : 2 Nos.

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Hydraulic Retention Time : Suitable for min. 12 hours of Operation

Free Board : 0.50 m min.

The solution will be dosed using mechanically/hydraulically actuated diaphragm type Metering Pumps. Dedicated Dosing Pumps shall be provided and shall be interlocked with COTDM in such a way that they Start/Stop along with related equipment.

Capacity and Head : As required

Type of dosing pump : Mechanically/ hydraulically Actuated Diaphragm Type

Liquid : Polyelectrolyte Solution of 0.1% Strength

Quantity : Working as per requirement + Min. 50% Standby.

5.0 Plant Utilities

5.1 SBR Air Blower / Administrative cum PMCC, & PLC/Control Building

SBR Air Blower / Administrative cum PMCC, PLC/Control Building shall be G+1 type RCC (M25) Frame and Brick Masonry Structure. SBR Air Blower House, workshop & tool room shall be constructed at ground floor whereas Administration Block, comprising Office, Laboratory and PLC/Control Room, Conference Room, Plant-In-Charge Room shall be placed at first floor. Conference room shall be provided with attached toilet. All partition walls of rooms on first floor shall be of glass partition.

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. Vibration free support system shall be provided to the foundation of air blower room so as to avoid any cracks to the room due to the vibration.

Laboratory shall be fully equipped with all necessary Equipments, Instruments, Chemicals, Reagents, Glassware and Furniture.

Rainwater harvesting system shall be provided at Administrative Building comprising one underground collection tank & pump, overhead tank.

Solar panel shall be placed on terrace of administrative building. No. of panels shall be decided by the bidders considering the load requirement of internal lighting of building.

Adequate number of Toilets and Washbasins shall be provided separately for Men & Women at each floor. A covered Overhead Tank of capacity 5 m3 shall be provided along with an Underground Water Tank of capacity 5 m3 to cater to the water requirements of the Building and2 Number of Tube well shall be provided of suitable capacity.

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 and Fire Alarms etc. Adequate Flooring shall be provided in various Rooms/Areas as per requirement or as per instructions of the

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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	2 Nos. of latest version & configuration complete.
2	Printer in PLC/Control Room	1 No. of A3 Size Laser Printer of latest version & configuration complete.
3	Telecommunication Facility	Min. 1 No Telephone Line with a Broad Band facility. The charges will be born 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.

5.2 HT Panel Room & Transformer Yard

The Electrical HT panel room shall be provided to house HT Components comprising Metering Kiosk, HT Panel, and Power Control Centres. It shall be RCC (M25) 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.

Transformer shall be of outdoor type and installed outdoor on RCC platform & provided with fencing.

5.3 Metering Room

Separate metering room shall be provided to at the entrance of plant. It shall be RCC (M25) 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.

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5.4 DG Platform

Diesel Generator (DG sets) shall be provided to run the complete plant on full load capacity. DG shall be placed in DG platform. Indicator light of red colour shall be provided on top of stack. It shall be RCC (M20) platform and Safety Equipments including Sand Buckets, Fire Extinguishers and Fire Alarms etc. complete.

5.5 Rest Room for Workers Use

4 no. of Rest Rooms (G+1) having 1BHK configuration comprising of one bed room, one living room, one kitchen, toilet & bathroom of following sizes shall be provided for Workers use It shall be RCC (M25) Frame and Brick Masonry Structures equipped with Doors/Windows/Ventilators, etc. complete with Flooring, Internal and External Plaster with Painting and Plinth Protection along the periphery as per specifications.

S. No.	Type	Minimum Carpet Area to be provided
1	Type-I	42 m2– 4nos

5.6 Security Cabin

Min. 1 no Security Cabin each of size 3.00 m x 3.00 m shall be provided at 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.

5.7 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 600 mm x 600 mm & thickness min 10 – 12 mm	Solid Core Flush Door with heavy duty Brass Fittings of approved make	Aluminium of approved make
2	SBR Air Blower House, Workshop & Tool Room, Chlorinator cum Chlorine Tonner House, Sludge Pump Houses, Electrical HT Substation, Gas Engine House	IPS Flooring with Abrasion Resistant Additives of approved make	MS Rolling Shutter (See Through Type) of approved make	Aluminium of approved make

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3	Centrifuge Platform, Gravity Table Thickener Platform	Anti Skid Tile Flooring of approved make	---	---
4	Vehicle Parking Area	Coloured Pre-cast Heavy Duty Paving Blocks with Lacquer Finish	---	---
5	Toilet Blocks	Coloured Glazed Tiles	UPVC of approved make	UPVC of approved make
6	Staircase: Inside Building	Grey Granite Flooring of approved make	---	---

5.8 Roads, Pathways & Vehicular Parking Area

All internal Roads shall be provided with Drainage and constructed to prevent standing water. All Roads shall be minimum 5.5 m wide of bitumen with RCC kerb stone & drain on both side of 350 mm RCC pipe of class NP-3 with manhole at suitable intervals.

Pathways shall be constructed interconnect the entire Plant with Roads. Minimum width of pathways shall be 1.50 m. Pathways shall be in coloured Pre-cast Heavy Duty Paving Blocks with Lacquer Finish.

Vehicle Parking Area shall be provided to accommodate at least 4 no. of four-wheeler vehicles& 10 nos. of two-wheeler vehicles 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 continuous route through the Works and get out again.

5.9 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 350 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/disposal pipe.

5.10 Boundary Wall with 1 no of Gate

Boundary Wall shall be constructed in stone masonry (R.R) pointing all around the STP 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 2.00 m from finished ground level& top of wall barbed wire fencing (GI wire gauge 18). However, It should be able to bear wind pressure up to 80 Km/hr. At least one Entry Gate, minimum 3.60 m wide each shall be provided. Each Entry Gate shall be provided with a Wicket Gate.

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5.11 Internal Water Supply and Water Supply for Gardening

Proper water facility shall be provided at STP. 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. RO unit shall be installed for potable water. Water cooler of minimum 100 ltr. capacity shall be installed.

5.12 Disposal of Plant Residuals &Treated Sewage

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. Contractor shall strictly note that sludge shall be safely disposed off to disposal site in vehicle having provision of suitable coverings. However, the Contractor shall be responsible for disposal of Plant Residuals within 10 km from Site. Treated Sewage shall be discharged into nearby river/ nallah by gravity/pumping. Sludge generated from STP shall be deemed as property of contractor & he may sell off the Dewatered Sludge after due treatments.

5.13 Landscaping

Landscaping involves beautification of Sewage Treatment Plant site by cultivating lands, plants and trees of environmental value and suitably modifying the appearance of STP site. It shall add scenic value to the STP site to obtain maximum visual impact. Contractor has to develop proper landscaping in the STP site from professional landscaper approved by OWNER. Area for future expansion shall also be considered for landscaping.

5.14 Overhead Tank

Contractor shall provide 1 no. RCC Overhead Tank of min. 5 Lac liter capacity with 22m stagging height & all necessary equipment. Epoxy coating shall be provided from internally. The entire construction shall be in 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. Lightening arrestor, level indicators, level censors for pump operations etc. shall be provided.

6.0 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	Min. Velocity shall not be less than 0.6 m/sec. Max. Velocity

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Sr. No.	Service	Design Velocity m/s	Limitations
		Designed as pipe line flowing full.	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 2.5 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 Bidder 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

Sr. No.	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

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Sr. No.	Service	Type of Flow	MOC
5a	Air Grid Piping: Aeration Zone	Pressurized	UPVC Schedule 40
5b	Air Grid Piping: Selector Zone	Pressurized	SS 304
6	Chemicals	Gravity / Pressurized	SS 304 except Chlorine & FeCl3
7	Chlorine & FeCl3	Gravity / Pressurized	Schedule 40 UPVC

Valve: Guide Line

Sr. No.	Service	Type	MOC	End Connection
A	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

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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			
1a	Gravity / Pressurized	Ball	As per Chemical Compatibility Chart	Flanged
1b	Gravity / Pressurized	Diaphragm	As per Chemical Compatibility Chart	Flanged
1c	Gravity / Pressurized	Plug	As per Chemical Compatibility Chart	Flanged

Notwithstanding the above, the Bidder 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.

7.0 Electrical & Instrumentation Works

33 KV HT Power Supply from State Electricity Authority (Jaipur Vidyut Vitaran Nigam) based on the maximum demand loadfrom nearby Source to the entrance of STP Site shall be arranged by Employer. Permanent power connection shall be in the name of Secretary, JDA-Jaipur. The Employer will pay the charges for obtaining the above connection including necessary liasoning for the same. Contractor scope shall start from outgoing of energy meter. Prior to commencement of work contractor should recheck the availability of power supply from Jaipur Vidyut Vitaran Nigam Ltd. (JVVNL).

Min. Two nos. of Transformers (1W + 1SB) for full load of the plant with 10% overload shall be provided. These shall be step down Transformers suitable for outdoor installation (oil filled type) 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:

- Outgoing of metering room.
- HT Cable with Termination Kit from "Source" to the Electrical HT Panel roomlocated at the Sewage Treatment Plant.
- HT Panel roomincluding Metering Kiosk, HT Panel, Power Control Centre etc. complete.

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- Motor Control Centres.
- Cabling including Power, Control and Instrumentation Cables. Cable tagging (power/control) shall be done at every 10 m interval.
- Maintenance free 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 Plant including Primary Treatment Units, Biological Treatment Units based on SBR technology, Chlorination system, Sludge Handling Units 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.

8.0 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 single PLC and SCADA for entire Sewage Treatment. This shall be located at control room of the STP.

The plant shall have provision for operations in following modes –

Automatic – Auto operation through PLC/digital controller.

Manual – Operator intervention through SCADA/HMI.

Local – Local operation through local control panel located near equipment.

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.

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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

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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).100% Redundancy for UPS shall be provided. 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.

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.

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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 15% 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.

HMI/SCADA system

The HMI system shall be designed as a minimum 6", 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

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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.

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		
	Processor	Intel i5 or higher
	Processor speed	2 GHz or higher
	Configuration	Tower
	Architecture	32 bit
	System memory	8 GB
	Hard disk	320 GB or higher
	DVD Drive	Combo (Read/Write)
	Operating system	Microsoft Windows 7 professional
	Communication	USB – 4Nos., Ethernet – 1Nos.
	Graphic	1 GB
	Power supply	240V, 50Hz, 1Phase
	Keyboard	Internet Keyboard (with USB interface)
	Mouse	Optical, 3 buttons (with USB interface)
Monitor		
	Type	Full HD LED color monitor
	Screen size	22” or higher
	Resolution	1920 x 1080
	Power supply	240V, 50Hz, 1Phase

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Complete Project shall operate in auto mode. As a minimum, following controls must be considered in Bidder's Control Philosophy:

Coarse screens

Each mechanical coarse screen shall be installed with ultrasonic differential level transmitter/ level switch, across it; the same shall be operated on the basis of set differential level in SCADA. Also if differential 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 coarse screen.

Raw Sewage Sump and Pumps

The sump will employ an Ultrasonic level transmitter to measure level. The combined operation of Raw Sewage Pumps will be dependent on rate of change of level with reference to time. The selection of Auto/Manual and Working/Stand-by shall be made available in SCADA. In manual mode the pump Start/Stop will be done through SCADA screen.

A clamp on type Ultrasonic or Electromagnetic flow transmittershall be provided at common header of pumps for measurement of flow to sewage treatment plant. PLC shall calculate instantaneous flow as well as cumulative flow, both shall be displayed on SCADA.

Necessary interlocks, controls, alarms, report generation, etc. shall be considered in PLC for auto operation of Raw Sewage Pumps.

Inlet chamber

An 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.

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.

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Grit Chambers

Each grit chamber will consist of agitator/mixer, grit pump, and Screw Conveyor for grit removal (1No.). As such grit 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 Vortex Grit chamber equipment.

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.

Sludge sumps and pumps

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 sludge handling system.

COTDM

The drives and instruments of COTDM 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 Centrifuge.

2.4 Technical Specifications – Civil Works

a) 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 Employer. Necessary information such as reference to the location as proposed for the treatment plant by him with respect to site boundary.

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b) 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.

c) 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 2.3.3 or even better.

Contractor shall submit design & drawing schedule to EIC & got approved from EIC.

d) 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 before its disposal.

e) 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.

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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 (latest) or other Indian/international standards in absence of BIS or sound engineering practice. 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.

f) Construction Works

The Contractor shall construct the civil units of the plant (including intermediate process pumping stations wherever required) to accommodate the mechanical units to fulfill 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.

g) 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.

h) 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

The name of the Project,

The name and addresses of the Employer, the Contractor and the Consultant;

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The name and short description of the Project and

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.

i) 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 Employer shall carry out supervision and quality control and monitoring the progress of works.

j) 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.

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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.

k) Erection

Bidders have to note that various major items shall be procured / executed under this Contract subject to inspection by the Employer or their authorized representatives at manufacturer's premises. Cost of inspection shall be borne by Contractor

l) 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 Employer. No extra payment will be made for the use of admixtures.

2.5 Mechanical Equipments for STP

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.

2.6 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.

2.7 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. JDA will provide landfill site where sludge will be disposed off. Contractor shall strictly note that sludge shall be safely disposed off to disposal site in suitable vehicle. 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.

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2.8 Disposal of Excavated Stuff

It will be the responsibility of Contractor to dispose all the excavated stuff within the Employer limits as directed by Engineer In-charge.

2.9 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 STP.

2.10 Safety Equipment:

Safety Equipments should be provided at STP 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.

2.11 Model of the Project:

A 3D 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 fir display.

2.12 Scope of Work for Operation & Maintenance

The Bidder shall operate and maintain the Raw Sewage Pumping Stations, Sewage Treatment Plant and all other allied works under this Contract for a period of 120 months after 03 months trial run and 1 year O&M, including defect liability period of 36 months. For this period, the scope of work shall include, but not be limited to the Operation and Maintenance of the following:

Raw Sewage Pumping Station and Sewage Treatment Plant near Chandlai Lake, Jaipur including all the Civil Units and Electro-Mechanical Equipments as per the Bidder's Proposal to ensure that all the output guarantees are met.

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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 electricity are 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 Employer staff as per specifications.

The Bidder shall, at no extra cost to the Employer, 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 Employer in proper & fully working condition.

2.13 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, Diesel cost for DG etc. excluding Cost of Electricity 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 Employer. Employer will provide power during trail run, commissioning period & O&M period free of cost.

The Bidders are to quote O&M Cost and provide Functional Guarantee based on the inlet parameters given as per clause 2.3.2, Raw Sewage Quality which shall be used for technical evaluation of qualifying Bids:

2.14 Contract Period

The total Contract Period shall be as follows:

Construction Period : 24Months (including Monsoon)

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Trial Run & Commissioning Period	:	03 months
O&M Period (by bidder)	:	1 year
O&M Period	:	120 Months including 36 months defect liability period

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1.0 (b) SCOPE OF WORK – OPERATION & maintenance

1.0 General Obligations

The Bidder shall during the O&M Period, undertake all services relating to operation and maintenance of the Project Facilities in conformity with O&M Requirements.

The Bidder shall submit to the Engineer-in-charge a plan for operation and maintenance of the Project Facilities("O&M Plan") in conformity with the Construction Requirements, O&M Requirements and Performance Standards as set out in Tender Document after the completion of the construction period.

The O&M Plan shall set out in detail the standards, schedules, procedures, type, periodicity and other details of the operation and maintenance activities to be carried out for the Project during the O & M Period so as to meet the O&M Requirements as well as details of the management information system to be incorporated, reports to be submitted and procedure for reviews, including developing a mechanism for corrective actions.

Engineer-in-charge shall review the same and convey its comments/observations to the Bidder on the O&M Plan, including the need, if any, to modify the same. If the comments/observations of the Engineer-in-charge require the O&M Plan to be modified, the Bidder shall suitably modify the O&M Plan. The O&M Plan shall be finalized with mutual consent.

Notwithstanding any review or failure to review by the Engineer-in-charge or the comments/ observations of the Engineer-in-charge, the Bidder shall be solely responsible for the adequacy of the O&M Plan and the conformity thereof with the Performance Standards, Construction Requirements and O&M Requirements and shall not be relieved or absolved in any manner whatsoever of any of its obligations hereunder.

The Bidder shall inform engineer-in-charge details of its key personnel responsible for O&M and subsequent changes, if any, from time to time. However minimum manpower as given in the tender document shall be provided for the Operation and Maintenance of the project at all times.

The Bidder shall undertake operations and maintenance of the Project Facilities by itself or through Contractor possessing requisite technical/financial/managerial expertise/ capability, but in either case, the Bidder shall remain solely responsible to meet the O&M Requirements.

The Bidder shall incorporate good management practices and appropriate technologies required for meeting the Performance Standards.

The Bidder shall, during the Agreement Period;

have requisite organization and designate and appoint suitable officers / representatives as it may deem appropriate to supervise the Project, to deal with the Engineer-in-charge and to be responsible for all necessary exchange of information required pursuant to the tender provisions; Minimum Manpower as required for the plant operation and maintenance as per the Tender Document shall be provided at all times.

for the purposes of determining that the Project Facilities are being maintained in accordance with the Construction Requirements and O&M Requirements, the Bidder shall with due diligence carry out all necessary and periodical Tests in accordance with the instructions and under the supervision of the Engineer-in-charge

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Bidder shall maintain proper record of such Tests and the remedial measures taken to cure the defects or deficiencies, if any, indicated by the Test results.

conduct all Tests / guaranteed trial runs to ascertain compliance with Construction Requirements and O&M Requirements.

suspend forthwith the whole or any part of the O&M activities upon receiving a written notice from the Engineer-in-charge who may require the Bidder to suspend the activities in whole or part if in the reasonable opinion of the Engineer-in-charge, the operations are being carried on in a manner that is not in conformity with the O&M Requirements.

be responsible for the security of the Project facilities and comply with all applicable laws, statutory requirements as may be applicable from time to time.

be responsible for the routine as well as any capital replacement that maybe required either to meet the agreed specifications and performance of the Project facilities.

The Bidder shall as per pre agreed format record the system performance and periodically provide the same to Engineer-in-charge.

In case sewage is not available (min. 25% of capacity) by employer, contractor shall give a notice in writing to employer to start the trial run & commissioning with clear water. Performance guarantee test shall be conducted after availability of min. 25% of sewage of plant capacity. O&M period will be started after successful completion of Performance guarantee test.

In case of major delaying in availability of sewage, contractor shall be payable 10% of total 1st year O&M cost on quarterly basis.

1.1 Other Obligations during O&M stage

The Bidder shall:

from the Date of commissioning, undertake all services relating to Development, operation and maintenance of the plant in conformity with O&M Requirements.

and shall meet its Performance Standards as per the Tender Document and all statutory laws as applicable.

From the Date of commissioning, carry out the following activities in the Project Area:

Ensure that treated sewage is recycled and used within the plant battery limits for various non-human consumption activities to the extent possible.

Obtain the desired Performance parameters from the plant, such that it is necessary that each unit's treatment process is operated and maintained to function at optimum level and the process parameters to be maintained at each unit of treatment plant is closely monitored.

The Bidder shall Operate & Maintain the Project facilities with the following scope of work:

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For a period of 120 (One Hundred Twenty) months after 03 months trial run and 1 year O&M from the date commissioning and .

Treat Raw Sewage to desired treatment standards and with the treatment process specified in the Tender Document.

Supply of necessary chemicals and consumables as required for treatment specified in the Tender Document under functions and responsibility of the Bidder.

Provide the qualified staff required including security for watch and ward, necessary skilled and trained men for preventive and breakdown maintenance of all the equipment's and components of the Project facility.

Cost of all repairs i.e., major and minor to all the equipment's, plant and machinery, electrical and mechanical equipment's, instrumentation and civil works etc.

Cost of all spares/replacements to all the equipment's, plant and machinery, electrical and mechanical equipment's, instrumentation and civil works etc.

Cost of all diesel, labor, materials, special tools and ordinary tools and parts required for maintenance of all equipment's.

Cost towards disposal of screenings, grit and dried sludge.

Supply of engine oil, lubricants, necessary spare parts.

Cost towards salary of staff, guidance and training of staff, monitory of the treatment process by Public health engineer as specified.

Carrying out Raw and Treated sampling, testing, according to the standard test procedures.

Cost of necessary chemicals reagents, and glass ware for testing the samples by the chemist employed including monitoring and control of treatment process and ensuring that the raw sewage is treated in accordance to the performance standards prescribed in Schedule - 7.

Maintaining log books/ registers for daily inputs and outputs , flow rates, quality test results , chemicals consumed , energy used, staff attendance , preventive and break down maintenance works done for each equipment and other plant O & M data etc.

Maintaining gardens, trees, roads and drains in the plant premises and keep the Project Facility / Project Area and equipment's in good working conditions conforming to all the requirements set out under this Agreement.

Any other item left out and necessary as per guidelines of statutory agencies will be carried out within scope of above work.

Take necessary action as may be appropriate and in accordance with Prudent Utility Practices in the event of an emergency or risk of danger or damage to persons or property (including the Project Facilities).

Tests To Be Carried Out During O&M Period

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The minimum requirement of sampling and testing is to be carried out daily at least at the points given below. This schedule shall be maintained during the O&M period.

Flow, pH, BOD, COD, Suspended solids/ MLSS, Dissolved oxygen, Residual Chlorine of untreated and treated waste water in the laboratory on daily basis where as Alkalinity, Total Nitrogen, Sulphate, Total Phosphate and faecal coliform to be tested weekly .

Online measurement for raw and treated sewage for the parameters of flow, pH, BOD, COD, Total Suspended solids.

1.2 O&M Cost Obligations

The Bidder rate quoted by him in the Price Bid shall include following O&M Cost obligation with other contractual obligation within the Project Area.

Water usage cost

Establishment cost

Chemicals & other consumables cost

Manpower for Plant operation

Maintenance & repairs / replacement of Project facility.

O&M obligation under this Contract unless excluded by this Contract.

All expenses towards Statutory permissions

Any other expense required for upkeep and smooth operation of the Project Facility.

1.3 General activities during O & M period

During O & M Period of 120 months, contractor shall perform, not limited but including, following general activities:

1. Operations

a. Daily Operations of Facility

The Contractor shall carry out all facility operation and waste water conveyance, treatment & disposal operations indicated below; in accordance with Good Operating Practices, as set out in this Contract. The Facility operation and waste water disposal operations shall include, but not be limited to the following:

Operating & Maintaining Raw Sewage Pumping Stations at Chandlai lake, Jaipur and Conveyance of Raw Sewage to STP site near Chandlai Lake, Jaipur.

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Operating & Maintaining Sewage Treatment Plant to maintain the quality of treated sewage within the standards prescribed in the Tender, operate electrical equipment during power failures by operating generators and operate Sludge Handling units.

Removal and Disposal of screening, grit and sludge on regular basis at the designated place.

Carrying out continuous flow measurements of treated & untreated sewage and recording the same online / offline.

Collecting samples of influent and effluent and analyzing them daily to determine the quality of sewage and performance of the treatment plant and

Providing security for facilities and system at all times.

b. Contingency Plan

Developing and implementing contingency plans in respect of responses to natural disasters, periods of power failure, storm water inflow into sewers during monsoon, de-silting of units of treatment plants, constraint operations or other similar emergencies to maintain the quality of treated sewage.

c. Energy Audit

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.

Reducing electricity consumption by regulating equipment operation through suitable modifications to the operating schedules.

Maintaining power factor of 0.95 and demand to avoid penalty. All penalties imposed in this regard shall be borne by the contractor.

Installing more efficient pumping equipment and following better maintenance practices for electrical installation.

d. Repairs and Maintenance

The Contractor shall carry out preventive, routing maintenance and break down maintenance Operations for proper upkeep of plant in accordance with good operating practices. The following items shall be included in such maintenances.

i) Machinery and Treatment Plant Equipment

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Dewatering and de-silting of sludge Sump,chemical dosing tanks at least twice a year as per approved programs and disposal of silt.

Cleaning and maintaining all rising mains/sewers in the plant area at least four times a year.

Repairing and replacing damaged pipes, fittings and valves for suction and delivery pipe.

Repairing and replacing pump impellers, body, bearings shafts column pipes.

Repairing and replacing motors

Repairing and replacing starters, circuit breakers, capacitors

Repairing and replacing vanes and/or gears of agitators

Repairing and replacing transformer.

Repairing of blowers, decanter, diffusers, chlorinator, chemical dosing equipment's&Centrifuges.

ii) Building and Civil Structures

Water proofing leaking roofs of the Buildings.

The preventive and routine maintenance shall include all repairs and provision of spares material and tools required for these repairs. The Contractors shall also carry out breakdown maintenance and repairs. The labour, tools and plant, spares shall be arranged by the Contractor. The following spares shall be the respective responsibility of the Contractor and the Employer during preventive routing and breakdown maintenance.

2. Advice Early Warning:

The Contractor is to warn the Engineer at the earliest opportunity of specific likely future events or circumstances that may adversely affect the operations or the condition of the facilities and / or system. The Contractor shall cooperate with the Engineer in making and considering proposals for how the effect of such an event or circumstances can be avoided or reduced and in carrying out any resulting instruction of the Engineer

The Contractor shall also advise the Employer from time to time, on improving the quality of operations, reduction in water / energy losses and betterment practices.

3. Reporting

The Contractor shall utilize the office space, provided by the Employer to establish its monitoring and reporting office along with computer and peripherals. It shall also obtain a telephone connection and maintain the same

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through the Contract period. All data transfers and updates made to the Employer shall be affected through the said telecommunications medium.

The Contractor shall carry out all reporting indicated below and as set out in this Contract. The reporting shall include, but not be limited to the following

Daily summary of Operations at Sewage Treatment Plant – A daily report of operation of the diffuses, agitators, decanter and other equipment at the sewage treatment plants providing information on the quantity of sewage treated, hours of operation of equipment, energy consumed and use of chemicals.

Sewage Quality Monitoring – A daily report monitoring the quality of raw and treated sewage through the analysis of samples.

Sewer / Storm Water Drains / wet well & other units etc. Monthly cleaning report sewer / storm water drain de-silted and record of silt disposed at disposal sites.

Continuous flow measurements of Raw & Treated Sewage and recording the same.

4. General Responsibilities

The Contractor shall maintain properly and keep intact all assets / works/facilities / system of the Employer throughout the Contract period and shall hand over the same in good working condition at the end of the Contract. The Contractor shall not modify or alter any operations regarding the facilities and / or system without prior written permission of the Employer or its representative.

The Contractor shall procure all spare parts required for the maintenance of equipment excluding those to be supplied by the Employer. The Contractor 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 the purpose for which it is being used.

The Contractor is expected to carry out the work in such a manner as not because any damage to public property on account of negligence or otherwise. The Contractor shall be fully responsible for making good the damages so caused by him entirely at his own cost.

The assets / works / facilities / systems of the Employer shall be at the risk and in the sole charge of the Contractor and it shall be responsible for making good any loss or damage there to arising from any cause whatever including that due to a theft or robbery.

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The Contractor 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.

The Contractor shall carry out its Operations, so far as compliance with the requirement of the Contract permits, so as not to interfere unnecessarily or improperly with:

The convenience of the public

The access to use and occupation of public or private roads and footpaths to or of properties.

Permissions: The Contractor shall obtain all required permissions, sanctions clearances and permits for carrying out its Operations, including Contractors clearances 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.

Safety: The Contractor shall be responsible for the safety of all activities on the site and shall be absolutely and solely responsible for any and all kinds of injuries or damages to persons and property of any description whatever may be caused by or result from the operations carried out, whether these may have been carried out skilfully and carefully and strictly in conformity with the provision of the specifications or not.

Discoveries: All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the Site shall as between the Employer and the Contractor, be deemed to be the absolute property of the Employer. The Contractor 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 Engineer of such discovery and carry out the Employer instructions for dealing with the same.

The Contractor shall be responsible for payment of reinstatement charges for roads, footpaths and land as per the Employer's rates.

The Contractor shall take full responsibility for the adequacy stability and safety of all Site operations.

5. Staff & Labour:

A. Engagement of Staff & Labour

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The Contractor shall employ skilled, semi-skilled and unskilled labour in sufficient numbers to carry out its operations at the required rate of progress and of quality to ensure workmanship of the degree specified in the Contract for timely fulfilling of the Contractor's obligations under the Contract and to the satisfaction of the Employer.

The Contractor shall not employ in connection with the operations any child who has not completed his/her fifteenth year of age. It shall also not employ an adolescent who has not completed his / her eighteenth year unless he/she is certified fit for carrying out operations as an adult as prescribed under clause b) of such section (2)(of Section 69 of the factories Act 1948.

The Contractor shall provide its staff, a minimum of two sets of uniforms with the titles the Employer inscribed on the back and subject to approval of the Employer. Each worker on duty shall wear a clean uniform whenever on duty.

The Contractor shall be required by the Engineer deliver to it, to such forms and at such intervals as the Engineer may prescribed a return showing the numbers of the several classes of staff employed by the Contractor on the site and such other information as the Engineer may require.

If the Employer asked the Contractor to remove a person who is a member of the Contractor's staff stating the reasons, the Contractor shall ensure that the person leave the site within seven (7) days and has no further connection with operations under the Contract.

At all times during continuance of the Contract, the Contractor and its sub-contractors shall abide by all existing and future labour enactment and rules made there under, regulations, notifications and bye-laws of the Central, State or Local Government. The Contractor shall keep the Employer indemnified in case any action is taken against the Employer 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.

If the Employer is caused to pay or reimburse such amounts as may be necessary to carry or observe, or for non-observance of the provisions stipulated in the notifications/bye-laws/acts/rules/regulations including amendments if any, on the part of the Contractor and in connection with labour enactment, the Engineer shall have the right to deduct any money due to the Contractor including its amount of security deposit. The Engineer shall also have the right to recover from the Contractor, any sum required or estimated to be required for making good the loss or damage suffered by the Employer.

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B. Contractor's Superintendence

The Contractor shall provide all necessary superintendence while carrying out its operations and as long thereafter as the Employer may consider necessary for the proper fulfilling of the Contractor's obligations under the Contract. The Contractor shall nominate a competent and authorized representative (Contractor Representative) approved of by the Engineer which approval may at any time be withdrawn. The Contractor's Representative shall give its whole time to the superintendence of the operations. The Contractor's Representative shall receive, on behalf of the Contractor, instructions from the Engineer which shall be deemed received by the Contractor.

6. Repairs and Maintenance Schedules

1. Sewage Treatment Plant Complex:

As per indicated period checking the operation, correcting defects, attending to calibration and setting is required attending to minor repairs and proper up keeping) such as cleaning and painting) required for the following :

i. Monthly

Roof and surroundings and

Lightning arrestors.

ii. Annual

Leakages in structures

Ladders

Railings

Structural damages to the wet and dry well and

Overflow drain.

2. Pumping Machinery and Treatment Plant Equipment:

As per indicated period checking the operation, correcting defects attending to calibration and setting is required attending to minor repairs and proper up keeping) such as cleaning and painting) required for the following:

i. Daily

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Screens/ Grit Channels

Moving parts of screens and grit removal equipment, Blowers /Agitators / Pumps/ Agitators /Return Sludge pumps/ Chemical mixer/Centrifuge/Decanter

Stuffing box

Bearing and

Cable insulation near the lugs.

Panels Breaker and Starter

Contacts of relay and circuit breaker and

Setting of over-current relay, no-volt coil and tripping mechanism and off in the dash pot relay.

Transformer Sub-station

Ground Operated Dis-connectors (GOD)

Contacts of GOD and of Over Current (OC) relays

Radiators and Earth pit

ii. Monthly

Screens and Grit channels

Chains in mechanically operated components

Screens performance

Transformer

Relay alarm circuit

Load (Amperes) and

Voltage

iii. Quarterly

Transformer

Bushing and

Dehydrating breathers

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iv. Half -Yearly

Pumps / Blowers /Agitators / Compressor /Decanters/Centrifuge

Gland of stuffing box

Gland bolts

Gland packing

Alignment of pump aerator and drive and

Oil lubricated bearings

Motors

Tripping elements for motor protection

Contact points and

Fuse ratings

v. Annual

Paint screens, grit removal mechanism, scrapers, scrapers , motors, pipes,

Valves, fittings agitators and inlet/outlet weirs with two coats of anticorrosive paints.

Replace worn out parts of mechanical equipment in sewage treatment plant.

3. Buildings and Civil Structures:

Carry out routine maintenance and minor repairs including cleaning, repairs to plaster, doors, windows and painting.

i. Daily

Sweep the premises

Clean the floors and parts inside the Building

Clear the cobwebs and other biological growth

Maintenance of horticulture

Disposal and transportation of dewatered sludge

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ii. Half - Yearly

Repair damaged floor, plaster, roof, leakages and

Repair damaged doors, windows and other fixtures.

Penalty:

The following other non-statutory shall also be monitored for the purpose of establishing satisfactory performance of the plant and the penalties will be imposed on non achievement of the same as per the table given below .

Sr. No.	Description	Penalty on non achievement per day during O & M
1	Treated sewage parameters	Rs. 2,000/-
2	No screenings more than 6 mm in sewage	Rs. 5,000/-
3	Power Consumption exceed above guaranteed consumption	Double the prevailing rate per unit excess power

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2) TECHNICAL SPECIFICATION FOR CIVIL AND BUILDING WORKS(SEWAGE TREATMENT PLANT) (PART A)

Design Submissions

Complete detailed design calculations of foundations and superstructure together with general arrangement drawings and explanatory sketches shall be submitted to EMPLOYER. Separate calculations for foundations or superstructures submitted independent of each other shall be deemed to be incomplete and will not be accepted by EMPLOYER.

The design considerations described hereunder establish the minimum basic requirements of plain and reinforced concrete structures, masonry structures and structural steel works. However, any particular structure shall be designed for the satisfactory performance of the functions for which the same is being constructed. The Contractor shall also take care to check the stability of partly completed structures.

Design Standards

All designs shall be based on the latest Indian Standard (I.S.) Specifications or Codes of Practice. The design standards adopted shall follow the best modern engineering practice in the field based on any other international standard or specialist literature subject to such standard reference or extract of such literature in the English language being supplied to and approved by EMPLOYER. In case of any variation or contradiction between the provisions of the I.S. Standards or Codes and the specifications given along with the submitted tender document, the provision given in this Specification shall be followed.

All reinforced concrete structural design shall generally conform to the following publications of the Indian Standards Institution :

I.S. 456 Code of Practice for plain and reinforced concrete

I.S. 875 Code of Practice for design loads for buildings and structures (Part 1 to 5)

I.S. 3370 Code of Practice for concrete structures for the storage of liquids (Part I to IV)

I.S. 1893 Criteria for earthquake resistant design of structures

I.S. 2974 Code of Practice for design and construction of machine foundations (Part 1 to 4

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All structural steel design shall generally conform to the following publications of the Indian Standards Institution :

I.S. 800: Code of Practice for general construction in steel

I.S. 806: Code of Practice for use of steel tubes in general building construction

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Design Life

The design life of all structures and buildings shall be 100 years.

Design Loading

All buildings and structures shall be designed to resist the worst combination of the following loads / stresses under test and working conditions; these include dead load, live load, wind load, seismic load, stresses due to temperature changes, shrinkage and creep in materials, dynamic loads, impact load and other specific loads.

Dead Load

This shall comprise all permanent construction including walls, floors, roofs, partitions, stairways, fixed service equipment and other items of machinery.

The following minimum loads shall be considered in design of structures :

(i)	Weight of water	:	9.81 kN/m3
(ii)	Weight of soil (irrespective of strata available at site and type of soil used for filling etc). However, for checking stability against uplift, actual weight of soil as determined by field test shall be considered.	:	20.00 kN/m3
(iii)	Weight of plain concrete	:	24.00 kN/m3
(iv)	Weight of reinforced concrete	:	25.00 kN/m3
(v)	Weight of brickwork (exclusive of plaster)	:	22.00 N/m2 per mm thickness of brickwork
(vi)	Weight of plaster to masonry surface	:	18.00 N/m2 per mm thickness
(vii)	Weight of granolithic terrazzo finish or rendering screed, etc.	:	24.00 N/m2 per mm thickness

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Live Load

Live loads shall be in general as per I.S. 875. However, the following minimum loads shall be considered in the design of structures:

(i)	Live load on roofs (accessible)	:	1.50 kN/m2
	(Non-accessible)	:	0.75 kN/m2
(ii)	Live load on floors supporting equipment such as pumps, blowers, compressors, valves, etc.	:	10.00 kN/m2
(iii)	Live load on all other floors walkways, stairways and platforms.	:	5.00 kN/m2

In the absence of any suitable provisions for live loads in I.S. Codes or as given above for any particular type of floor or structure, assumptions made must receive the approval of EMPLOYER prior to starting the design work. Apart from the specified live loads or any other load due to material stored, any other equipment load or possible overloading during maintenance or erection / construction shall be considered and shall be partial or full whichever causes the most critical condition.

Wind Load

Wind loads shall be as per I.S. 875.

Earthquake Load

This shall be computed as per I.S. 1893. An importance factor appropriate to the type of structure shall be considered for design of all the structures.

Dynamic Load

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Dynamic loads due to working of items such as pumps, blowers, compressors, switch gears, travelling cranes, etc. shall be considered in the design of structures as per manufacturer's data.

Joints

Movement joints such as expansion joints, complete contraction joints, partial contraction joints and sliding joints shall be designed to suit the structure. However, contraction joints shall be provided at specified locations spaced not more than 7.5 m in both right angle directions for all walls and rafts.

Expansion joints of suitable gap at suitable intervals not more than 30 m shall be provided in all walls, floors and roof slabs of water retaining structures.

Construction joints shall be provided at right angles to the general direction of the member. The locations of construction joints shall be decided on convenience of construction. To avoid segregation of concrete in walls, horizontal construction joints are normally to be provided at every 2-m height. PVC waterstops of 150 mm width shall be used for walls and 230 mm width for base slabs.

Expansion joints for non liquid retaining structures shall be provided as per IS 3414.

Design Conditions for ESR, Underground or Partly Underground Liquid Retaining Structures.

All underground or partly underground liquid containing structures shall be designed for the following conditions :

(i) liquid depth to be considered up to full height of wall and no relief due to soil pressure from other side to be considered.

structure empty condition (i.e., empty of liquid, any material, etc.) : full earth pressure with saturation and surcharge pressure wherever applicable, to be considered.

partition wall between dry sump and wet sump : to be designed for full liquid depth up to full height of wall.

partition wall between two compartments : to be designed as one compartment empty and other full for both the directions.

structures shall be designed for uplift in empty conditions with no live load with the appropriate water table.

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walls shall be designed under operating conditions to resist earthquake forces from earth pressure mobilisation and dynamic water loads.

underground or partially underground structures shall also be checked against stresses developed due to any combination of full and empty compartments with appropriate ground/uplift pressures from below to base slab. A minimum factor of 1.2 shall be ensured against uplift or floatation.

Foundations

The minimum depth of foundations for all structures, equipment, buildings and frame foundations and load bearing walls shall be as per IS 1904.

Maximum safe bearing capacity of soil strata shall be taken as indicated in geotechnical reports.

Care shall be taken to avoid the foundations of adjacent buildings or structure foundations, either existing or not within the scope of this Contract. Suitable adjustments in depth, location and sizes may have to be made depending on site conditions. No extra claims for such adjustments shall be accepted by EMPLOYER.

Special attention is drawn to danger of uplift being caused by the ground water table. All underground structural slab shall be designed for uplift forces due to ground water pressure.

Where there is level difference between the natural ground level & the foundations of structure or floor slabs, this difference shall be filled up in the following ways:

In case of non-liquid retaining structures the natural top soil shall be removed till a firm strata is reached (minimum depth of soil removed shall be 500 mm.) and the level difference shall be made up by compacted backfill as per specifications. However the thickness of each layer shall not exceed 150 mm. The area of backfilling for floor slabs shall be confined to prevent soil from slipping out during compaction. The safe bearing capacity of this well compacted backfilled soil shall not exceed 100 kN/sq.m.

In case of liquid retaining structures, the natural top soil shall be removed as described above and the level difference shall be made up with Plain Cement Concrete (1:5:10)

Design Requirements

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

All blinding and leveling concrete shall be a minimum 100 mm thick in concrete grade 1 : 4 : 8 for non water retaining structures and 1 : 3 : 6 for water retaining structures.

All structural reinforced concrete for water retaining structures shall be of a minimum M30 grade with a maximum 20 mm aggregate size for footings and base slabs and with a maximum 20 mm aggregate size for all

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other structural members. For non water retaining structures the concrete shall be of M 25 grade. The structures shall have to be designed as per IS : 3370 (Part I-IV).

The reinforced concrete for water retaining structures shall have a minimum cement content of 360 kg/m3 with a maximum 20 mm size aggregate and 330 kg/m3 with a maximum 40 mm size aggregate as per IS : 3370 (Part I-IV).

The minimum reinforcement for water retaining structures in each direction should be 0.35% of cross section. The minimum clear cover to all reinforcement including stirrups and links shall be 50 mm for all water retaining structures.

All buildings shall have a minimum 1 metre wide, 100 mm thick plinth protection paving in M15 grade concrete or stone slabs/tiles. All plinth protection shall be supported on well compacted strata.

Any structure or pipeline crossing below roads shall be designed for Class A of IRC loading.

The bridges & bridge supporting structures shall be designed to safely withstand the loading.

All pipes & conduits laid below the structural plinth & road works shall be embedded in reinforced concrete of grade M15 of minimum thickness 150 mm.

Approved quality water proofing compound (chloride free) shall be added during concreting of all liquid containing structure in the proportions specified by manufacturer or 2 % by weight of cement whichever is higher.

The wall and floor panels shall be poured in sequential order with a minimum time gap of 4 days.

i) All water retaining structures shall be constructed in S. R. Cement as per IS specification.

j) Design of water retaining structure shall be for uncracked section as per IS:3370.

The following minimum thickness shall be used for different reinforced concrete members, irrespective of design thickness:

Walls for liquid retaining structures	:	200 mm
Channel / Launder	:	150mm
Roof slabs for liquid retaining structures (other than flat slabs)	:	150 mm
Bottom slabs for liquid retaining structures	:	150 mm
Floor slabs including roof slabs, walkways, canopy slabs	:	100 mm

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Walls of cables / pipe trenches,

underground pits etc.	:	125 mm
Column footings	:	300 mm
Parapets, chajja	:	100 mm
Precast trench cover	:	75 mm

Materials in General

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.

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.

All materials shall be new and of the kinds and qualities described in the Contract and shall be at least equal to approved samples.

As soon as practicable after receiving the order to commence the Works, the Contractor shall inform EMPLOYER of the names of the suppliers from whom he proposes to obtain any materials but he shall not place any order without the approval of EMPLOYER which may be withheld until samples have been submitted and satisfactorily tested. The Contractor shall thereafter keep EMPLOYER informed of orders for and delivery dates of all materials.

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.

Samples and Tests of Materials

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The Contractor shall submit samples of such materials as may be required by EMPLOYER and shall carry out the specified tests directed by EMPLOYER at the Site, at the supplier's premises or at a laboratory approved by EMPLOYER. EMPLOYER may appoint separate third party inspection for the material testing to ensure the quality of the work. The Contractor shall replace the defective material as an outcome of these tests.

Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by EMPLOYER.

The Contractor shall give EMPLOYER 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 EMPLOYER. Representative of EMPLOYER 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 EMPLOYER to carry out such a test on a mutually agreed date in his presence. The Contractor shall in any case submit to EMPLOYER’s Representative within seven days of every test such number of certified copies (minimum six) of the test results as EMPLOYER may require.

Approval by EMPLOYER as to the placing of orders for materials or as to samples or tests shall not prejudice any of EMPLOYER's powers under the Contract.

The provisions of this clause shall also apply fully to materials supplied under any nominated sub-contract.

Standards

Materials and workmanship shall comply with the relevant Indian Standards (with amendments) current on the date of submission of the tender.

Where the relevant standard provides for the furnishing of a certificate to 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 EMPLOYER.

The specifications, standards and codes listed below are considered to be part of this Bid specification. All standards, specifications, codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions.

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In case of discrepancy between the Bid Specification and the Standards referred to herein, the Bid Specification shall govern.

a) Materials

IS : 269 Specification for 33 grade ordinary Portland cement

IS : 383 Specification for coarse and fine aggregates from natural sources for concrete

IS : 428 Specification for distemper, oil emulsion, colour as required

IS : 432 Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement (Parts 1 & 2)

IS : 455 Specification for Portland slag cement

IS : 458 Specification for precast concrete pipes(with and without reinforcement)

IS : 650 Specification for standard sand for testing of cement

IS : 651 Specification for salt glazed stoneware pipes and fittings

IS : 777 Specification for glazed earthenware tiles

IS : 808 Specification for dimensions for hot rolled steel beam, column, channel and angle sections

IS : 814 Specification for covered electrodes for manual metal arc welding of Carbon and Carbon Manganese steel

IS : 1003 Specification for timber paneled and glazed shutters(Parts 1 & 2)

IS : 1038 Specification for steel doors, windows and ventilators

IS : 1077 Specification for common burnt clay building bricks

IS : 1398 Specification for packing paper, water proof, bitumen laminated

IS : 1489 Specification for Portland pozzolana cement (Parts 1 & 2)

IS : 1566 Specification for hard drawn steel wire fabric for concrete reinforcement

IS :1580 Specification for bituminous compounds for water proofing and caulking purposes

IS : 1786 Specification for high strength deformed steel bars and wires for concrete reinforcement

IS : 1852 Specification for rolling and cutting tolerances for hot rolled steel products

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IS : 1948 Specification for aluminium doors, windows and ventilators

IS : 1977 Specification for structural steel (ordinary quality)

IS : 2062 Specification for steel for general structural purposes

IS : 2185 Specification for concrete masonry units (Parts 1 & 2)

IS : 2202 Specification for wooden flush door shutters (Parts 1 & 2)

IS : 2645 Specification for integral cement water proofing compounds

IS : 2750 Specification for steel scaffoldings

IS : 2835 Specification for flat transparent sheet glass

IS : 3384 Specification for bitumen primer for use in waterproofing and damp roofing

IS : 3502 Specification for steel chequerred plates

IS : 4021 Specification for timber door, window and ventilator frames

IS : 4350 Specification for concrete porous pipes for under drainage

IS : 4351 Specification for steel door frames

IS : 4990 Specification for plywood for concrete shuttering work

IS : 8112 Specification for 43 grade ordinary Portland cement

IS : 9862 Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and chlorine resisting

IS : 10262 Recommended guidelines for concrete mix design

IS : 12269 Specification for 53 grade ordinary Portland cement

IS : 12330 Specification for sulphate resisting Portland cement

IS : 12709 Glass fibre reinforced plastics (GRP) pipes, joints and fittings for use for potable water supply

b) Tests

IS : 516 Method of test for strength of concrete

IS : 1182 Recommended practice for radiographic examination of fusion welded butt joints in steel plates

IS : 1199 Methods of sampling and analysis of concrete

IS : 2386 Methods of test for aggregates for concrete(Parts 1 to 8)

IS : 2720 Methods of test for soils (Parts 1 to 39)

IS : 3025 Methods for sampling and test (physical and chemical) for water and wastewater (Parts 1 to 4

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IS : 3495 Method of test for burnt clay building bricks(Parts 1 to 4)

IS : 3613 Acceptance tests for wire flux combination for submerged arc welding

IS : 4020 Methods of tests for wooden flush doors Type tests

IS : 4031 Methods of physical tests for hydraulic cement (Parts 1 to 15)

IS : 5807 Method of test for clear finishes for wooden furniture (Parts 1 to 6)

IS : 7318 Approval tests for welders when welding procedure approval is not required (Parts 1 and 2)

c) Codes of Practice

IS :456 Code of practice for plain and reinforced concrete

IS : 783 Code of practice for laying of concrete pipes

IS : 800 Code of practice for general construction in steel

IS : 806 Code of practice for use of steel tubes in general building construction

IS : 816 Code of practice for use of metal arc welding for general construction in mild steel

IS : 817 Code of practice for training and testing of metal arc welders

IS : 875 Code of practice for design loads (other than earthquake) for building structures(Parts 1 to 5)

IS : 1081 Code of practice for fixing and glazing of metal (steel and aluminum) doors, windows and ventilators

IS : 1172 Code of practice for basic requirements for water supply, drainage and sanitation

IS : 1477 Code of practice for painting of ferrous metals in buildings (Parts 1&2)

IS : 1597 Code of practice for construction of stone masonry (Parts 1 &2)

IS : 1742 Code of practice for building drainage

IS : 1893 Criteria for earthquake resistant design of structures

IS : 2065 Code of practice for water supply in buildings

IS : 2212 Code of practice for brickwork

IS : 2338 Code of practice for finishing of wood and wood based materials (Parts 1 & 2)

IS : 2394 Code of practice for application of lime plaster finish

IS : 2395 Code of practice for painting, concrete, masonry and plaster surfaces (Parts1 & 2)

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IS : 2470 Code of practice for installation of septic tanks (Parts 1 & 2)

IS : 2502 Code of practice for bending and fixing of bars for concrete reinforcement

IS : 2571 Code of practice for laying in situ cement concrete flooring

IS : 2595 Code of practice for radiographic testing

IS : 2751 Recommended practice for welding of mild steel plain and deformed bars for reinforced construction

IS : 2974 Code of practice for design and construction of machine foundations (Parts 1 to 4)

IS : 3114 Code of practice for laying of Cast Iron pipes

IS : 3370 Code of practice for concrete structures for the storage of liquids (Parts 1 to 4)

IS : 3414 Code of practice for design and installation of joints in buildings

IS : 3558 Code of practice for use of immersion vibrators for consolidating concrete

IS : 3658 Code of practice for liquid penetrant flaw detection

IS : 3935 Code of practice for composite construction

IS : 4000 Code of practice for High strength bolts in steel structures

IS : 4014 Code of practice for steel tubular scaffolding (Parts 1 & 2)

IS : 4111 Code of practice for ancillary structures in sewerage system (Parts 1-4)

IS : 13920 Code of practice for laying of glazed stoneware pipes

IS: 4326Code of practice for Earthquake Resistant Design and Construction of Buildings

IS : 4353 Recommendations for submerged arc welding of mild steel and low alloy steels

IS : 5329 Code of practice for sanitary pipe work above ground for buildings

IS : 5334 Code of practice for magnetic particle flaw detection of welds

IS : 5822 Code of practice for laying of welded steel pipes for water supply

IS : 7215 Tolerances for fabrication of steel structures

IS : 9595 Recommendations for metal arc welding of carbon and carbon manganese steels

IS : 10005 SI units and recommendations for the use of their multiples and of certain other units

d) Construction Safety

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IS : 3696 Safety code for scaffolds and ladder (Parts 1 & 2)

IS : 3764 Safety code for Excavation work

IS : 7205 Safety code for erection of structural steel work

Orientation

1.12.1 The works shall be laid out within the confines of the Site in order to interface to the existing infrastructure of roadways and inlet and outlet pipework . Underground services requiring to be relocated in order to accommodate the proposed site layout shall, with the approval of EMPLOYER, be relocated by the Contractor.

Buildings and Structures

All the building and structure works shall generally comply with the following EMPLOYER's requirements unless otherwise specified elsewhere.

All building works shall be of reinforced concrete framework.

All external walls shall be in 230 mm thick brick masonry built cement mortar in 1:4. Transoms and mullions of 115 mm x 230 mm size with four numbers 6 mm bars and 6 mm links at 150 mm c/c shall be provided to form panels not exceeding 3500 mm x 3500 mm in size.

All internal partition walls except for toilets and Residential units shall be in 230 mm thick brick masonry built in cement mortar 1:4 with transoms 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 transoms and mullions as in (2) above and shall form panels not exceeding 1200 mm x 1200 mm in size.

(a) Finishes to concrete liquid retaining structures (for details, refer clause 3.16 of this volume) shall be :

F1 - External surfaces, buried

F2 - External surfaces exposed and up to 300 mm below ground level

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F2 - Internal surfaces

Finishes to other concrete structures (for details, refer clause 3.16 of this volume) shall be :

F1 - Buried

F1 - Exposed, where plastering is specified

F2 - Exposed

4. All internal masonry surfaces finish shall have 13 mm thick plain faced cement plaster in cement mortar (1:4) with neat lime or neeru finish on top. Over this, one coat of primer and two coats of plastic emulsion paint of approved quality and shade shall be provided.

5. All external masonry surfaces shall have 20 mm thick sand faced cement plaster in cement mortar (1:3) in two coats. Waterproofing compound of approved make and quality shall be added to the cement mortar in proportions as specified by the manufacturer.

6. All external surfaces above ground level shall have one coat of primer and two coats of waterproof cement based paint of approved quality and shade. A coat of silicone water repellent paint shall also be applied thereon.

Toilet areas, walls and ceilings, shall have one coat of primer and two coats of plastic emulsion paint.

Toilet floor slab shall be filled with brick bat coba (broken bricks in lime) and provided with waterproofing as per the specifications of an approved specialist waterproofing company.

The finished floor level in toilet areas shall be 25 mm below general finished floor level elsewhere in the building.

The flooring in all areas except toilets and staircases shall be in 250 mm x 250 mm x 20 mm thick white cement based marble mosaic tiles of approved shade and pattern and placed in cement mortar or lime mortar to give overall thickness of 50 mm. Half tile skirting shall also be provided in these areas.

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Toilet areas shall have 450 mm x 450 mm x 25 mm thick glazed floor tiles placed in cement mortar to be provided. 2200 mm high ceramic tile (size 200 mm x 200 mm x 6 mm thick) dado placed in cement mortar shall also be provided in these areas. In W.C. areas, the flooring and 2200 mm high dado shall be provided with 200 mm x 200 mm x 6 mm thick coloured ceramic tiles.

12. 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.

Stairways shall be provided to permit access between different levels within buildings. All roof tops and overhead tanks shall be made accessible with ladder provision. Vertical ladders fitted with landing point extensions will be permitted where considered appropriate by the EMPLOYER to access areas not frequently visited.

13 All floor cut-outs and cable ducts, etc. shall be covered with precast concrete covers in outdoor areas and mild steel chequered plates of adequate thickness in indoor areas. All uncovered openings shall be protected with M.S. hand railing of 32 NB (M).

All staircases shall be provided with 32 NB (M) galvanised M.S. pipe hand railing for protection.

The reinforced concrete roofs shall be made waterproof by application of an approved roof polythene / bitumen membrane. The finished roof surface shall have adequate slope to drain quickly the rain water to R.W downtake inlet points.

For roofing drainage, cast iron rainwater downtakes with C.I. bell mouth and C.I. grating at top shall be provided. For roof areas up to 100 sq.m minimum two nos. 100 mm diameter downtake pipes shall be provided. For every additional area of 100 sq.m or part thereof, at least one no. 100 mm dia. downtake pipe shall be provided.

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 drain the rain water. Chajjas, canopies and roof projections shall have drip moulds.

Building plinth shall be minimum 450 mm above average finished ground level around building.

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All doors, windows, rolling shutters shall have lintels above. Chajja protection to lintels on external walls shall be such as to prevent the rain water splashing into the building.

All windows and ventilators shall have 25 mm thick marble stone sills bedded in cement mortar (1:3)

All concrete channels and ducts used for conveying liquid shall have inside finish of type F2. The width of concrete channels shall not be less than 500 mm. All open channels shall be provided with handrailings.

Kerbs to be provided below the hand railing on the catwalks/pathways should be as per relevant sections of Factory Act.

All rooms in the buildings shall be provided with appropriate sign boards indicating the function of the rooms involved.

Wherever equipment and machinery are to be moved for inspection, servicing, replacement etc., suitable movable gantry in the form of EOT / HOT crane shall be provided. Minimum capacity of 2 tonnes or more as required shall be provided for monorail.

The design of buildings shall be suitable for the climatic conditions existing on site. Buildings shall as far as is possible permit the entry of natural light.

Emergency exit doorways with Signboards shall be provided from all buildings in order to comply with local and international regulations. Stairways and paved areas shall be provided at the exit points.

The side walls of buildings shall, comprise at least 15% ventilated brickwork or louvers. Ventilated brickwork or louvers shall not be used where the ingress of driven rain could affect equipment or stored materials.

Roadways, & Pathways

1.14.1 A comprehensive network of roadways shall be provided around the structures to link in with the existing road network and permit access to the units for necessary maintenance, delivery of Consumables and personnel

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access. All roads shall be of asphalt macadam and minimum 5 metres wide. Vehicular access shall be provided for all Plant structures and buildings. All roads shall be provided with drainage and shall be constructed to prevent standing water.

Site Drainage

The contractor shall provide a site drainage system which shall comprise of the Storm Water Drainage and Foul Drainage.

Storm Water Drainage

Deleted.

Foul Drainage

The foul drainage system shall accept discharge from toilets, washrooms, offices and shall discharge to separate septic tank and further to a soak pit, both of appropriate volumes for individual buildings.

Cable and Pipework Trenches

Cable and pipework trenches shall generally be constructed in reinforced concrete. However, 500 mm x 500 mm size or smaller trenches, not on fill may be constructed in 350 mm thick brick masonry (1:4). The trenches will be plastered internally with cement mortar (1:4) and externally in cement mortar (1:3).

1.16.2 Trenches within the buildings or Plant areas shall be covered with M.S chequered plates, suitably painted and those outside the buildings shall be covered with M20 precast R.C.C covers. The trenches shall be suitably sloped to drain rain water.

1.16.3 Layout of trenches outside the buildings shall allow space for construction of future trenches where necessary with due consideration for planning for future developments. This aspect shall be brought to the notice of EMPLOYER while planning the works.

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Pipes and Ducts

1.17.1 R.C.C ducts for drainage shall have minimum 1 metre cover while laid under roads. Access shafts of size not less than 600 mm x 1000 mm shall be provided.

1.17.2 All drains (except storm water drains adjacent to roads) shall be covered and designed structurally for appropriate loads.

Valve Chambers

All valve chambers are to be of an adequate size to facilitate maintenance and operation. The base slab of valve chambers shall slope towards a sump pit from which water can be pumped to keep the chamber dry. All valve chambers shall be constructed in M20 grade reinforced concrete. Chambers shall have removable reinforced concrete covers, as appropriate, approach ladders and valve supports.

Landscaping

1.19.1 The STP plot site shall be landscaped once the Works are substantially complete. The landscaping scheme shall be submitted and got approved from EMPLOYER prior to start of actual work.

1.19.2 Landscaping shall include planting of suitable trees and development of grassed areas. Landscaping in general shall meet ecological and environmental conditions of the site. Road widths shall determine the size of the tree height and spread to be selected for planting. Trees suitable for local conditions shall be selected. Medicinal and fruit trees shall be avoided.

1.19.3 Tree Planting

Pits dug a few days in advance of actual planting shall be allowed to weather and be filled with top soil mixed with manure. Size of the pit shall be as per standard requirement. Only one tree shall be planted in each pit. A guard made of bamboo with wire mesh shall be provided.

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Security Fencing and Gates

1.20.1 Security fencing for the STP plot complex and associated works shall be of 2000mm high with 230/350 mm thick brick/random rubble masonry, in cement mortar (1:6), with recessed pointing in cement mortar (1:3), on both the faces. There shall be concrete coping over brick/random rubble masonry wall and 750 mm high barbed wire fencing above it.

1.20.2 Substation shall have internal fencing as per Electricity Board guidelines.

1.20.3 4.5m wide x 2.2m high main steel gates and 1m wide x 2.2 m high steel wicket gate made out of tubular sections/square bars/flats of welded construction alongwith the locking arrangement and posts to match with security fencing shall be provided at appropriate places. Gates shall be painted with similar synthetic enamel paint.

Chain link fencing with gates around electrical installations shall be provided as per GEB's requirements.

EARTHWORKS

2.1 Applicable Codes

The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to.

a) IS 783 - 1985 - Code of practice for laying of concrete pipes.

b) IS 3764 - 1992 - Excavation work - Code of Safety .

c) IS 2720 - Methods of test for soils:

(Part-1) - 1983 - Part 1 Preparation of dry soil samples for various tests.

(Part-2) - 1986 - Part 2 Determination of Water Content.

(Part-4) - 1985 - Part 4 Grain size analysis.

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(Part-5) - 1985 - Part 5 Determination of liquid and plastic limit.

(Part-7) - 1980 - Part 7 Determination of water content - dry density relation using light compaction.

(Part-9) - 1971 - Part 9 Determination of dry density - moisture content by constant weight of soil method.

(Part-14) – 1983 - Part 14 Determination of density index (relative density) of cohesionless soils.

(Part-22) – 1978 - Part 22 Determination of organic matter.

(Part-26) – 1987 - Part 26 Determination of pH Value.

(Part-27) – 1987 - Part 27 Determination of total soluble sulphates.

(Part-28) – 1974 - Part 28 Determination of dry density of soils in place, by the sand replacement method.

(Part-33) – 1971 - Part 33 Determination of the density in place by the ring and water replacement method.

(Part-34) – 1972 - Part 34 Determination of density of soil in place by rubber balloon method.

(Part-38) – 1976 - Part 38 Compaction control test (Hilf Method)

2.2 General

2.2.1 The Contractor shall furnish all tools, plant, instruments, qualified supervisory personnel, labour, materials, any temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein for completion of the work in accordance with the Employer's Requirements.

2.2.2 The Contractor shall survey the site before excavation and set out all lines and establish levels for various works such as grading, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to established reference/grid lines at 8m intervals or nearer, if necessary, based on ground profile and thereafter properly recorded.

2.2.3 The excavation shall be carried out to correct lines and levels. This shall also include, where required, proper shoring to maintain excavations and also the furnishing, erecting and maintaining of substantial barricades around excavated areas and warning lamps at night.

2.2.4 Excavated material shall be dumped in regular heaps, bunds, riprap with regular slopes within the lead specified and levelling the same so as to provide natural drainage. Rock/soil excavated shall be stacked properly as approved by the Employer's Representative. As a rule, all softer material shall be laid along the center of heaps, the harder and more weather resisting materials forming the casing on the sides and the top. Rock shall be stacked separately.

2.2.5 Topsoil shall be stock piled separately for later re-use.

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2.3 Clearing the site

2.3.1 The area to be excavated/filled shall be cleared of fences, trees, plants, logs, stumps, bush, vegetation, rubbish, slush, etc. and other objectionable matter. If any roots or stumps of trees are encountered during excavation, they shall also be removed. The material so removed shall be disposed off as approved by the Employer's Representative. Where earthfill is intended, the area shall be stripped of all loose/ soft patches, top soil containing objectionable matter/ materials before fill commences.

2.4 Excavation

2.4.1 All excavation work shall be carried out by mechanical equipment unless, in the opinion of Employer's Representative, the work involved requires it to be carried out by manual methods.

2.4.2 Excavation for permanent work shall be taken out to such widths, lengths, depths and profiles as are shown on the drawings provided by the Contractor or such other lines and grades as may be agreed with the Employer's Representative. Rough excavation shall be carried out to a depth of 150mm above the final level. The balance shall be excavated with special care. Soft pockets shall be removed below the final level and extra excavation filled up with lean concrete as approved by the Employer's Representative. The final excavation should be carried out just prior to laying the blinding course.

2.4.3 To facilitate the permanent works the Contractor may excavate, and also backfill later, outside the lines shown on the drawings provided by the Contractor as agreed with the Employer's Representative. Should any excavation be taken below the specified elevations, the Contractor shall fill it up with concrete of the same class as in the foundation resting thereon, upto the required elevation at no cost to the Employer.

All excavations shall be to the minimum dimensions required for safety and ease of working. Prior approval of the Employer's Representative shall be obtained by the Contractor in each individual case, for the method proposed for the excavation, including dimensions, side slopes, dewatering, disposal, etc. This approval, shall not in any way relieve the Contractor of his responsibility for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. Side slopes shall be as steep as will stand safely for the actual soil conditions encountered. Every precaution shall be taken to prevent slips. Should slips occur, the slipped material shall be removed and the slope dressed to a modified stable slope.

This work shall consist of removing, as hereinafter set fouth, existing buildings,roofs,ceiling,flooring and paving, concrete and brick work, partitions, wood work, steel and iron work, doors and windows, pipes and sewer lines, posts or struts,fencing wire mesh, glazing, culverts, bridges, pavements, kerbs and other structures like guard-raills, utility services, catch basins, inlets,etc., which are in place but interfere with the new construction or are not suitable to remain in place, and of salvaging and disposing of the resulting materials and back filling the resulting trenches and pits.

Unless otherwise directed on the project specifications, all the following items are included in the excavation:

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Removing all surface obstructions including shrubs,jungle etc.

Making all necessary excavations true to line and grade,

Furnishing and installing all shoring and bracing as necessary or as directed

Pumping and bailing out water to keep trenches free of water during pipe laying and jointing and thereafter until joints mature,

Providing for uninterrupted surface water flow during work in progress,

Providing for disposing off water flows from strom, drains, nallas or other sources, suitably,

Protecting all pipes, conduits, culverts, railway tracks, utility poles, wire fences,buildings, and other public and private property adjacent to or in the line of work,

Removing all shoring and bracing which is not ordered to be left in place or not required by the project plans or specifications to remain in place,

Hauling away and disposing of excavated materials not necessary or else unsuitable for back filling purpose. The extra excavated soil will have to be properly as directed,

Backfilling the trenches as directed or as per specifications,

Restoring all property injured or disturbed by these construction activities to the condition as near its original condition as possible,

Restoring the surface and repairing of all roads, streets, alleys,walks, drives, working spaces, and rights of way to a condition as good as prior to excavation.

Slipes and Slides

If slips,slides,over-breaks or subsidence occur in cutting during the process of construcyion, they shall be removed at the cost of the contractor as ordered by the Engineer.Should slips occur, the slipped material shall be removed and the slope dressed to a modified stable slope.

Rock

2.5.1 General

'Rock' means a natural aggregate of mineral crystals which for its excavation would normally require the use of heavy pneumatic/hydraulic breaker and/or cutting equipment or explosives. the term shall exclude any materia

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that can be removed by ordinary excavating machinery and which in any individual mass has a volume not exceeding 1m3 or 0.25m3 where the net width of excavation is less than 2 m. Ordinary excavating machinery means a hydraulic back hoe with rated output of 50 KW or less.

2.5.2 Before classification of material as rock the Contractor shall demonstrate to the satisfaction of the Employer's Representative his inability to excavate it without resort to heavy percussion tools complete with rock bits, hydraulic wedges or blasting. Excavation by the use of explosive will not normally be permitted except for pipeline.

2.5.3 Material shall not be classified as rock unless the Employer's Representative has agreed to such classification on the basis of such a demonstration before its excavation. Excavations where rock has been encountered and classified as such shall not be backfilled before examination of the excavated faces by the Employer's Representative to enable the extent of the rock excavation to be determined.

2.5.4 Excavation by the Use of Explosives

Unless otherwise stated herein, I.S. Specification " IS:4081: Safety Code for Blasting and related Drilling Operations" shall be followed. As far as possible all blasting shall be completed prior to commencement of construction. At all stages of excavation, precautions shall be taken to preserve the rock below and beyond the lines specified for the excavation, in the soundest possible condition. The quantity and strength of explosives used, shall be such as will neither damage nor crack the rock outside the limits of excavation. All precautions, as directed by Employer's Representative, shall be taken during the blasting operations and care shall be taken that no damage is caused to adjoining buildings or structures as a result of blasting operations. In case of damage to permanent or temporary structures, Contractor shall repair the same to the satisfaction of Employer's Representative at his cost. As excavation approaches its final lines and levels, the depth of the charge holes and amount of explosives used shall be progressively and suitably reduced.

2.5.5 The contractor shall obtain a valid Blasting License from the authorities concerned. No explosive shall be brought near the work in excess of quantity required for a particular amount of firing to be done; and surplus left after filling the holes shall be removed to the magazine. The magazine shall be built as away as possible from the area to be blasted. Employer's Representative's prior approval shall be taken for the location proposed for the magazine.

2.5.6 In no case shall blasting be allowed closer than 30 metres to any structure or to locations where concrete has just been placed. In the latter case the concrete must be at least 7 days old.

2.5.7 For blasting operations, the following points shall be observed.

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i) Contractor shall employ a competent and experienced supervisor and licensed blaster in-charge of each set of operation, who shall be held personally responsible to ensure that all safety regulations are carried out.

ii) Before any blasting is carried out, Contractor shall intimate Employer's Representative and obtain his approval in writing for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions taken for ensuring safety.

iii) Contractor shall ensure that all workmen and the personnel at site are excluded from an area within 200 m radius from the firing point, at least 15 minutes before firing time by sounding warning whistle. The area shall also be given a warning by sounding a distinguishing whistle.

iv) The blasting of rock near any existing buildings, equipments or any other property shall be done under cover and Contractor has to make all such necessary muffling arrangements. Covering may preferably be done by MS plates with adequate dead weight over them. Blasting shall be done with small charges only and where directed by Employer's Representative, a trench shall have to be cut by chiseling prior to the blasting operation, separating the area under blasting from the existing structures.

v) The firing shall be supervised by a Supervisor and not more than 6 (six) holes at a time shall be set off successively. If the blasts do not tally with the number fired, the misfired holes shall be carefully located after half an hour and when located, shall be exploded by drilling a fresh hole along the misfired hole (but not nearer than 600 mm from it) and by exploding a new charge.

vi) A wooden tamping rod with a flat end shall be used to push cartridges home and metal rod or hammer shall not be permitted. The charges shall be placed firmly into place and not rammed or pounded. After a hole is filled to the required depth, the balance of the hole shall be filled with stemming which may consist of sand or stone dust or similar inert material.

vii) Contractor shall preferably detonate the explosives electrically.

viii) The explosives shall be exploded by means of a primer which shall be fired by detonating a fuse instantaneous detonator (F.I.D) or other approved cables. The detonators with F.I.D. shall be connected by special nippers.

ix) In dry weather and normal dry excavation, ordinary low explosive gunpowder may be used. In damp rock, high explosive like gelatin with detonator and fuse wire may be used. Underwater or for excavation in rock with substantial accumulated seepage electric detonation shall be used.

x) Holes for charging explosives shall be drilled with pneumatic drills, the drilling pattern being so planned that rock pieces after blasting will be suitable for handling without secondary blasting.

xi) When excavation has almost reached the desired level, hand trimming shall have to be done for dressing the surface to the desired level. Any rock excavation beyond an overbreak limit of 75 mm shall be filled up as instructed by Employer's Representative, with concrete of strength not less than M10. Stopping in rock excavation shall be done by hand trimming.

xii) Contractor shall be responsible for any accident to workmen, public or Employer's property due to blasting operations. Contractor shall also be responsible for strict observance of rules, laid by Inspector of

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explosives, or any other Authority duly constituted under the State and / or Union Government as applicable at the place of excavation.

2.6 Stripping Loose Rock

2.6.1 All loose boulders, detached rocks partially and other loose material which might move therewith not directly in the excavation but so close to the area to be excavated as to be liable, in the opinion of Employer's Representative, to fall or otherwise endanger the workmen, equipment, or the work shall be stripped off and removed from the area of the excavation. The method used shall be such as not to render unstable or unsafe the portion which was originally sound and safe.

2.6.2 Any material not requiring removal in order to complete the permanent works, but which, in the opinion of Employer's Representative, is likely to become loose or unstable later, shall also be promptly and satisfactorily removed.

2.7 Fill, Backfilling and Site Grading

2.7.1 General

All fill material shall be subject to the Employer's Representative's approval. If any material is rejected by Employer's Representative, the Contractor shall remove the same forthwith from the site. Surplus fill material shall be deposited/disposed off as directed by Employer's Representative after the fill work is completed.

2.7.2 No earthfill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with to the approval of the Employer's Representative.

2.7.3 Material

To the extent available, selected surplus soil from excavations shall be used as backfill. Backfill material shall be free from lumps, organic or other foreign material. All lumps of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of murum or earth to fill the voids and the mixture used for filling.

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If fill material is required to be imported, the Contractor shall make arrangements to bring such material from outside borrow pits. The material and source shall be subject to the prior approval of the Employer's Representative. The approved borrow pit areas shall be cleared of all bushes, roots of trees, plants, rubbish, etc. Top soil containing foreign material shall be removed. The materials so removed shall be disposed of as directed by Employer's Representative. The Contractor shall provide the necessary access roads to borrow areas and maintain the same if such roads do not exist.

2.7.5 Filling in pits and trenches around foundations of structures, walls, etc.

As soon as the work in foundations has been accepted and measured, the spaces around the foundations, structures, pits, trenches, etc., shall be cleared of all debris, and filled with earth in layers not exceeding 15 cm, each layer being watered, rammed and properly consolidated, before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of Employer's Representative. Earth shall be rammed with approved mechanical compaction machines. Usually no manual compaction shall be allowed unless the Employer's Representative is satisfied that in some cases manual compaction by tampers cannot be avoided. The final backfill surface shall be trimmed and leveled to a proper profile to the approval of the Employer's Representative.

2.7.6 Plinth Filling

Plinth filling shall be carried out with approved material as described hereinbefore in layers not exceeding 15cm, watered and compacted with mechanical compaction machines. The Employer's Representative may, however, permit manual compaction by hand tampers where he is satisfied that mechanical compaction is not possible. When filling reaches the finished level, the surface shall be flooded with water, unless otherwise directed, for at least 24 hours, allowed to dry and then the surface again compacted as specified above to avoid settlement at a later stage. The finished level of the filling shall be trimmed to the level/slope specified.

2.7.7 Compaction of the plinth fill shall be carried out by means of 12 ton rollers smooth wheeled, sheep-foot or wobbly wheeled rollers. In case of compaction of granular material such as sands and gravel, vibratory rollers shall be used. A smaller weight roller may be used only if permitted by the Employer's Representative. As rolling proceeds, water sprinkling shall be done to assist consolidation. Water shall not be sprinkled in case of sandy fills.

2.7.8 The thickness of each unconsolidated fill layer can in this case be upto a maximum of 300mm. The Contractor will determine the thickness of the layers in which fill has to be consolidated depending on the fill material and equipment used and the approval of the Employer's Representative obtained prior to commencing filling.

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2.7.9 Rolling shall commence from the outer edge and progress towards the centre and continue until compaction is to the satisfaction of Employer's Representative, but in no case less than 10 passes of the roller will be accepted for each layer.

2.7.10 The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated, then filled and consolidated.

2.7.11 At some locations/areas, it may not be possible to use rollers because of space restrictions, etc. The Contractor shall then be permitted to use pneumatic tampers, rammers, etc. and he shall ensure proper compaction.

Sand Filling in Plinth and Other Places

Where backfilling is required to be carried out with local sand it shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Employer's Representative has inspected and approved the fill.

2.7.13 Filling in Trenches

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipe and drains have been tested and passed. The backfilling material shall be properly consolidated by watering and ramming, taking due care so that no damage is caused to the pipes.

2.7.14 Where the trenches are excavated in soil, the filling from the bottom of the trench to the level of the centre line of the pipe shall be done by hand compaction with selected approved earth in layers not exceeding 8 cm; backfilling above the level of the centre line of the pipes shall be done with selected earth by hand compaction, or other approved means in layers not exceeding 15 cm.

2.7.15 In case of excavation of trenches in rock, the filling upto a level 30 cm above the top of the pipe shall be done with fine materials such as earth, murum, etc. The filling up to the level of the centre line of the pipe shall be done by hand compaction in layers not exceeding 8 cm whereas the filling above the centre line of the pipe shall be done by hand compaction or approved means in layers not exceeding 15 cm. The filling from a level 30 cm above the top of the pipe to the top of the trench shall be done by hand or other approved mechanical

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methods with broken rock filling of size not exceeding 15 cm mixed with fine material as available to fill up the voids.

2.7.16 Filling of the trenches shall be carried out simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.

2.8 General Site Grading

2.8.1 Site grading shall be carried out as indicated in the drawings and as approved by the Employer's Representative. Excavation shall be carried out as specified in the Employer's Requirements. Filling and compaction shall be carried out as specified under Clause 2.7 and elsewhere unless otherwise indicated below.

2.8.2 If no compaction is called for, the fill may be deposited to the full height in one operation and levelled. If the fill has to be compacted, it shall be placed in layers not exceeding 225 mm and levelled uniformly and compacted as indicated in Clause 2.7 before the next layer is deposited.

2.8.3 To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by the Contractor.

2.8.4 Field compaction tests shall be carried out in each layer of filling until the fill to the entire height has been completed. This shall hold good for embankments as well. The fill will be considered as incomplete if the desired compaction has not been obtained.

2.8.5 The Contractor shall protect the earth fill from being washed away by rain or damaged in any other way. Should any slip occur, the Contractor shall remove the affected material and make good the slip.

2.8.6 If so specified, the rock as obtained from excavation may be used for filling and levelling to indicated grades without further breaking. In such an event, filling shall be done in layers not exceeding 50 cms approximately. After rock filling to the approximate level, indicated above has been carried out, the void in the rocks shall be filled with finer materials such as earth, broken stone, etc. and the area flooded so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 12 ton roller. No less than twelve passes of the roller shall be accepted before subsequent similar operations are taken up.

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2.9 Fill Density

2.9.1 The compaction, under the plant road area and building plinths shall comply with minimum 95% compaction by Standard Proctor at moisture content differing not more than 4% from the optimum moisture content. The Contractor shall demonstrate adequately by field and laboratory tests that the specified density has been obtained. In other areas the soil should be backfilled and compacted suitably as specified by the Engineer.

2.10 Timber Shoring

2.10.1 Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called 'polling boards'. These shall be of minimum 25 cm x 4 cm sections or as approved by the Employer's Representative. The boards shall generally be placed in position vertically side by side without any gap on each side of the excavation and shall be secured by horizontal walling of strong wood at maximum 1.2 metre spacings, strutted with ballies or as approved by the Employer's Representative. The length of the ballie struts shall depend on the width of the trench or pit. If the soil is very soft and loose, the boards shall be placed horizontally against each side of the excavation and supported by vertical walling, which in turn shall be suitably strutted. The lowest boards supporting the sides shall be taken into the ground and no portion of the vertical side of the trench or pit shall remain exposed, so as to render the earth liable to slip out.

2.10.2 Timber shoring shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench. The type of timbering shall be as approved by the Employer's Representative. It shall be the responsibility of the Contractor to take all necessary steps to prevent the sides of excavations, trenches, pits, etc. from collapsing.

2.10.3 Timber shoring may also be required to keep the sides of excavations vertical to ensure safety of adjoining structures or to limit the slope of excavations, or due to space restrictions or for other reasons. Such shoring shall be carried out, except in an emergency, only under instructions from the Employer's Representative.

2.10.4 The withdrawal of the timber shall be done carefully to prevent the collapse of the pit or trench. It shall be started at one end and proceeded with, systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber.

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2.10.5 In the case of open timbering, the entire surface of the side of trench or pit is not required to be covered. The vertical boards of minimum 25 cm x 4 cm sections shall be spaced sufficiently apart to leave unsupported strips of maximum 50 cm average width. The detailed arrangement, sizes of the timber and the spacings shall be subject to the approval of the Employer's Representative. In all other respects, the Employer's Requirements for close timbering shall apply to open timbering.

2.10.6 In case of large pits and open excavations, where shoring is required for securing safety of adjoining structures or for any other reasons and where the planking across sides of excavations/pits cannot be strutted against, suitable inclined struts supported on the excavated bed shall be provided. The load from such struts shall be suitably distributed on the bed to ensure no yielding of the strut.

2.11 Dewatering

2.11.1 The Contractor shall ensure that the excavation and the structures are free from water during construction and shall take all necessary precautions and measures to exclude ground/rain water so as to enable the works to be carried out in reasonably dry conditions in accordance with the construction programme. Sumps made for dewatering must be kept clear of the excavations/trenches required for further work. The method of pumping shall be approved by Employer's Representative, but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction. The dewatering shall be continued for at least (7) seven days after the last pour of the concrete. The Contractor shall, however, ensure that no damage to the structure results on stopping of dewatering.

2.11.2 The Contractor shall study the sub-soil conditions carefully and shall conduct any tests necessary at the site with the approval of the Employer's Representative to test the permeability and drainage conditions of the sub-soil for excavation, concreting etc., below ground level.

2.11.3 The scheme for dewatering and disposal of water shall be approved by the Employer's Representative. The Contractor shall suitably divert the water obtained from dewatering from such areas of site where a build up of water in the opinion of the Employer's Representative obstructs the progress of the work, leads to insanitary conditions by stagnation, retards the speed of construction and is detrimental to the safety of men, materials, structures and equipment.

2.11.4 When there is a continuous inflow of water and the quantum of water to be handled is considered in the opinion of Employer's Representative, to be large, a well point system- single stage or multistage, shall be adopted. The Contractor shall submit to the Employer's Representative, details of his well point system including

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the stages, the spacing, number and diameter of well points, headers etc., and the number, capacity and location of pumps for approval.

2.12 Rain Water Drainage

2.12.1 Grading in the vicinity of excavation shall be such as to exclude rain/ surface water draining into excavated areas. Excavation shall be kept clean of rain and such water as the Contractor may be using for his work by suitably pumping out the same. The scheme for pumping and discharge of such water shall be approved by the Employer's Representative.

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3.0 CONCRETE WORKS

3.1Applicable Codes

3.1.1 Materials

IS.269 Specification for 33 grade ordinary portland cement.

IS.455 Specification for portland slag cement.

IS.1489 Specification for portland-pozzolana cement (Part 1&2).

IS:8112 Specification for 43 grade ordinary portland cement.

IS:12269 Specification for 53 grade ordinary portland cement.

IS:12330 Specification for sulphate resisting portland cement.

7) IS:383 Specification for coarse and fine aggregates from natural sources for concrete.

8) IS:432 Specification for mild steel and medium (tensile steel bars and hard-drawn steel) wires for concrete reinforcement. (Part 1 and 2)

9) IS:1786 Specification for high strength deformed steel bars and wires for concrete reinforcement.

10) IS:1566 Specification for hard-drawn steel wire fabric for concrete reinforcement.

11) IS:9103 Specification for admixtures for concrete.

12) IS:2645 Specification for integral cement water- proofing compounds.

13) IS:4990 Specification for plywood for concrete shuttering work.

3.1.2 Material Testing

IS.4031 Methods of physical tests for hydraulic cement (Parts 1 to 15)

IS:4032 Method chemical analysis of hydraulic cement.

IS:650 Specification for standard sand for testing of cement.

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IS:2430 Methods for sampling of aggregates for concrete.

IS.2386 Methods of test for aggregates for concrete (Parts 1 to 8)

IS:3025 Methods of sampling and test (physical and chemical) for water used in industry.

IS:6925 Methods of test for determination of water soluble chlorides in concrete admixtures.

3.1.3 Material Storage

IS:4082 Recommendations on stacking and storing of construction materials at site.

3.1.4 Concrete Mix Design

IS:10262 Recommended guidelines for concrete mix design.

2) SP:23 (S&T) Handbook on Concrete Mixes

3.1.5 Concrete Testing

IS.1199 Method of sampling and analysis of concrete.

IS:516 Method of test for strength of concrete.

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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.

3.1.6 Equipments

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 and agitator.

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.

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IS:3366 Specification for pan vibrators.

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).

14) IS:2750 Specification for steel scaffoldings.

3.1.7 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 1 to 4)

IS:3935 Code of practice for composite construction.

IS:2204 Code of practice for construction of reinforced concrete shell roof.

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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 buildings.

IS:4326 Code of practice for earthquake resistant design and construction of building.

IS:4014 Code of practice for steel tubular scaffolding (Parts 1 & 2)

IS:2571 Code of practice for laying insitu cement concrete flooring.

16) IS:7861 Code of practice for extreme weather concreting : Part 1 Recommended practice for hot weather concreting.

3.1.8 Construction Safety

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IS.3696 Safety code for scaffolds and ladders. (Parts 1 & 2)

IS:7969 Safety code for handling and storage of building materials.

3) IS:8989 Safety code for erection of concrete framed structures.

3.2 General

3.2.1 The EMPLOYER shall have the right at all times to inspect all operations including the sources of materials, procurement, layout and storage of materials, the concrete batching and mixing equipment and the quality control system. Such an inspection shall be arranged and the EMPLOYER's approval obtained, prior to starting of concrete work. This shall, however, not relieve the Contractor of any of his responsibilities. All materials which do not conform to the Specifications shall be rejected.

3.2.2 Materials should be selected so that they can satisfy the design requirements of strength, serviceability, safety, durability and finish with due regards to the functional requirements and the environmental conditions to which the structure will be subjected. Materials complying with codes/standards shall generally be used. Other materials may be used after approval of the EMPLOYER and after establishing their performance suitability based on previous data, experience or tests.

3.3 Materials

3.3.1 Cement

Cement shall be ordinary portland cement conforming to IS:269, IS:8112 or IS:12269 for all structures.

3.3.2 Where Portland pozzolana or slag cements are used, it shall be ensured that consistency of quality is maintained, there will be no adverse interactions between the materials and the finish specified is not marred.

3.3.3 Only one type of cement shall be used in any one mix. The source of supply, type or brand of cement within the same structure or portion thereof shall not be changed without approval from the EMPLOYER.

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3.3.4 Cement which is not used within 90 days from its date of manufacture shall be tested at a laboratory approved by the EMPLOYER and until the results of such tests are found satisfactory, it shall not be used in any work.

3.3.5 Aggregates (General)

Aggregates shall consist of naturally occurring stones (crushed or uncrushed), gravel and sand. They shall be chemically inert, strong, hard, clean, durable against weathering, of limited porosity, free from dust/silt/ organic impurities/deleterious materials and conform to IS:383. Aggregates such as slag, crushed over burnt bricks, bloated clay ash, sintered fly ash and tiles shall not be used.

3.3.6 Aggregates shall be washed and screened before use where necessary or if directed by the EMPLOYER.

3.3.7 Aggregates containing reactive materials shall be used only after tests conclusively prove that there will be no adverse effect on strength, durability and finish, including long term effects, on the concrete.

3.3.8 The fineness modulus of sand shall neither be less than 2.2 nor more than 3.2.

3.3.9 The maximum size of coarse aggregate shall be as stated on the drawings but in no case greater than 1/4 of the minimum thickness of the member.

3.3.10 Plums 160 mm and above of a reasonable size may be used in mass concrete fill where directed. Plums shall not constitute more than 20% by volume of the concrete.

3.3.11 Water

Water used for both mixing and curing shall conform to IS:456. Potable waters are generally satisfactory. Water containing any excess of acid, alkali, sugar or salt shall not be used.

3.3.12 Reinforcement

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All reinforcement steel shall be of TMT Fe-500 grade and welded wire fabric to IS:1566 as shown or specified on the drawing.

All reinforcement shall be clean, free from pitting, oil, grease, paint, loose mill scales, rust, dirt, dust, or any other substance that will destroy or reduce bond.

3.3.13 Admixtures

3.3.13.1 Accelerating, retarding, water-reducing and air entraining admixtures shall conform to IS:9103 and integral water proofing admixtures to IS:2645.

3.3.13.2 Admixtures may be used in concrete as per manufacturer's instructions only with the approval of the EMPLOYER. An admixture's suitability and effectiveness shall be verified by trial mixes with the other materials used in the works. If two or more admixtures are to be used simultaneously in the same concrete mix, their interaction shall be checked and trial mixes done to ensure their compatibility. There should also be no increase in risk of corrosion of the reinforcement or other embedments.

3.3.13.3 Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement or embedded steel parts. When calcium chloride is permitted such as in mass concrete works, it shall be dissolved in water and added to the mixing water by an amount not exceeding 1.5 percent of the weight of the cement in each batch of concrete. The designed concrete mix shall be corrected accordingly.

3.3.14 Wastage

Wastage allowance for cement and steel shall not be considered and no extra payment shall become payable to the Contractor on any account.

3.4 Samples and Tests

3.4.1 All materials used for the works shall be tested before use.

3.4.2 Manufacturer's test certificate shall be furnished for each batch of cement/steel and when directed by the EMPLOYER samples shall also be got tested by the Contractor in a laboratory approved by the EMPLOYER at

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no extra cost to Employer. EMPLOYER may appoint separate third party inspection for the material testing to ensure the quality of the work. The Contractor shall replace the defective material as an outcome of these tests.

3.4.3 Sampling and testing shall be as per IS:2386 under the supervision of the EMPLOYER.

3.4.4 Water to be used shall be tested to comply with requirements of IS:456.

3.4.5 The Contractor shall furnish manufacturer's test certificates and technical literature for the admixture proposed to be used. If directed, the admixture shall be got tested at an approved laboratory at no extra cost.

3.5 Storing of Materials

3.5.1 All materials shall be stored in a manner so as to prevent its deterioration and contamination which would preclude its use in the works. Requirements of IS:4082 shall be complied with.

3.5.2 The Contractor will have to make his own arrangements for the storage of adequate quantity of cement. If such cement is not stored properly and has deteriorated, the material shall be rejected. Cement bags shall be stored in dry weatherproof shed with a raised floor, well away from the outer walls and insulated from the floor to avoid moisture from ground. Not more than 15 bags shall be stacked in any tier. Storage arrangement shall be approved by the EMPLOYER. Storage under tarpaulins shall not be permitted. Each consignment of cement shall be stored separately and consumed in its order of receipt.

3.5.3 Each size of coarse and fine aggregates shall be stacked separately and shall be protected from leaves and contamination with foreign material. The stacks shall be on hard, clean, free draining bases, draining away from the concrete mixing area.

3.5.4 The Contractor shall make his own arrangements for storing water at site in tanks to prevent contamination.

3.5.5 The reinforcement shall be stacked on top of timber sleepers to avoid contact with ground/water. Each type and size shall be stacked separately.

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3.6 Concrete

3.6.1 General

Concrete grade shall be as designated on drawings. In concrete grade M15, M20 etc. the number represents the specified characteristic compressive strength of 150 mm cube at 28 days, expressed in N/sq.mm as per IS:456. Concrete in the works shall be "DESIGN MIX CONCRETE" or "NOMINAL MIX CONCRETE". All concrete works of grade M5, M7.5 and M10 shall be NOMINAL MIX CONCRETE whereas all other grades, M15 and above, shall be DESIGN MIX CONCRETE.

3.6.2 Design Mix Concrete

3.6.2.1 Mix Design & Testing

3.6.2.1.1 For Design Mix Concrete, the mix shall be designed according to IS:10262 and SP:23 to provide the grade of concrete having the required workability and characteristic strength not less than appropriate values given in IS:456. The design mix shall be cohesive and does not segregate and should result in a dense and durable concrete and also capable of giving the finish as specified. For liquid retaining structures, the mix shall also result in water tight concrete. The Contractor shall exercise great care while designing the concrete mix and executing the works to achieve the desired result.

3.6.2.1.2 The minimum cement content for Design Mix Concrete shall be as per Appendix-A of IS:456 or as given below, whichever is higher.

Grade of Concrete	Minimum Cement Content in Kg/Cu.m of Concrete
M15	260
M20	315
M25	360

3.6.2.1.3 The minimum cement content stipulated above shall be adopted irrespective of whether the Contractor achieves the desired strength with less quantity of cement. The CONTRACTOR's quoted rates for concrete shall provide for the above eventuality and nothing extra shall become payable to the CONTRACTOR in this account. Even in the case where the quantity of cement required is higher than that specified above to

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achieve desired strength based on an approved mix design, nothing extra shall become payable to the CONTACTOR.

3.6.2.1.4 It shall be the Contractor's sole responsibility to carry out the mix designs at his own cost. He shall furnish to the EMPLOYER at least 30 days before concreting operations, a statement of proportions proposed to be used for the various concrete mixes and the strength results obtained. The strength requirements of the concrete mixes ascertained on 150 mm cubes as per IS:516 shall comply with the requirements of IS:456.

Grade of Concrete	Minimum Compressive Strength N/sq. mm at 7 days	Specified Characteristic Compressive Strength N/sq. mm at 28 days
M 15	10.0	15.0
M 20	13.5	20.0
M 25	17.0	25.0
M 30	20.0	30.0
M 35	23.5	35.0
M 40	27.0	40.0

3.6.2.1.5 A range of slumps which shall generally be used for various types of construction unless otherwise instructed by the EMPLOYER is given below :

Structure/Member	Slump in millimeters	
	Maximum	Minimum
Reinforced foundation walls and footings	75	25
Plain footings, caissons and substructure walls	100	25
Slabs, Beams and reinforced walls	75	25
Pump & miscellaneous Equipment Foundations	100	25
Building columns	50	25
Pavements	50	25

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Heavy mass construction	50	25

3.6.2.2 Batching & Mixing of Concrete

3.6.2.2.1 Proportions of aggregates and cement, as decided by the concrete mix design, shall be by weight. These proportions shall be maintained during subsequent concrete batching by means of weigh batchers capable of controlling the weights within one percent of the desired value.

3.6.2.2.2 Amount of water added shall be such as to produce dense concrete of required consistency, specified strength and satisfactory workability and shall be so adjusted to account for moisture content in the aggregates. Water- cement ratio specified for use by the EMPLOYER shall be maintained. Each time the work stops, the mixer shall be cleaned out, and while recommencing, the first batch shall have 10% additional cement to allow for sticking in the drum.

3.6.2.2.3 Arrangement should be made by the Contractor to have the cubes tested in an approved laboratory or in field with prior consent of the EMPLOYER. Sampling and testing of strength and workability of concrete shall be as per IS:1199, IS:516 and IS:456, IS 3370.

3.6.3 Nominal Mix Concrete

3.6.3.1 Mix Design & Testing

Mix design and preliminary tests are not necessary for Nominal Mix Concrete. However works tests shall be carried out as per IS:456. Proportions for Nominal Mix Concrete and w/c ratio may be adopted as per Table 3 of IS:456. However it will be the Contractor's sole responsibility to adopt appropriate nominal mix proportions to yield the specified strength.

3.6.3.2 Batching & Mixing of Concrete

Based on the adopted nominal mixes, aggregates shall be measured by volume. However cement shall be by weight only.

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3.7 Formwork

3.7.1 Formwork shall be all inclusive and shall consist of but not be limited to shores, bracings, sides of footings, walls, beams and columns, bottom of slabs etc. including ties, anchors, hangers, inserts, falsework, wedges etc.

3.7.2 The design and engineering of the formwork as well as its construction shall be the responsibility of the Contractor. However, if so desired by the EMPLOYER, the drawings and calculations for the design of the formwork shall be submitted to the EMPLOYER for approval.

Formwork shall be designed to fulfill the following requirements :

(a) Sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages and appropriate to the methods of placing and compacting.

(b) Made of suitable materials.

(c) Capable of providing concrete of the correct shape and surface finish within the specified tolerance limits.

(d) Capable of withstanding without deflection the worst combination of selfweight, reinforcement and concrete weight, all loads and dynamic effects arising from construction and compacting activities, wind and weather forces.

(e) Capable of easy striking out without shock, disturbance or damage to the concrete.

(f) Soffit forms capable of imparting a camber if required.

(g) Soffit forms and supports capable of being left in position if required.

(h) Capable of being cleaned and/or coated if necessary immediately prior to casting the concrete; design temporary openings where necessary for these purposes and to facilitate the preparation of construction joints.

3.7.4 The formwork may be of timber, plywood, steel, plastic or concrete depending upon the type of finish specified. Sliding forms and slip form may be used with the approval of the EMPLOYER. Timber for formwork

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shall be well seasoned, free from sap, shakes, loose knots, worm holes, warps and other surface defects. Joints between formwork and formwork and between formwork and structures shall be sufficiently tight to prevent loss of slurry from concrete, using seals if necessary.

3.7.5 The faces of formwork coming in contact with concrete shall be cleaned and two coats of approved mould oil applied before fixing reinforcement. All rubbish, particularly chippings, shavings, sawdust, wire pieces dust etc. shall be removed from the interior of the forms before the concrete is placed. Where directed, cleaning of forms shall be done by blasting with a jet of compressed air at no extra cost.

3.7.6 Forms intended for reuse shall be treated with care. Forms that have deteriorated shall not be used. Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes suitably plugged, joints repaired and warped lumber replaced to the satisfaction of the EMPLOYER. The Contractor shall equip himself with enough shuttering to allow for wastage so as to complete the job in time.

3.7.7 Permanent formwork shall be checked for its durability and compatibility with adjoining concrete before it is used in the structure. It shall be properly anchored to the concrete.

3.7.8 Wire ties passing through beams, columns and walls shall not be allowed. In their place bolts passing through sleeves shall be used. Formwork spacers left insitu shall not impair the desired appearance or durability of the structure by causing spalling, rust staining or allowing the passage of moisture.

3.7.9 For liquid retaining structures, sleeves shall not be provided for through bolts nor shall through bolts be removed if provided. The bolts, in the latter case, shall be cut at 25 mm depth from the surface and the hole made good by cement mortar of the same proportion as the concrete just after striking the formwork.

3.7.10 Where specified all corners and angles exposed in the finished structure shall have chamfers or fillets of 20 mm x 20 mm size.

3.7.11 Forms for substructure may be omitted when, in the opinion of the EMPLOYER, the open excavation is firm enough (in hard non-porous soils) to act as a form. Such excavations shall be larger, as approved by the EMPLOYER, than that required as per drawing to compensate for irregularities in excavation.

3.7.12 The Contractor shall provide adequate props carried down to a firm bearing without overloading any of the structures.

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3.7.13 The shuttering for beams and slabs shall be so erected that the side shuttering of beams can be removed without disturbing the bottom shuttering. If the shuttering for a column is erected for the full height of the column, one side shall be built up in sections as placing of concrete proceeds or windows left for placing concrete from the side to limit the drop of concrete to 1.0m or as approved by the EMPLOYER. The Contractor shall temporarily and securely fix items to be cast (embedments/ inserts) in a manner that will not hinder the striking of forms or permit loss of grout.

3.7.14 Formwork showing excessive distortion, during any stage of construction, shall be repositioned and strengthened. Placed concrete affected by faulty formwork, shall be entirely removed and formwork corrected prior to placement of new concrete at Contractor's cost.

3.7.15 The striking time for formwork shall be determined based on the following requirements:

Development of adequate concrete strength;

Permissible deflection at time of striking form work;

Curing procedure employed - its efficiency and effectiveness;

Subsequent surface treatment to be done;

Prevention of thermal cracking at re-entrant angles;

Ambient temperatures; and

Aggressiveness of the environment (unless immediate adequate steps are taken to prevent damage to the concrete).

3.7.16 Under normal circumstances (generally where temperatures are above 20oC) forms may be struck after expiry of the time period given in IS:456 unless approved otherwise by the EMPLOYER. For Portland Pozzolana/slag cement the stripping time shall be suitably modified as approved by the EMPLOYER. It is the Contractor's responsibility to ensure that forms are not struck until the concrete has developed sufficient strength to support itself, does not undergo excessive deformation and resist surface damage and any stresses arising during the construction period.

3.8 Reinforcement Workmanship

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3.8.1 Reinforcing bars supplied bent or in coils shall be straightened cold without damage. No bending shall be done when ambient temperature is below 5oC. Local warming may be permitted if steel is kept below 10o C.

3.8.2 All bars shall be accurately bent gradually and according to the sizes and shapes shown on the drawings/ schedules or as directed by EMPLOYER.

3.8.3 Re-bending or straightening incorrectly bent bars shall not be done without the approval of the EMPLOYER.

3.8.4 Reinforcement shall be accurately fixed and maintained firmly in the correct position by the use of blocks, spacers, chairs, binding wire etc. to prevent displacement during placing and compaction of concrete. The tied in place reinforcement shall be approved by the EMPLOYER prior to concrete placement. Spacers shall be of such materials and designs as will be durable, not lead to corrosion of the reinforcement and not cause spalling of the concrete cover.

3.8.5 Binding wire shall be 16 gauge soft annealed wire. Ends of the binding wire shall be bent away from the concrete surface and in no case encroach into the concrete cover.

3.8.6 Substitution of reinforcement, laps/splices not shown on drawing shall be subject to EMPLOYER's approval.

3.9Tolerances

3.9.1 Tolerance for formwork and concrete dimensions shall be as per IS:456 unless specified otherwise.

3.9.2 Tolerances specified for horizontal or vertical building lines or footings shall not be construed to permit encroachment beyond the legal boundaries.

3.9.3 The formwork shall be designed and constructed to the shapes, lines and dimensions shown on the drawings within the tolerances given below :

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(a)	Deviation from specified dimensions of cross section of columns and beams	- 6 mm + 12 mm
(b)	Deviations from dimensions of footings (Tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel or dowels	
1)	Dimension in plan	- 12 mm + 50 mm
2)	Eccentricity	0.02 times the width of the footing in the direction of deviation but not more than 50 mm
3)	Thickness	± 0.05 times the specified thickness

3.10 Preparation Prior to Concrete Placement

3.10.1 Before concrete is actually placed in position, the inside of the formwork shall be cleaned and mould oil applied, inserts and reinforcement shall be correctly positioned and securely held, necessary openings, pockets, etc. provided.

3.10.2 All arrangements-formwork, equipment and proposed procedure, shall be approved by the EMPLOYER. Contractor shall maintain separate Pour Card for each pour as per the format enclosed.

3.11 Transporting, Placing and Compacting Concrete

3.11.1 Concrete shall be transported from the mixing plant to the formwork with minimum time lapse by methods that shall maintain the required workability and will prevent segregation, loss of any ingredients or ingress of foreign matter or water.

3.11.2 In all cases concrete shall be deposited as nearly as practicable directly in its final position. To avoid segregation, concrete shall not be rehandled or caused to flow. For locations where direct placement is not possible and in narrow forms the Contractor shall provide suitable drops and "Elephant Trunks". Concrete shall not be dropped from a height of more than 1.0m.

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3.11.3 Concrete shall not be placed in flowing water. Under water, concrete shall be placed in position by tremies or by pipeline from the mixer and shall never be allowed to fall freely through the water.

3.11.4 While placing concrete the Contractor shall proceed as specified below and also ensure the following:

(a) Continuously between construction joints and pre- determined abutments.

(b) Without disturbance to forms or reinforcement.

(c) Without disturbance to pipes, ducts, fixings and the like to be cast in; ensure that such items are securely fixed. Ensure that concrete cannot enter open ends of pipes and conduits etc.

(d) Without dropping in a manner that could cause segregation or shock.

(e) In deep pours only when the concrete and formwork designed for this purpose and by using suitable chutes or pipes.

(f) Do not place if the workability is such that full compaction cannot be achieved.

(g) Without disturbing the unsupported sides of excavations; prevent contamination of concrete with earth. Provide sheeting if necessary. In supported excavations, withdraw the linings progressively as concrete is placed.

(h) If placed directly onto hardcore or any other porous material, dampen the surface to reduce loss of water from the concrete.

(i) Ensure that there is no damage or displacement to sheet membranes.

(j) Record the time and location of placing structural concrete.

3.11.5 Concrete shall normally be compacted in its final position within thirty minutes of leaving the mixer. Concrete shall be compacted during placing with approved vibrating equipment without causing segregation until it forms a solid mass free from voids thoroughly worked around reinforcement and embedded fixtures and into all corners of the formwork. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn slowly till air bubbles cease to come to the surface, leaving no voids. When placing concrete in layers advancing horizontally, care shall be taken to ensure adequate vibration, blending and melding of the concrete between successive layers. Vibrators shall not be allowed to come in contact with reinforcement, formwork and finished surfaces after start of initial set. Over-vibration shall be avoided.

3.11.6 Concrete may be conveyed and placed by mechanically operated equipment after getting the complete procedure approved by the EMPLOYER. The slump shall be held to the minimum necessary for conveying concrete by this method. When concrete is to be pumped, the concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

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3.11.7 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 before the start of subsequent placement. Placing shall stop when concrete reaches the top of the opening in walls or bottom surface of slab, in slab and beam construction, and it shall be resumed before concrete takes initial set but not until it has had time to settle as approved by the EMPLOYER. Concrete shall be protected against damage until final acceptance.

3.12 Mass Concrete Works

3.12.1 Sequence of pouring for mass concrete works shall be as approved by the EMPLOYER. The Contractor shall exercise great care to prevent shrinkage cracks and shall monitor the temperature of the placed concrete if directed.

3.13 Curing

3.13.1 Curing and protection shall start immediately after the compaction of the concrete to protect it from:

(a) Premature drying out, particularly by solar radiation and wind;

(b) leaching out by rain and flowing water;

(c) rapid cooling during the first few days after placing;

(d) high internal thermal gradients;

(e) low temperature or frost;

(f) vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.

3.13.2 All concrete, unless approved otherwise by the EMPLOYER, shall be cured by use of continuous sprays or ponded water or continuously saturated coverings of sacking, canvas, hessain or other absorbent material for the period of complete hydration with a minimum of 7 days. The quality of curing water shall be the same as that used for mixing.

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3.13.3 Where a curing membrane is approved to be used by the EMPLOYER, the same shall be of a non-wax base and shall not impair the concrete finish in any manner. The curing compound to be used shall be approved by the EMPLOYER before use and shall be applied with spraying equipment capable of a smooth, even textured coat.

3.13.4 Curing may also be done by covering the surface with an impermeable material such as polyethylene, which shall be well sealed and fastened.

3.14 Construction Joints and Keys

3.14.1 Construction joints will be as shown on the drawing or as approved by the EMPLOYER. Concrete shall be placed without interruption until completion of work between construction joints. If stopping of concreting becomes unavoidable anywhere, a properly formed construction joint shall be made with the approval of the EMPLOYER.

3.14.2 Dowels for concrete work, not likely to be taken up in the near future, shall be coated with cement slurry and encased in lean concrete as indicated on the drawings or as approved by the EMPLOYER.

3.14.3 Before resuming concreting on a surface which has hardened all laitance and loose stone shall be thoroughly removed by wire brushing/hacking and surface washed with high pressure water jet and treated with thin layer of cement slurry for vertical joints and horizontal layers.

3.14.4 When concreting is to be resumed on a surface which has not fully hardened, all laitance shall be removed by wire brushing, the surface wetted, free water removed and a coat of cement slurry applied. On this, a layer of concrete not exceeding 150 mm thickness shall be placed and well rammed against the old work. Thereafter work shall proceed in the normal way.

3.15 Foundation Bedding

3.15.1 All earth surfaces upon which or against which concrete is to be placed, shall be well compacted and free from standing water, mud or debris. Soft or spongy areas shall be cleaned out and back filled with either soil-cement mixture, lean concrete or clean sand compacted as approved by the EMPLOYER. The surfaces of absorptive soils shall be moistened.

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3.15.2 Concrete shall not be deposited on large sloping rock surfaces. The rock shall be cut to form rough steps or benches by picking, barring or wedging. The rock surface shall be kept wet for 2 to 4 hours before concreting.

3.16 Finishes

3.16.1 General

The formwork for concrete works shall be such as to give the finish as specified. The Contractor shall make good any unavoidable defects as approved consistent with the type of concrete and finish specified; defects due to bad workmanship (e.g. damaged or misaligned forms, defective or poorly compacted concrete) will not be accepted. The Contractor shall construct the formwork using the correct materials and to meet the requirements of the design and to produce finished concrete to required dimensions, plumbs, planes and finishes. Inside and outside 15 mm thick smooth cement plaster in CM (1:3) with water proofing compound shall be done in all water retaining structures.

3.16.2 Surface Finish Type F1

The main requirement is that of dense, well compacted concrete. No treatment is required except repair of defective areas, filling all form tie holes and cleaning up of loose or adhering debris. For surfaces below grade which will receive waterproofing treatment the concrete shall be free of surface irregularities which would interfere with proper and effective application of waterproofing material specified for use.

3.16.3 Surface Finish Type F2

The appearance shall be that of a smooth dense, well- compacted concrete showing the slight marks of well fitted shuttering joints. The Contractor shall make good any blemishes.

3.16.4 Surface Finish Type F3

This finish shall give an appearance of smooth, dense, well-compacted concrete with no shutter marks, stain free and with no discolouration, blemishes, arises, airholes etc. Only lined or coated plywood with very tight joints shall be used to achieve this finish. The panel size shall be uniform and as large as practicable. Any minor blemishes that might occur shall be made good by the Contractor.

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3.16.5 Integral Cement Finish on Concrete Floor

In all cases where integral cement finish on a concrete floor has been specified, the top layer of concrete shall be screeded off to proper level and tamped with tamper having conical projections so that the aggregate shall be forced below the surface. The surface shall be finished with a wooden float and a trowel with pressure. The finish shall be continued till the concrete reaches its initial set. No cement or cement mortar finish shall be provided on the surface. Where specified, a floor hardener as approved by the EMPLOYER shall be supplied and used as recommended by the manufacturer.

3.17 Repair and Replacement of Unsatisfactory Concrete work

3.17.1 Immediately after the shuttering is removed, all the defective areas such as honey-combed surfaces, rough patches, holes left by form bolts etc. shall be inspected by the EMPLOYER who may permit patching of the defective areas or reject the concrete work.

3.17.2 All through holes for shuttering shall be filled for full depth and neatly plugged flush with surface.

3.17.3 Rejected concrete shall be removed and replaced by the Contractor at no additional cost to the Employer.

3.17.4 For patching of defective areas all loose materials shall be removed and the surface shall be prepared as approved by the EMPLOYER.

3.17.5 Bonding between hardened and fresh concrete shall be done either by placing cement mortar or by applying epoxy. The decision of the EMPLOYER as to the method of repairs to be adopted shall be final and binding on the Contractor. The surface shall be saturated with water for 24 hours before patching is done with 1:5 cement sand mortar. The use of epoxy for bonding fresh concrete shall be carried out as approved by the EMPLOYER.

3.18 Vacuum Dewatering of Slabs

3.18.1 Where specified floor slabs, either grade or suspended, shall be finished by vacuum dewatering including all operations such as poker vibration, surface vibration, vacuum processing, floating and trowelling as per

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equipment manufacturers recommendation. The equipment to be used shall be subject to the EMPLOYER's approval.

3.19 Hot Weather Requirements

3.19.1 Concreting during hot weather shall be carried out as per IS:7861 (Part I).

3.19.2 Adequate provisions shall be made to lower concrete temperatures which shall not exceed 40o C at the time of placement of fresh concrete.

3.19.3 Where directed by the EMPLOYER, the Contractor shall spray non-wax based curing compound on unformed concrete surfaces at no extra costs.

3.20 Cold Weather Requirements

3.20.1 Concreting during cold weather shall be carried out as per Is : 7861 (Part II).

3.20.2 The ambient temperature during placement and upto final set shall not fall below 5 Deg.C. Approved antifreeze/accelerating additives shall be used where directed.

3.20.3 For major and large scale concreting works the temperature of concrete at times of mixing and placing, the thermal conductivity of the formwork and its insulation and stripping period shall be closely monitored.

3.21 Liquid Retaining Structures

3.21.1 The Contractor shall take special care for concrete for liquid retaining structures, underground structures and those others specifically called for to guarantee the finish and water tightness.

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3.21.2 The minimum level of surface finish for liquid retaining structures shall be Type F2. All such structures shall be hydro-tested.

3.21.3 The Contractor shall make all arrangements for hydro-testing of structure, all arrangements for testing such as temporary bulk heads, pressure gauges, pumps, pipe lines etc.

3.21.4 The Contractor shall also make all temporary arrangements that may have to be made to ensure stability of the structures during construction.

3.21.5 Any leakage that may occur during the hydro-test or subsequently during the defects liability period or the period for which the structure is guaranteed shall be effectively stopped either by cement/epoxy pressure grouting, guniting or such other methods as may be approved by the EMPLOYER. All such rectification shall be done by the CONTRACTOR to the entire satisfaction of the EMPLOYER at no extra cost to the EMPLOYER.

3.22 Testing Concrete Structures for Leakage

3.22.1 Hydro-static test for water tightness shall be done at full storage level or soffit of cover slab, as may be directed by the EMPLOYER, as described below :

3.22.2 In case of structures whose external faces are exposed, such as elevated tanks, the requirements of the test shall be deemed to be satisfied if the external faces show no sign of leakage or sweating and remain completely dry during the period of observation of seven days after allowing a seven day period for absorption after filling with water.

3.22.3 In the case of structures whose external faces are buried and are not accessible for inspection, such as underground tanks, the structures shall be filled with water and after the expiry of seven days after the filling, the level of the surface of the water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hrs. over a period of seven days. Backfilling shall be withheld till the tanks are tested. The total drop in surface level over a period for seven days shall be taken as an indication of the watertightness of the structure. The EMPLOYER shall decide on the actual permissible nature of this drop in the surface level, taking into account whether the structures are open or closed and the corresponding effect it has on evaporation losses. Unless specified otherwise, a structure whose top is covered shall be deemed to be water tight if the total drop in the surface level over a period of seven days does not exceed 40 mm.

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3.22.4 Each compartment/segment of the structure shall be tested individually and then all together.

3.22.5 For structures such as pipes, tunnels etc. the hydrostatic test shall be carried out by filling with water, after curing as specified, and subjecting to the specified test pressure for specified period. If during this period the loss of water does not exceed the equivalent of the specified rate, the structure shall be considered to have successfully passed the test.

3.23 Optional Tests

3.23.1 If the EMPLOYER feels that the materials i.e. cement, sand, coarse aggregates, reinforcement and water are not in accordance with the Specifications or if specified concrete strengths are not obtained, he may order tests to be carried out on these materials in laboratory, to be approved by the EMPLOYER, as per relevant IS Codes. Contractor shall have to pay for these tests.

3.23.2 In the event of any work being suspected of faulty material or workmanship requiring its removal or if the works cubes do not give the stipulated strengths, the EMPLOYER reserves the right to order the Contractor to take out cores and conduct tests on them or do ultrasonic testing or load testing of structure, etc. The EMPLOYER also reserves the right to ask the Contractor to dismantle and re-do such unacceptable work, at no cost to the Employer. Alternately EMPLOYER also reserves the right to ask the CONTRACTOR to dismantle and re-do such unacceptable work at the cost of CONTRACTOR.

3.24 Grouting

3.24.1 Standard Grout

Grout shall be provided as specified on the drawings.

The proportion of Standard Grout shall be such as to produce a flowable mixture consistent with minimum water content and shrinkage. Surfaces to be grouted shall be thoroughly roughened and cleaned. All structural steel elements to be grouted, shall be cleaned of oil, grease, dirt etc. The use of hot, strong caustic solution for this purpose will be permitted. Prior to grouting, the hardened concrete shall be saturated with water and just before grouting, water in all pockets shall be removed. Grouting once started shall be done quickly and continuously. Variation in grout mixes and procedures shall be permitted if approved by the EMPLOYER. The grout proportions shall be limited as follows :

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Use	Grout Thickness	Mix Proportions	W/C Ratio (max)
a) Fluid mix	Under 25mm	One part Portland Cement to one part sand	0.44
b) General mix	25mm and over but less than 50mm	One part Portland Cement to 2 parts of sand	0.53
c) Stiff mix	50mm and over	One part Portland Cement to 3 parts of sand	0.53

3.24.2 Non-Shrink Grout

Non–shrink grout where required shall be provided in strict accordance with the manufacturer's instructions / specifications on the drawings.

3.24.3 General

3.24.3.1 Inspection

All materials, workmanship and finished construction shall be subject to continuous inspection and approval of EMPLOYER. Materials rejected by EMPLOYER shall be expressly removed from site and shall be replaced by Contractor immediately.

3.24.3.2 Clean-Up

Upon the completion of concrete work, all forms, equipment, construction tools, protective coverings and any debris, scraps of wood, etc. resulting from the work shall be removed and the premises left clean.

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3.24.3.3 Acceptance Criteria

Any concrete work shall satisfy the requirements given below individually and collectively for it to be acceptable.

a) properties of constituent materials;

b) characteristic compressive strength;

c) specified mix proportions;

d) minimum cement content;

e) maximum free-water/cement ratio;

f) workability;

g) temperature of fresh concrete;

h) density of fully compacted concrete;

i) cover to embedded steel;

j) curing;

k) tolerances in dimensions;

l) tolerances in levels;

m) durability;

n) surface finishes;

o) special requirements such as;

i) water tightness

ii) resistance to aggressive chemicals

iii) resistance to freezing and thawing

iv) very high strength

v) improved fire resistance

vi) wear resistance

vii) resistance to early thermal cracking

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3.24.4 The EMPLOYER's decision as to the acceptability or otherwise of any concrete work shall be final and binding on the Contractor.

3.24.5 For work not accepted, the EMPLOYER may review and decide whether remedial measures are feasible so as to render the work acceptable. The EMPLOYER shall in that case direct the Contractor to undertake and execute the remedial measures. These shall be expeditiously and effectively implemented by the Contractor. Nothing extra shall become payable to the Contractor by the Employer for executing the remedial measures.

3.25 Waterstops

3.25.1 Material

The material for the PVC waterstops shall be a plastic compound with the basic resin of polyvinyl chloride and additional resins, plasticizers, inhibitors, which satisfies the performance characteristics specified below as per IS:12200. Testing shall be in accordance with IS:8543.

a)	Tensile strength	:	3.6 N/mm2 minimum
b)	Ultimate elongation	:	300% minimum
c)	Tear resistance	:	4.9 N/mm2 minimum
d)	Stiffness in flexure	:	2.46 N/mm2 minimum
e)	Accelerated extraction		
	i) Tensile strength	:	10.50 N/mm2 minimum
	ii) Ultimate elongation	:	250% minimum
(f)	Effect of Alkali	:	7 days
	i) Weight increase	:	0.10% maximum
	ii) Weight decrease	:	0.10% maximum
	iii) Hardness change	:	± 5 points
(g)	Effect of Alkali	:	28 days
	i) Weight increase	:	0.40% maximum
	ii) Weight decrease	:	0.30% maximum
	iii) Dimension change	:	±1%

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3.25.2 PVC water stops shall be either of the bar type, serrated with centre bulb and end grips for use within the concrete elements or of the surface (kicker) type for external use.

3.25.3 PVC water stops shall be of approved manufacture. Samples and the test certificate shall be got approved by the EMPLOYER before procurement for incorporation in the works.

3.25.4 Workmanship

3.25.4.1 Waterstops shall be cleaned before placing them in position. Oil or grease shall be removed thoroughly using water and suitable detergents.

3.25.4.2 Waterstops shall be procured in long lengths as manufactured to avoid joints as far as possible. Standard L or T type of intersection pieces shall be procured for use depending on their requirement. Any non-standard junctions shall be made by cutting the pieces to profile for jointing. Lapping of waterstops shall not be permitted. All jointing shall be of fusion welded type as per manufacturer's instructions.

3.25.4.3 Waterstops shall be placed at the correct location/level and suitably supported at intervals with the reinforcement to ensure that it does not deviate from its intended position during concreting and vibrating. Care shall also be taken to ensure that no honey-combing occurs because of the serrations/end grips, by placing concrete with smaller size aggregates in this region. Projecting portions of the waterstops embedded in concrete shall be thoroughly cleaned of all mortar/ concrete coating before resuming further concreting operations. The projecting waterstop shall also be suitably supported at intervals with the reinforcement to maintain its intended position during concreting so as to ensure that it does not bend leading to formation of pockets. In addition, smaller size aggregates shall be used for concreting in this region also.

3.26 Preformed Fillers and Joint Sealing Compound

3.26.1 Materials

3.26.1.1 Preformed filler for expansion/isolation joints shall be non-extruding and resilient type of bitumen impregnated fibres conforming to IS:1838 (Part I).

3.26.1.2 Bitumen coat to concrete/masonry surfaces for fixing the preformed bitumen filler strip shall conform to IS:702. Bitumen primer shall conform to IS:3384.

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3.26.1.3 Sealing compound for filling the joints above the preformed bitumen filler shall conform to Grade 'A' as per IS:1834.

3.26.2 Workmanship

3.26.2.1 The thickness of the preformed bitumen filler shall be 25mm for expansion joints and 50mm for isolation joints around foundation supporting rotatory equipment's. Contractor shall procure the strips of the desired thickness and width in lengths as manufactured. Assembly of small pieces/thicknesses of strips to make up the specified size shall not be permitted.

3.26.2.2 The concrete/masonry surface shall be cleaned free from dust and any loose particles. When the surface is dry, one coat of industrial blown type bitumen of grade 85/25 conforming to IS:702 shall be applied hot by brushing at the rate of 1.20 kg/sq.m. When the bitumen is still hot the preformed bitumen filler shall be pressed and held in position till it completely adheres. The surface of the filler against which further concreting/masonry work is to be done shall similarly be applied with one coat of hot bitumen at the rate of 1.20 kg/sq.m.

3.26.2.3 Sealing compound shall be heated to a pouring consistency for enabling it to run molten in a uniform manner into the joint. Before pouring the sealing compound, the vertical faces of the concrete joint shall be applied hot with a coat of bitumen primer conforming to IS: 3384 in order to improve the adhesive quality of the sealing compound.

3.26.2.4 Expansion joints between beams/slabs shall be provided with 100mm wide x 4mm thick mild steel plate at the soffit of RCC beams/slabs to support and prevent the preformed joint filler from dislodging. This plate shall be welded to an edge angle of ISA 50 x 50 x 6mm provided at the bottom corner, adjacent to the expansion joint of one of the beams/slabs, by intermittent fillet welding. Steel surfaces shall be provided with 2 coats of red oxide zinc chrome primer and 3 coats of synthetic enamel paint finish.

CONCRETE POUR CARD	
POUR NO. :	DATE :
DRG. NO. :	STRUCTURE :
CONCRETE GRADE/QUANTITY/ :	MAX. AGGREGATE SIZE /
	START / COMPLETION TIME :
SLUMP :	

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SL. NO.	ITEM					Remarks If Any
1.	BEFORE CONCRETING	CENTRELINES CHECKED		YES/NO		
2.		FORMWORK AND STAGING CHECKED FOR ACCURACY, STRENGTH & FINISH		YES/NO		
3.		REINFORCEMENT CHECKED		YES/NO		
4.		COVER TO REINFORCEMENT CHECKED		YES/NO		
5.		VERIFIEDTEST CERTIFICATE FOR CEMENT/STEEL		YES / NO		
6.		ADEQUACY OF MATERIALS / EQUIPMENT FOR POUR		YES / NO		
7.		EMBEDDED PARTS (LOCATION & PLUMB) CHECKED	CIVIL	YES/NO		
			MECH.	YES/NO		
			ELEC.	YES/NO		
8.	SOFFIT(S) & POUR TOP(T) LEVELS CHECKED BEFORE (B) & AFTER (A) FORM REMOVAL (ONLY OF BEAMS OF OVER 10 M SPAN & IMPORTANT STRUCTURE LIKE T.G. ETC.)			S(B) T(B) S(B) T(B)		
9.	CONSTRUCTION JOINTS LOCATION & TIME (IF NOT AS PER DRAWING)					
10.	CEMENT CONSUMPTION IN KGS.					
11.	NUMBER OF CUBES AND IDENTIFICATION MARKS					

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12.	TEST CUBE RESULTS (7 DAYS / 28 DAYS)		
13.	CONCRETE CONDITION ON FORM REMOVAL	V.GOOD/GOOD/FAIR /POOR	

Contractor's Representative EMPLOYER's Representative

NOTES: 1. EACH POUR TO HAVE SEPARATE CARDS, IN TRIPLICATE ONE EACH FOR CLIENT,CONTRACTOR & SITE OFFICE.

UNDER REMARKS INDICATE DEVIATIONS FROM DWGS. & SPECIFICATIONS, CONGESTION IN REINFORCEMENT IF ANY, UNUSUAL OCCURRENCES SUCH AS FAILURE OF EQUIPMENTS, SINKING OF SUPPORTS / PROPS. HEAVY RAINS AFFECTING CONCRETING, POOR COMPACTION, IMPROPER CURING, OTHER DEFICIENCIES, OBSERVATIONS ETC.

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STRUCTURAL STEEL WORK

4.1 Applicable Codes and Specifications

4.1.1 The supply, fabrication, erection and painting of structural steel works shall comply with the following specifications, standards and codes unless otherwise specified herein. All standards, specifications and codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions.

IS : 808	Dimensions for Hot Rolled Steel sections
IS : 814	Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Maganese Steel
IS : 800	Code of Practice for General Construction in Steel
IS : 801	Code of Practice for Use of Cold Formed Light Gauge Steel Structural Members in General Building Construction
IS : 806	Code of Practice for Use of Steel Tubes in General Building Construction
IS : 7205	Safety Code for Erection of Structural Steel Work
IS : 7215	Tolerances for Fabrication of Steel Structures
IS : 4000	High Strength Bolts in Steel Structure – Code of Practice
AISC	Specifications for Design, Fabrication and Erection of Buildings
IS : 1161	Steel Tubes for structural purposes
IS:10 IS:102	Ready Mixed paint, Brushing, Red Lead, Non-setting, Priming.
IS:110	Ready Mixed paint, brushing, grey filler for enamels for use over primers.
IS:117	Ready Mixed paint, Brushing, Finishing, Exterior Semigloss for general purposes, to Indian Standard colours.
IS:158	Ready Mixed paint, Brushing, Bituminous, Black, Lead free, Acid, Alkali and heat resisting.

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IS:159	Ready Mixed paint, Brushing, Acid resisting for protection against acid fumes, colour as required.
IS:341	Black Japan, Types A, B and C
IS:2339	Aluminium paint for general purposes, in Dual container
IS:2932	Specification for enamel, synthetic, exterior, type 1, (a) undercoating, (b) finishing
IS:2933	Specification for enamel, exterior, type 2, (a) undercoating, (b) finishing
IS:5905	Sprayed aluminium and zinc coatings on Iron and Steel.
IS:6005	Code of practice for phosphating of Iron and Steel.
IS:9862	Specification for ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water & chlorine resisting.
IS:13183	Aluminium paint, Heat resistant.
SIS-05-5900	(Swedish Standard)
IS : 1239	Mild steel tubes, tubulars and other Wrought steel fittings Part 1 – Mild steel tubes Part 2 – Mild steel tubulars and other wrought steel pipe fittings
IS : 1363 (Parts 1 to 3)	Hexagon Head Bolts, Screws and Nuts of product Grade C (Size range M5 to M64)
IS : 1367 (All parts)	Technical Supply Conditions for Threaded Fasteners
IS : 1852	Rolling and Cutting Tolerances for Hot Rolled Steel Products
IS : 1977	Structural Steel (Ordinary Quality)
IS : 2062	Steel for General Structural Purposes
IS : 2074	Ready Mixed Paint, Air drying, Red Oxide Zinc Chrome and Priming
IS : 3502	Steel Chequered Plate

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IS : 3757	High Strength Structural Bolts
IS : 5369	General Requirements for Plain Washers and Lock Washers
IS : 5372	Taper Washers for Channels
IS : 5374	Taper Washer for 1 Beams
IS : 6610	Heavy Washers for Steel Structures
IS : 8500	Structural Steel-microalloyed (medium and high strength qualities)
IS : 803	Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded storage tanks
IS : 816	Code of Practice for use of Metal Arc Welding for General construction in Mild Steel
IS : 822	Code of Procedure for Inspection of Welds
IS : 1182	Recommended Practice for Radiographic examination of Fusion – Welded Butt Joints in Steel Plates
IS : 1200	Method of Measurement in Building Civil Works
IS : 1477	Code of Practice for Painting of (Parts 1&2) Ferrous Metals in Buildings
IS : 2595	Code of Practice for Radiographic Testing
IS : 3658	Code of Practice for Liquid Penetrant Flaw Detection
IS : 5334	Code of Practice for Magnetic Particle Flaw Detection of Welds
IS : 9595	Recommendations for Metal Arc Welding of Carbon and Carbon Manganese Steel

4.2 Steel Materials

4.2.1 Steel materials shall comply with the referred to in Sub-Clause 4.1.

4.2.2 All materials used shall be new, unused and free from defects.

4.2.3 Steel conforming to IS:1977 shall be used only for the following :

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Fe310-0(St 32-0)	:	For general purposes such as door/window frames, grills, steel gates, handrails, fence posts, tee bars and other non-structural use.
Fe410-0(St 42-0)	:	For structures not subjected to dynamic loading other than wind loads such as :Platform roofs, foot over bridges, building, factory sheds etc.
Fe510-0(St 42-0)	:	Grade steel shall not be used If welding is to be employed for fabrication If site is in severe earthquake zone If plastic theory of design is used

4.2.4 Drawings prepared by the VENDOR/CONTRACTOR

4.2.4.1 The VENDOR/CONTRACTOR shall prepare all fabrication and erection drawings for the entire work. All the drawings for the entire work shall be prepared in metric units. The drawings shall preferably be of one standard size and the details shown there in shall be clear and legible.

4.2.4.2 All fabrication drawings shall be submitted to the EMPLOYER for approval.

4.2.4.3 No fabrication drawings will be accepted for EMPLOYER's approval unless checked and approved by the VENDOR/CONTRACTOR's qualified structural engineer and accompanied by an erection plan showing the location of all pieces detailed. The VENDOR/CONTRACTOR shall ensure that connections are detailed to obtain ease in erection of structures and in making field connections.

4.2.4.4 Fabrication shall be started by the VENDOR/CONTRACTOR only after EMPLOYER's approval of fabrication drawings. Approval by the EMPLOYER of any of the drawings shall not relieve the VENDOR/CONTRACTOR from the responsibility for correctness of engineering and design of connections, workmanship, fit of parts, details, material, errors or omissions or any and all work shown thereon. The EMPLOYER's approval shall constitute approval of the size of members, dimensions and general arrangement but shall not constitute approval of the connections between members and other details.

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4.2.4.5 The drawings prepared by the VENDOR/CONTRACTOR and all subsequent revisions etc. shall be at the cost of the VENDOR/CONTRACTOR for which no separate payment will be made.

4.3 Fabrication

4.3.1 General

4.3.1.1 All workmanship and finish shall be of the best quality and shall conform to the best approved method of fabrication. All materials shall be finished straight and shall be machined/ground smooth true and square where so specified. All holes and edges shall be free of burrs. Shearing and chipping shall be neatly and accurately done and all portions of work exposed to view shall be neatly finished. Unless otherwise approved by the EMPLOYER, reference may be made to relevant IS codes for providing standard fabrication tolerance. Material at the shops shall be kept clean and protected from weather.

4.3.2 Connections

4.3.2.1 Shop/field connections shall be as per approved fabrication drawings.

4.3.2.2 In case of bolted connections, taper washers or flat washers or spring washers shall be used with bolts as necessary. In case of high strength friction grip bolts, hardened washers be used under the nuts or the bolt heads whichever are turned to tighten the bolts. The length of the bolt shall be such that atleast one thread of the bolt projects beyond the nut, except in case of high strength friction grip bolts where this projection shall be at least three times the pitch of the thread.

4.3.2.3 In all cases where bearing is critical, the unthreaded portion of bolt shall bear on the members assembled. A washer of adequate thickness may be provided to exclude the threads from the bearing thickness, if a longer grip bolt has to be used for this purpose.

4.3.2.4 All connections and splices shall be designed for full strength of members or loads. Column splices shall be designed for the full tensile strength of the minimum cross section at the splice.

4.3.2.5 All bolts, nuts, washers, electrodes, screws etc., shall be supplied/brought to site 10% in excess of the requirement in each category and size. Rates shall cover the cost of this extra quantity.

4.3.2.6 All members likely to collect rain water shall have drain holes provided.

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4.3.3 Straightening

4.3.3.1 All materials, shall be straight and, if necessary, before being worked shall be straightened and/or flattened by pressure and shall be free from twists. Heating or forging shall not be resorted to without the prior approval of the EMPLOYER in writing.

4.3.4 Rolling and Forming

4.3.4.1 Plates, channels, R.S.J. etc., for circular bins, bunkers, hoppers, gantry girders, etc., shall be accurately laid off and rolled or formed to required profile/shape as called for on the drawings. Adjacent sections shall be match-marked to facilitate accurate assembly, welding and erection in the field.

4.3.5 High Strength Friction Grip Bolting

4.3.5.1 Inspection after tightening of bolts shall be carried out as stipulated in the appropriate standards depending upon the method of tightening and the type of bolt used.

4.3.6 Welding

4.3.6.1 Welding procedure shall be submitted to the EMPLOYER for approval. Welding shall be entrusted to qualified and experienced welders who shall be tested periodically and graded as per IS 817, IS : 7310 (Part 1) and IS : 7318 (Part 1).

4.3.6.2 While fabricating plated beams and built up members, all shop splices in each component part shall be made before such component part is welded to other parts of the members. Wherever weld reinforcement interferes with proper fit-up between components to be assembled off welding, these welds shall be ground flush prior to assembly.

4.3.6.3 Approval of the welding procedure by the EMPLOYER shall not relieve the Contractor of his responsibility for correct and sound welding without undue distortion in the finished structure.

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4.3.6.4 No welding shall be done when the surface of the members is wet nor during periods of high wind.

4.3.6.5 Each layer of a multiple layer weld except root and surfaces runs may be moderately penned with light blows from a blunt tool. Care shall be exercised to prevent scaling or flaking of weld and base metal from overpeening.

4.3.6.6 No welding shall be done on base metal at a temperature below –5 Deg.C. Base metal shall be preheated to the temperature as per relevant IS codes.

4.3.6.7 Electrodes other than low-hydrogen electrodes shall not be permitted for thicknesses of 32 mm and above.

4.3.6.8 All welds shall be inspected for flaws by any of the methods described under Sub-clause 4.6.3. The choice of the method adopted shall be agreed with the EMPLOYER.

4.3.6.9 The correction of defective welds shall be carried out in a manner approved by the EMPLOYER without damaging the parent metal. When a crack in the weld is removed, magnetic particle inspection or any other equally positive means approved by the EMPLOYER shall be used to ensure that the whole of the crack and material upto 25 mm beyond each end of the crack has been removed. The cost of all such tests and operations incidental to correction shall be borne by the Contractor.

4.4 Tolerances

4.4.1 The dimensional and weight tolerances for rolled shapes shall be in accordance with IS : 1852 for indigenous steel and equivalent applicable codes for imported steel. The tolerances for fabrication of structural steel shall be as per IS : 7215.

4.4.2 Cutting, punching, drilling, welding and fabrication tolerances shall be generally as per relevant IS codes.

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4.5 End Milling

4.5.1 Where compression joints are specified to be designed for bearing, the bearing surfaces shall be milled true and square to ensure proper bearing and alignment.

4.6 Inspection

4.6.1 General

4.6.1.1 The Contractor shall give due notice to the EMPLOYER in advance of the works being made ready for inspection. All rejected material shall be promptly removed from the shop and replaced with new material for the EMPLOYER's inspection. The fact that certain material has been accepted at the Contractor's shop shall not invalidate final rejection at site by the EMPLOYER if it fails to conform to the requirements of these specifications, to be in proper condition or has fabrication inaccuracies which prevent proper assembly nor shall it invalidate any claim which the Employer may make because of defective or unsatisfactory materials and/or workmanship.

4.6.1.2 No materials shall be painted or despatched to site without inspection and approval by the EMPLOYER unless such inspection is waived in writing by the EMPLOYER.

4.6.1.3 The Contractor shall provide all the testing and inspection services and facilities for shop work except where otherwise specified.

4.6.1.4 For fabrication work carried out in the field the same standard of supervision and quality control shall be maintained as in shop fabricated work. Inspection and testing shall be conducted in a manner satisfactory to the EMPLOYER.

4.6.1.5 Inspection and tests on structural steel members shall be as set forth below.

4.6.2 Material Testing

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4.6.2.1 If mill test reports are not available for any steel materials the same shall be tested by the Contractor to the Employer's Representative's satisfaction to demonstrate conformity with the relevant specification.

4.6.3 Tests on Welds

4.6.3.1 Magnetic Particle Test

Where welds are examined by magnetic particle testing, such testing shall be carried out in accordance with relevant IS codes. If heat treatment is performed, the completed weld shall be examined after the heat treatment. All defects shall be repaired and retested. Magnetic particle tests shall be carried out using alternating current. Direct current may be used with the permission of the EMPLOYER.

4.6.3.2 Liquid Penetrant Inspection

In the case of welds examined by Liquid Penetrant Inspection, such tests shall be carried out in accordance with relevant IS Code. All defects shown shall be repaired and rechecked.

4.6.3.3 Radiographic Inspection

All full strength butt welds shall be radiographed in accordance with the recommended practice for radiographic testing as per relevant IS code.

4.6.4 Dimensions, Workmanship & Cleanliness

4.6.4.1 Members shall be inspected at all stages of fabrication and assembly to verify that dimensions, tolerances, alignment, surface finish and painting are in accordance with the requirements shown in the Contractor's approved fabrication drawings.

4.6.5 Test Failure

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4.6.5.1 In the event of failure of any member to satisfy inspection or test requirement, the Contractor shall notify the EMPLOYER. The Contractor must obtain permission from the EMPLOYER before any repair `is undertaken. The quality control procedures to be followed to ensure satisfactory repair shall be subject to approval by the EMPLOYER.

4.6.5.2 The EMPLOYER has the right to specify additional testing as he deems necessary, and the additional cost of such testing shall be borne by the Employer, only in case of successful testing.

4.6.5.3 The Contractor shall maintain records of all inspection and testing which shall be made available to the EMPLOYER.

4.7 Shop Matching

4.7.1 For structures like bunkers, tanks, etc. shop assembly is essential. For other steel work, such as columns along with the tie beams/bracings may have to be shop assembled to ensure satisfactory fabrication, obtaining of adequate bearing areas etc., if so desired by the EMPLOYER. All these shop assemblies shall be carriedout by the Contractor.

4.8 Drilling Holes for other works

4.8.1 As a part of this Contract, holes in members required for installing equipment or steel furnished by other manufacturers or other contractors shall be drilled by the VENDOR/CONTRACTOR at no extra cost of the EMPLOYER. The information for such extra holes will be supplied by the EMPLOYER/EMPLOYER.

4.9 Marking of Members

4.9.1 After checking and inspection, all members shall be marked for identification during erection. This mark shall correspond to distinguishing marks on approved erection drawings and shall be legibly painted and stamped on it. The erection mark shall be stamped with a metal dye with figures at least 20 mm high and to such optimum depth as to be clearly visible.

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4.9.2 All erection marks shall be on the outer surface of all sections and near one end, but clear of bolt holes. The marking shall be so stamped that they are easily discernible when sorting out members. The stamped marking shall be encircled boldly by a distinguishable paint to facilitate easy location.

4.9.3 Erection marks on like pieces shall be in identical locations. Members having lengths of 7.0 m or more shall have the erection mark at both ends.

4.10 Errors

4.10.1 Any error in shop fabrication which prevents proper assembling and fitting up of parts in the field by moderate use of drift pins or moderate amount of reaming will be classified by the EMPLOYER as defective workmanship. Where the EMPLOYER rejects such material or defective workmanship, the same shall be replaced by materials and workmanship conforming to the Specifications by the Contractor, at no cost to the Employer.

Painting of Steel Works

All fabricated steel material, except those galvanised shall receive protective paint coating as specified in specification, which is described below.

Materials

4.11.1.1 Red-oxide – zinc chrome primer shall conform to IS:2074.

4.11.1.2 Synthetic enamel paint shall conform to IS : 2932.

4.11.1.3 Aluminium paint shall conform to IS:2339.

4.11.1.4 All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the EMPLOYER for the brand of manufacture and the colour/shade. All the materials shall be brought to the site in sealed containers.

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Workmanship

4.11.2.1 Painting work shall be carried out only on thoroughly dry surfaces. Painting shall be applied either by brushing or by spraying. Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer. The workmanship shall generally conform to the requirement of IS:1477 (Part 2).

4.11.2.2 The type of paint, number of costs etc. shall be as specified in the respective items of work.

4.11.2.3 Primer and finish paint shall be compatible with each other to avoid cracking and wrinkling. Primer and finish paint shall be from the same manufacturer.

4.11.2.4 All the surfaces shall be thoroughly cleaned of oil, grease, dirt, rust and scale. The methods to be adopted using solvents, wire brushing, power tool cleaning etc., shall be as per IS:1477 (Part – I) and as indicated in the item of work.

4.11.2.5 It is essential to ensure that immediately after preparation of the surfaces, the first coat of red oxide-zinc chrome primer shall be applied by brushing and working it well to ensure a continuous film without holidays. After the first coat becomes hard dry, a second coat of primer shall be applied by brushing to obtain a film free from 'holidays'.

4.11.2.6 After the second coat of primer is hard dry, the entire surface shall be wet rubbed cutting down to a smooth uniform surface. When the surface becomes dry, the undercoat of synthetic enamel paint of optimum thickness shall be applied by brushing with minimum of brush marks. The coat shall be allowed to hard-dry. The under coat shall then be wet rubbed cutting down to a smooth finish, taking adequate care to ensure that at no place the undercoat is completely removed. The surface shall then be allowed to dry.

4.11.2.7 The first finishing coat of paint shall be applied by brushing and allowed to hard-dry. The gloss from the entire surface shall then be gently removed and the surface dusted off. The second finishing coat shall then be applied by brushing.

4.11.2.8 Atleast 24 hours shall elapse between the application of successive coats. Each coat shall vary slightly in shade and this shall be got approved by the EMPLOYER.

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4.12 Acceptance of Steel, its Handling & Storage

4.12.1 The Contractor shall carefully check the steel to be erected at the time of acceptance. Any fabrication defects observed should be brought to the notice of the EMPLOYER.

4.12.2 No dragging of steel shall be permitted. All steel shall be stored 300mm above ground on suitable packing to avoid damage. It shall be stored in the order required for erection, with erection marks visible. All storage areas shall be prepared and maintained by the Contractor. Steel shall not be stored in the vicinity of areas where excavation or grading will be done and, if so stored temporarily, this shall be removed by the Contractor well before such excavation and/or grading commences to a safe distance to avoid burial under debris.

4.12.3 Scratched or abraded steel shall be given a coat of primer in accordance with the Specifications for protection after unloading and handling prior to erection. All milled and machined surfaces shall be properly protected from rust/corrosion by suit able coating and also from damage.

4.13 Anchor Bolts & Foundations

4.13.1 The Contractor shall carefully check the location and layout of anchor bolts embedded in foundations constructed, to ensure that the structures can be properly erected as shown on the drawings. Any discrepancy in the anchor bolts/foundation shall be reported to the EMPLOYER.

4.13.2 Leveling of column bases to the required elevation may be done either by providing shims or three nuts on the upper threaded portion of the anchor bolt. All shim stock required for keeping the specified thickness of grout and in connection with erection of structures on foundations, crane brackets or at any other locations shall be of good M.S. plates and shall be supplied by the Contractor at his cost.

4.13.3 A certain amount of cleaning of foundations and preparing the area is considered normal and shall be carried out by the Contractor at no extra cost.

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4.13.4 Where beams bear in pockets or on walls, bearing plates shall be set and levelled as part of the work. All grouting under column base plates or beam bearing plates will be carried out by the Contractor.

4.14 Assembly & connections

4.14.1 Field connections may be effected either by riveting, bolting, welding or by use of high strength friction grip bolts as shown on the design and erection drawings.

4.14.2 All field connection work shall be carried as per the drawings. All bolts, nuts, washers, rivets, electrodes required for field connections shall be supplied by the Contractor free of cost.

4.14.3 All assembling shall be carried on a level platform.

4.14.4 Drifts shall be used only for drawing the work to proper position and must not be used to such an extent as to damage the holes. Size of drifts larger than the normal diameter of hole shall not be used. Any damaged holes or burrs must be rectified to the satisfaction of the EMPLOYER.

4.14.5 Corrections of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets shall be considered as a part of erection. Any error in the shop, which prevents proper fit on a moderate amount of reaming and slight chipping or cutting, shall be immediately reported to the EMPLOYER.

4.15 Erection

4.15.1 All structural steel shall be erected as shown on the drawings prepared by the Contractor. Proper size steel cable slings, etc., shall be used for hoisting. Guys shall not be anchored to existing structures, foundations, etc., unless so permitted by the EMPLOYER in writing. Care shall be taken to see that ropes in use are always in good condition.

4.15.2 Steel columns in the basement, if any, are to be lowered and erected carefully with the help of a crane and/or derrick without damaging the basement walls or floor.

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4.15.3 Structural steel frames shall be erected plumb and true. Frames shall be lifted at points such that they are not liable to buckle and deform. Trusses shall be lifted only at node points. In the case of trusses, roof girders, all of the purlins and wind bracing shall be placed simultaneously and the columns shall be erected truly plumb on screed bars over the pedestals. All steel columns and beams shall be checked for plumb and level individually before and after connections are made. Temporary bracings shall be introduced wherever necessary to take care of all loads to which the structure may be subjected, including erection equipment and the operation thereof. Such bracings shall be left in place as long as may be required for safety and stability.

4.15.4 Chequered plates shall be fixed to supporting members by tack welding or by countersunk bolts as shown/specified in relevant drawings and/or as approved by the EMPLOYER. The edges shall be made smooth and no burrs or jagged ends shall be left. While splicing, care should be taken so that there is continuity in pattern between the two portions. Care should also be taken to avoid distortion of the plate while welding. The erection of chequered plates shall include :

Welding of stiffening angles/vertical stiffening ribs

Cutting to size and making holes to required shape wherever necessary to allow service piping and/or cables to pass through

Splicing as shown in relevant drawings

Smoothening of edges

Fixing of chequered plates by tack welding or by countersunk bolts

Providing lifting hooks for ease of lifting.

4.15.5 As erection progresses, the work shall be securely bolted to take care of all dead load, wind, seismic and erection stresses.

4.15.6 No riveting or welding or final bolting shall be done until the structure has been properly aligned and approved by the EMPLOYER. No cutting, heating or enlarging of the holes shall be carried out without the prior written approval of the EMPLOYER.

4.15.7 Test certificates shall be furnished by the Contractor.

4.16 Inspection

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4.16.1 The EMPLOYER shall have free access to all parts of the job during erection and all erection shall be subjected to his approval. In case of faulty erection, all dismantling and re-erection required will be at the Contractor's cost. No paint shall be applied to rivet heads or field welds or bolts until these have been approved by the EMPLOYER.

4.17 Tolerances

4.17.1 General

Tolerances mentioned below shall be achieved after the entire structure or part thereof is in line, level and plumb.

4.17.2 Columns

Deviation of column axes at foundation top level with respect to true axes :

(a) In longitudinal direction ±5 mm

(b) In lateral direction ±5 mm

Deviation in the level of bearing surface of columns at foundation top with respect to true level ±5 mm

Out of plumbness (verticality) of column axis from true vertical axis, as measured at column top :

(a) For columns upto and including 15 metres in height ±1/1000 of column height in mm or ±15 mm whichever is less

(b) For columns exceeding 15 metres in height ±1/1000 of column height in mm or ±20 mm whichever is less

Deviation in straightness in longitudinal and transverse planes of column at any point along the height ±1/1000 of column height in mm or ±10 mm whichever is less

Difference in erected position of adjacent ±10mm

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pairs of columns along length or across

width of building prior to connecting

trusses/beams with respect to true distance

Deviation in any bearing or seating level ±5 mm

with respect to true level

Deviation in differences in bearing level ±10 mm

of a member on adjacent pair of columns

both across and along the building

4.17.3 Trusses And Beams

Shift at the centre of span of top chord member with respect to the vertical plane passing through the centre of bottom chord	±1/250 of height of truss in mm or ±15 mm whichever is less
Lateral shift of top chord of truss at the centre of span from the vertical plane passing through the centre of supports of the truss	±1/1500 of span of truss in mm or ±15 mm whichever is less
Lateral shift in location of truss from its true vertical position	±10 mm
Lateral shift in location of purlin true position	±5 mm
Deviation in difference of bearing levels of trusses or beams from the true difference	i) ±20 mm for trusses ii) For beams : Depth < 1800mm : ±6mm Depth > 1800mm : ±10mm

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Deviation in sag in chords and diagonals of truss between node points	1/1500 of length in mm or 10mm whichever is smaller
Deviation in sweep of trusses, beams etc. in the horizontal plane	1/1000 of span in mm subject to a maximum of 10 mm

4.17.4 Crane Girders & Rails

Shift in the centre line of crane rail with respect to centre line of web of crane girder	±5 mm
Shift in plan of alignment of crane rail with respect to true axis of crane rail at any point	±5 mm
Difference in alignment of crane rail in plan measured between any two points 2 metres apart along rail	±1 mm

Deviation in crane track with respect to Time gauge

(a)	For track gauges upto and Including 15 metres	±5 mm
(b)	For track gauges more than 15 metres	± [5 + 0.25 (S-15)] where S in metres is true gauge

Deviation in the crane rail level at any point from true level	±1/1200 of the gauge distance or ±10mm whichever is less
Difference in the crane rail actual levels between any two points 2 metres apart	±2 mm

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along the rail length

Difference in levels between crane track Rails at

(a)	Supports of crane girders	±15 mm
(b)	Mid span of crane girders	± 20 mm
Relative shift of crane rail surfaces at a joint in plane and elevation		2 mm subject to grinding of surfaces for smooth transition
Relative shift in the location of crane stops (end buffers) along the crane tracks with track gauge S in mm		1/1000 of track gauge S in mm subject to maximum of 20 mm

4.17.5 Painting

After steel has been erected, all bare and abraded spots, rivet heads, field welds, bolt heads and nuts shall be spot painted with primer. Before paint is applied, the surface shall be dry and free from dust, dirt, scale and grease. All surfaces inaccessible after erection shall receive two coats of the approved paint before erection.

4.18 Clean up of Work site

During erection, the Contractor shall at all times keep the working and storage areas used by him free from accumulation of waste materials or rubbish. Before completion of erection, he shall remove or dispose of in a satisfactory manner all temporary structures, waste and debris and leave the premises in a condition satisfactory to the EMPLOYER.

5.0 PLUMBING WORKS FOR WATER SUPPLY AND SANITARY ARRANGEMENTS

5.1 Applicable Codes

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5.1.1 The following standards and codes are made a part of this Employer's Requirement. All standards, codes of practice referred to herein shall be the latest editions including all official amendments and revisions.

IS : 210	:	Specification for grey iron castings
IS : 269	:	Specification for ordinary and low heat 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 bars and hard drawn steel wire for concrete reinforcement
IS : 456	:	Code of Practice for plain and reinforced concrete
IS : 458	:	Concrete Pipes (with and without reinforcement).
IS : 516	:	Methods of tests for strength of concrete
IS : 554	:	Dimensions for pipe threads where pressure tight joints are required on the threads.
IS : 651	:	Salt glazed stoneware pipes and fittings.
IS : 774	:	Flushing Cisterns for water closets and urinals (valveless siphonic type)
IS : 775	:	Cast iron brackets and supports for wash basins and sinks.
IS : 781	:	Sand-cast brass screw-down bib taps and stop taps for water services.
IS : 783	:	Code of practice for laying of concrete pipes.
IS : 1068	:	Electroplated coatings of nickel and chromium of iron and steel.
IS : 1077	:	Specification for common burnt clay building bricks
IS : 1786	:	Specification for high strength deformed steel bars and wires for concrete reinforcement
IS : 1239	:	Mild steel tubes (Part I) and mild steel tubulars and other wrought steel pipe fittings (Part II)
IS : 1536	:	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
IS : 1626	:	Asbestos cement building pipes, gutters and fittings (spigot and socket types).
IS : 1703	:	Copper Alloy float valves (horizontal plunger type) for water supply purposes.

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IS : 1726	:	Cast iron manhole covers and frames.
IS : 1729	:	Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 1742	:	Code of practice for buildings drainage
IS : 2116	:	Specification for sand for masonry mortars
IS : 2212	:	Code of practice for brickwork
IS : 2250	:	Code of practice for preparation and use of masonry mortars
IS : 2326	:	Automatic flushing cisterns for urinals
IS : 2470	:	Code of practice for design and construction of septic tanks (Parts I & II)
IS : 2556	:	Vitreous sanitary appliances (Part I to Part XV)
IS : 2963	:	Specification for copper alloy waste fittings for wash basins and sinks
IS : 3006	:	Specification for chemically resistant glazed stoneware pipes and fittings
IS : 3311	:	Waste plug and its accessories for sinks and wash basins
IS : 5455	:	Specification for cast iron steps for manholes
IS : 4127	:	Code of Practice for laying of glazed stoneware pipes
IS : 3495	:	Methods of tests of burnt clay building bricks
IS : 4111	:	Code of practice for ancillary structures in sewerage system manholes
IS : 5382	:	Specification for rubber sealing rings for gas mains, water mains and sewers
IS : 5329	:	Code of practice for sanitary pipe work above ground for buildings
IS : 5434	:	Non-ferrous alloy bottle traps for marine use

5.2 Sanitary Installation

5.2.1 The work shall be carried out complying in all respects with any specific requirements of the local body in whose jurisdiction the work is situated, and as approved by the Employer's Representative.

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5.2.2 Any damage caused to the building, or to installations therein, either due to negligence on the part of the Contractor, or due to actual requirements of the work, shall be made good and the building or the installation shall be restored to its original condition by the Contractor.

5.2.3 All sanitary and plumbing work shall be carried out by licensed plumbers.

5.2.4 All sanitary appliances including sanitary fittings, fixtures, toilet requisites shall be of size, and design as approved by the Employer's Representative.

5.2.5 All white glazed porcelain fixtures, such as wash basin, sink drain board, water closet pan, urinal, `P' trap etc. shall have hard durable white glazed finish. They shall be free from cracks and other glazing defects. No chipped porcelain fixtures shall be used.

5.2.6 Joints between iron and earthenware pipes shall be made perfectly air and water tight by caulking with neat cement mortar.

5.3 Indian Type Water Closet

5.3.1 This shall be the long pan pattern with separate footrests made of white glazed earthenware, white glazed vitreous china or of white glazed fire clay. The general requirements shall conform to IS:2556 (Parts III and X). Each pan shall have an integral flushing rim of suitable type. It shall also have an inlet or supply horn for connecting the flush type. The flushing rim and inlet shall be of the self draining type. It shall have a weephole at the flushing inlet to the pan. The flushing inlet shall be in the front, unless otherwise approved by the Employer's Representative. The inside of the bottom of pan shall have sufficient slope from the front towards the outlet and the surface shall be uniform and smooth enable easy and quick disposal while flushing. The exterior surface shall be unglazed and sufficiently rough or grooved at right angles to the axis of the outlet. Pans shall be provided with a trap `P' or `S' type with a minimum 50 mm water seal and 50 mm dia. vent horn. Pan shall be laid at the correct location and level over a bed of lime concrete using brick aggregates (1 part lime mortar to 2 parts brick bats with lime mortar to 2 parts of sand) or cement-sand admixture as specified in the drawings.

5.4 European Type Water Closet

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5.4.1 Water closets shall be either of white glazed earthenware, white grazed vitreous china or white glazed fire clay as specified and shall be of "Siphonic Wash down type" conforming to IS.2556 (Part VIII). The closets shall be of one piece construction with approved plastic/bakelite seat and cover. Each water closet shall have 4 fixing holes having a minimum diameter of 6.5 mm for fixing to floor and shall have an integral flushing rim of suitable type. It shall also have an inlet of supply horn for connecting the flush pipe. The flushing rim and inlet shall be of the self-draining type. The water closet shall have a weephole at the flushing inlet. Each water closet shall have an integral trap with either "S" or "P" outlet with at least 50 mm water seal. The water closets shall have an antisiphonage 50 mm dia. vent horn on the outlet side of the trap. The inside of water closets and traps shall be uniform and smooth in order to ensure in efficient flush. The serrated part of the outlet shall not be glazed externally. The water closet when sealed at the bottom of the trap in line with the back plate, shall be capable of holding not less than 10 litres of water between the normal water level and the highest possible water level of the water closet installed.

5.5 Urinals

5.5.1 Urinals shall be of the bowl pattern, either flat back or angle back type lipped in front. They shall be of white glazed earthenware, white glazed vitreous china or white glazed fire clay, and of size as specified conforming to IS.2556 (Part VI). The urinals shall be of one piece construction. Each urinal shall be provided with not less than two fixings holes of a minimum dia. of 6.5 mm on each side. Each urinal shall have an integral flushing box rim of suitable type and inlet or supply horn for connecting the flush pipe. The flushing rim and inlet shall be of the self-draining type. It shall have a weephole at the flushing inlet of the urinal. At the bottom of the urinal, an outlet horn for connecting to an outlet pipe shall be provided. The exterior of the outlet horn shall not be glazed and the surface shall be provided with grooves at right angles to the axis of the outlet to facilitate fixing to the uniform and smooth throughout to ensure efficient flushing. The bottom of pan shall have sufficient slope from the front, towards the outlet such that there is efficient draining of the urinal. The waste fittings shall be chromium plated.

5.6 Wash Basins

5.6.1 Wash basins shall be of white glazed earthenware, white glazed vitreous china or white glazed fire clay as approved by the Employer’s Representative and conforming to IS.2556

Type	Size
Flat Back	630 x 450 mm

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Flat Back 550 x 400 mm

5.6.2 Wash basins shall be of one piece construction, including a combined overflow. All internal angles shall be designed so as to facilitate cleaning. Each shall have a rim sloping inside towards the bowl on all sides except skirting at the back. Basins shall be provided with single or double tap holes as approved. The tap holes shall be square. A suitable tap hole button shall be supplied if one tap hole is not required in installation. Each basin shall have a circular waste hole to which the interior of basin shall drain. The waste hole shall be either rebated or bevelled internally with diameter of 65 mm at top and a depth of 10 mm to suit a waste plug having 64 mm diameter. Each basin shall be provided with a non-ferrous 32 mm waste fittings. Stud slots to receive the brackets on the under side of the wash basins shall be suitable for a bracket with stud not exceeding 13 mm diameter, 5 mm high and 305 mm from the back of basin to the centre of the stud. The stud slots shall be of depth sufficient to take 5 mm stud. Every basin shall have an integral soap holder recess or recesses which shall fully drain into the bowl. The position of the chain stay-hole shall not be lower than the overflow slot. A slot type of overflow having an area of not less than 5 sq.cm. shall be provided and shall be so designed as to facilitate cleaning of the overflow. The Employer's Requirements for waste plug, chain and stay shall be the same as given for sinks.

5.6.3.1 All the waste fittings shall be chromium plated. Bottle trap shall conform to IS. 5434. The chromium plating shall be of service grade No. 2 conforming to IS.1068.

5.7 Sinks

5.7.1 The sinks shall be of white glazed earthenware, white glazed vitreous china or white glazed fire clay as approved by the Employer's Representative conforming to IS.2556 (Part V) and shall be of the following sizes:

450 x 300 x 150 mm

600 x 450 x 200 mm

5.7.2 They shall be of one piece construction, including a combined overflow. The floor of the sink shall gently slope towards the outlet. The outlet shall in all cases be suitable for waste fittings having flange of 64 mm diameter and the waste hole shall have a minimum diameter of 65 mm at the bottom to suit the waste fittings. The waste hole shall be either rebated or bevelled having a depth of 10 mm. Each sink shall be provided with a non-ferrous 40 mm dia. waste fitting. The sink shall have overflow of the weir type and the inverts shall be 30 mm below the top edge. Each sink shall be provided with a waste plug, of suitable dia. chain and stay. The plug shall be of rubber or other equally suitable material and shall be water tight when fitted. Plug chains shall be of brass wire chromium plated. It shall have an overall length from the collar to the stay of not less than 300 mm. There shall be a triangular or D shackle at each end, one of which shall be brazed to the plug and the other securely fixed to the stay. The 150 mm long shank of the waste shall be threaded conforming to the

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requirements of IS.2556 for sinks only. The waste fittings and plug fittings shall be chromium plated. The chromium plating shall be of service grade No.2 conforming to IS.1068.

5.8 Flushing Cisterns

5.8.1 The flushing cisterns shall be automatic or manually operated, high level or low level, as approved by the Employer's Representative. For water closets and urinals high level cistern is intended to operate with minimum height of 125 cm and a low level cistern a maximum height of 30 cm between the top of the pan and the underside of the cistern. They shall be of cast iron, glazed earthenware, or pressed steel complying iron, glazed requirement of IS.774. Automatic flushing cistern for urinals shall conform to IS.2326.

5.9 Cast Iron Soil Waste and Vent Pipes and Fittings

5.9.1 All cast iron pipes and fittings shall be of uniform thickness with strong and deep sockets, free from flaws, air holes, cracks, sand holes and other defects and conform to IS.1536 . The diameter approved shall be internal diameter of pipe. The pipes and fittings shall be true to shape, smooth and cylindrical and shall ring clearly when struck over with a light hand hammer. All pipes and fittings shall be properly cleaned of all foreign material before being fixed.

5.9.2 All plug bends of drainage pipes shall be provided with inspection and cleaning caps, covers, which shall be fixed with nuts and screws. Pipes shall be fixed to the wall by W.I. or M.S. holder bat clamps, unless projecting ears with fixing holes are provided at socket end of pipe. The pipes shall be installed, truly vertical or to the lines and slopes as indicated. The clamps shall be fixed to the walls by embedding their hooks in cement concrete blocks (1:2:4) 10 cm x 10 cm making necessary holes in the walls at proper places. All holes and breakages shall be made good. The clamps shall be kept 25 mm clear of the finished face of the walls to facilitate cleaning and painting of pipes.

5.9.3 The annular space between the socket and spigot shall be filled with a gasket of hemp or spun yarn soaked in neat cement slurry. The joint shall then be filled with stiff cement mortar 1:2 (1 cement : 2 fine sand) well pressed with caulking tool and finished smooth on top at an angle of 45°. The joint shall be kept wet for not less then 7 days by tying a piece of gunny bag kept moist. Joints shall be perfectly air tight as well as water tight.

5.9.4 C.I. pipes and fittings which are exposed shall be first cleaned and then painted with a coat of red leadprimer. Two coats of zinc paint with white base and mixed with pigment of required colour to get the approved shade shall be given over the base primer coat.

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5.9.5 The thickness of fittings and their socket and spigot dimensions shall conform to the thickness and dimensions approved for the corresponding sizes of straight pipes.

5.9.6 The connection between the main pipe and branch pipes shall be made by using branches and bends with access for cleaning. Floor traps shall be provided with 25 mm dia. puff pipe where the length of the waste is more than 1800 mm or the floor trap is connected to a waste stack through bends.

5.9.7 All cast iron pipes and fittings including joints shall be tested by a smoke test to the satisfaction of the Employer's Representative and left in working condition after completion. The smoke test shall be carried out as stated under :

5.9.8 Smoke shall be pumped into the pipe at the lowest and from a smoke machine which consists of a bellow and a burner. The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detectable by sight as well as by smell if there is a leak at any point of the pipeline.

5.9.9 Water test and air test shall be conducted as stipulated in IS.5329.

5.10 Galvanised Mild Steel (G.I) Pipes

5.10.1 The pipes shall be galvanised mild steel welded pipes and seamless screwed and sockets tubes conforming to the requirements of IS.1239, for medium grade. They shall be of the diameter (nominal bore) approved. The sockets shall be designated by the respective nominal bores of the pipes for which they are intended. The pipes and sockets shall be finished neatly, well galvanised on both inner and outer surfaces, and shall be free from cracks, surface flaws, laminations and other defects. All screws, threads shall be clean and well cut. The ends shall be cut cleanly and square with the axis of the tube.

5.10.2 All screwed tubes and sockets shall have pipe threads conforming to the requirements of IS.554. Screwed tubes shall have taper threads while the sockets shall have parallel threads.

5.10.3 The fittings shall be of malleable cast iron or mild steel tubes complying with all the appropriate requirements as approved for pipes. The fittings shall be designated by the respective nominal bores of the pipes for which they are intended. The fittings shall have screw threads at the ends conforming to the requirments of

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IS.554. Female threads on fittings shall be parallel and male threads (except on running nipples and collars of unions) shall be tapered.

5.10.4 The pipes and fittings shall be inspected at site before use to ascertain that they conform to the specification. The defective pipes shall be rejected. Where the pipes have to be cut or rethreaded, the ends shall be carefully filled out so that no obstruction to bore is offered. The ends of the pipes shall then be threaded conforming to the requirements of IS.554 with pipe dies and taps carefully in such a manner as will not result in slackness of joints when the two pieces are screwed together. The taps and dies shall be used only for straightening bent and damaged screw threads and shall not be used for turning of the threads so as the make them slack, water tight joint. The screw- thread of pipes and fittings shall be protected from damage until they are fitted.

5.10.5 The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of spun yarn wrapped around the screwed end of the pipe. The end shall then be screwed in the socket, tee, etc., with the pipe wrench. Care should be taken that all pipes and fittings are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during fixing. Burrs from the joint shall be removed after screwing. After laying, the open ends of the pipes shall be temporarily plugged to prevent access of soil or any other foreign matter.

5.10.6 Any threads exposed after jointing shall be painted or in the case of underground piping thickly coated with approved anticorrosive paint to prevent corrosion.

5.10.7 For internal work the galvanised iron pipes and fittings shall run on the surface of the walls or ceiling (not in chase) unless otherwise specified. The fixing shall be done by means of standard pattern holder bat clamps, keeping the pipes about 1.5 cm clear of the wall. Pipes and fittings shall be fixed truly vertical/horizontal. When it is found necessary to conceal the pipes, chasing may be adopted or pipes fixed in the ducts of recesses etc. provided there is sufficient space to work on the pipes with the usual tools. The pipes shall not ordinarily be buried in walls or solid floors. Where unavoidable, pipes may be buried for short distances provided adequate protection is given against damage, but the joints in pipes shall not be buried. M.S. pipe sleeve shall be fixed at a place where a pipe is passing through a wall or floor for reception of the pipe and to allow freedom for expansion/contraction and other movements/maintenance. In case the pipe is embedded in walls or floors it should be painted with anti-corrosive bitumastic paint of approved quality. The pipe should not come in contract with lime mortar or lime concrete as the pipe is affected by lime. Under the floors the pipes shall be laid in layer of sand filling or as approved by the Employer's Representative.

5.10.8 G.I. pipes with socket and spigot ends shall be provided with lead caulked joints wherever specified and the joints shall conform to the requirements of IS.3114.

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5.10.9 The work of excavation and backfilling shall be done true to line and gradient in accordance with general Employer's Requirements for earthworks in trenches for pipes laid underground.

5.10.10 The pipes shall be laid on a layer of 10.0 cm sand and filled upto 15 cm above the pipes. A sand cushion of 15cm on either side of the pipe shall also be provided. The remaining portion of the trench shall then be filled with excavated earth. The surplus earth shall be got rid of as directed. when excavation is done in rock the bottom shall be cut deep enough to permit the pipes to be laid on a cushion of sand 75 mm minimum.

5.10.11 The pipes and fittings after they are laid and jointed shall be subjected to hydrostatic pressure test as approved by the Employer's Representative and shall satisfactorily pass the test. Pipe line system shall be tested in sections as the work proceeds, keeping the joints exposed for inspection. Pipes shall be slowly and carefully charged with water allowing all air to escape. All draw off taps shall then be closed and water pressure gradually raised to test pressure. Care shall be taken to ensure that pressure gauge is accurate and preferably should have been recalibrated before the test. Pump used having been stopped, the section of the pipeline shall maintain the test pressure for at least half an hour. Any joints or pipes found leaking shall be removed and replaced by the Contractor.

5.10.12 The G.I. pipe line shall be cut to the required length at the position where the meter and stop cock are required to be fixed. The ends of the pipes shall be threaded. The meter and stop cock shall be fixed in position by means of connecting pipe, G.I. nuts, sockets, etc. The stop cock shall be fixed near the inlet of the water meter. The paper disc inserted in the ripples of the meter shall be removed and meter installed exactly horizontally or vertically and with the arrow cast on the body of the meter pointing in the direction of flow. Care shall be taken that the factory seal of the meter is not disturbed. Whenever the meter is to be fixed to a newly fitted pipe line, the pipe line will have to be completely washed before fixing the meter. For this purpose, a connecting piece of pipe equal to the length of the meter is to be fixed on the new pipe line. The water shall be allowed to flow completely to wash the pipe line and then the meter installed as described above by replacing the connecting piece.

5.11 Stoneware Pipes and Fittings

5.11.1 All pipes with spigot and socket ends shall conform to IS.651/3006 and shall be of grade `A'. These shall be sound, free from visible defects such as fine cracks or hair cracks. The glaze of the pipes shall be free from crazing. The pipes shall give a sharp clear note when struck with a light hammer.

5.11.2 The following information shall be clearly marked on each pipe and fitting :

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(a) Internal diameter;

(b) Grade;

(c) Date of manufacture;

(d) Name of manufacturer or his registered trade-mark or both.

All pipes and fittings shall have ISI mark.

5.11.3 Jointing of GSW pipes and fittings shall be done as per the requirements of the following Employer's Requirements and the relevant IS. After jointing, extraneous material if any, shall be removed from the inside of the pipes and fittings and the newly made joints shall be thoroughly cured. In case, rubber sealing rings are used for jointing, these shall conform to IS : 5382.

5.11.4 Spigot and Socket Joint (Cement Joint)

5.11.4.1 The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. In each joint, spun yarn soaked in neat cement slurry or tarred gasket shall be passed around the joint and inserted in it by means of a caulking tool. More skeins of yarn or gasket shall be added if necessary and shall be well caulked. Yarn or gasket so rammed shall not occupy more than one- fourth of the depth or socket.

5.11.4.2 Cement mortar (1:1) shall be slightly moistened and carefully inserted by hand into the remaining space of the joint after caulking of yarn or gasket. The mortar shall than be caulked into the joint with a caulking tool. More cement mortar shall be added until the space of joint has been completely filled with tightly caulked mortar. The joint shall then be finished of neatly outside the socket at an angle of 45 degrees.

5.11.4.3 The cement mortar joints shall be cured at least for seven days before testing.

5.11.4.4 The approximate quantity of cement required for each joint for certain common sizes of pipes are give below for guidance :

Nominal diameter of pipe (mm)	Cement (kg)
150	1.5

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200	2.0
250	2.5
300	3.25
350	4.5
400	5.5
450	6.5

5.11.5 Spigot and Socket Joint (Bituminous Joint)

5.11.5.1 The general requirements for this type of joint shall be as specified in 5.12.1 The material for jointing shall consist of composition of asphalt and sand in the ratio of 1:7. Asphalt and sand shall be boiled together and filled into the socket in a molten state with the aid of special moulds.

5.11.6 Spigot and Socket Joint (Rubber Ring Joint)

5.11.6.1 The pipe with the rubber ring accurately positioned on the spigot shall be pushed well home into the socket of the previously laid pipe by means of uniformly applied pressure with the aid of a jack or similar appliance. The rubber rings conforming to IS : 5382 shall be used, and the manufacturer's instructions shall be deemed to form a part of this Employer’s Requirements. The rubber rings shall be lubricated before making the joint and the lubricant shall be soft soap water or an approved lubricant supplied by the manufacturer.

5.11.7 Cleaning of Pipes

5.11.7.1 As soon as a stretch of GSW pipes has been laid complete from manhole to manhole or for a length as approved by the Employer’s Representative, the Contractor shall run through the pipes both backward and forward a double disc or solid or closed cylinder 50 mm less in diameter than the internal diameter of pipes. The open end of an incomplete stretch of pipeline shall be securely closed as approved by the Employer’s Representative to prevent entry of mud or silt etc.

5.11.7.2 If as a result of the removal of any obstruction the Employer’s Representative considers that damages may have been caused to the pipe lines, he shall be entitled to order the length to be tested immediately. Should such test prove unsatisfactory the Contractor shall repair the pipeline and carry out such further tests as are required by the Employer’s Representative.

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5.11.7.3 It shall also be ascertained by the Contractor that each length from manhole to manhole or the length as approved by the Employer's Representative is absolutely clear and without any obstruction by means of visual examination of the interior of the pipeline suitably illuminated by projected sunlight or otherwise.

5.11.7.4 After laying and jointing of GSW pipes is completed the pipe line shall be tested as per the following Employer's Requirements and as approved by the Employer's Representative. All equipment for testing at work site shall be supplied and erected by the Contractor. Water for testing of pipeline shall be arranged by him. Damage during testing shall be the Contractor's responsibility and shall be rectified by him to the full satisfaction of the Employer's Representative. Water used for test shall be removed from pipes and not released to the excavated trenches.

5.11.7.5 After the joints have thoroughly set and have been checked by the Employer's Representative and before backfilling the trenches, the entire section of the sewer or storm water drain shall be proved by the Contractor to be water tight. Before commencing the hydraulic test, the pipelines shall be filled with water and maintained full for 24 hours by adding water, if necessary, under a head of 0.6 m of water. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system with water. A knuckle bend shall be temporarily jointed at the top end and a sufficient length of vertical pipe jointed to it so as to provide the required test head; or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation. The pipeline shall be subjected to a test pressure of at least 2.5 m head of water at the highest point of the section under test. The tolerance of two litres per centimeter of diameter per kilometer may be allowed during a period of 10 minutes. Any leakage including excessive sweating which causes a drop in the test water level will be visible and the defective part of the work should be removed and made good.

5.11.7.6 If any damage is caused to the pipeline during the execution of work or while cleaning/testing the pipeline as specified. The Contractor shall be held responsible for the same and shall replace the damaged pipeline and re-test the same to the full satisfaction of the Employer's Representative.

5.11.7.7 Water for testing of pipeline shall be arranged by the Contractor.

Stop Cock and Bib Cock

5.12.1 A bibcock (bibtap) is a draw off tap with a horizontal inlet and free outlet and stopcock (stop tap) is a valve with a suitable means of connections for insertion in a pipe line for controlling or stopping the flow. They shall be of specified size and shall be of the screw down type. The closing device should work by means of a dis

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carrying a renewable non-metallic washer, which shuts against water pressure on a seating at right angles to the axis of the threaded spindle which operates it. The handle shall be either crutch or butterfly type securely fixed to the spindle. The cocks shall open in anti-clockwise direction. When the bib cocks and stop cocks are required to be chromium plated, the chromium plating shall be of service Grade No. 2 conforming to IS.1068. in finish and appearance, the plated articles shall be free from plating defects such as blisters, pits, roughness and shall not be stained or discoloured.

5.12.2 These fittings shall be of brass heavy class, chromium plated (C.P) and of approved manufacture and pattern with screwed of flanged ends as specified. The fittings shall in all respects comply with the requirements of IS.781. The standard size of brass fittings shall be designated by the nominal bore of the pipe to which the fittings are attached. A sample of each kind of fitting shall be approved by the Employer's Representative and all supplies made according to the approved samples.

5.12.3 All cast fittings shall be sound and free from laps, blow holes and fittings, both internal and external surfaces shall be clean, smooth and free from sand etc. Burning, plugging stopping or patching of the casting shall not be permitted. The bodies, bonnets, spindles and other parts shall be truly machined and when assembled the parts shall be axial, parallel and cylindrical with surfaces smoothly finished. The area of the waterway of the fittings shall not be less than the area of the nominal bore.

5.12.4 The fittings shall be fully examined and cleared of all foreign matter before being fixed. The fittings shall be fitted in the pipe line in a workman like manner. The joints between fittings and pipes shall be made leak-proof. The joints and fittings shall be leak proof when subjected to a pressure test approved by the Employer's Representative and the defective fittings and joints shall be replaced or redone.

Soak Pit

5.13.1 Soak pit shall be constructed at the location specified by the Employer's Representative. Earthwork excavation shall be carried out to the exact dimensions. Brick masonry lining with open joints shall be constructed in the pit upto 150 mm below the outlet pipeline. Brick masonry in cement mortar 1:6 shall be constructed above this level upto ground. Well burnt brick aggregates of nominal size 40 mm to 80 mm and coarse sand shall be filled within the chamber. Construction of pit lining and filling of the brick ballast shall progress simultaneously.

Manholes

Location

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Manholes shall be constructed at places approved by the Employer's Representative.

Excavation

Excavation, shoring, dewatering etc. for the pits of manholes, laying of pipes and fittings/specials shall be done in accordance with Employer's Requirements described elsewhere in the document.

5.14.3 Bed Concrete

The bed concrete for manholes shall be done in accordance with Employer's Requirements described elsewhere in the document.

5.14.4 Bricks

5.14.4.1 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 red, 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. Bricks containing ungrounded particles and/or which absorb water more than 1/6th of their weight when soaked in water for twenty-four hours shall be rejected. Overburnt or underburnt bricks shall be liable to rejection. The bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 50 kg/sq.cm. unless otherwise noted in drawings. The class and quality requirements of bricks shall be as laid down in IS : 1077.

5.14.4.2 The size of the brick shall be 23.0 x 11.5 x 7.5 cm. unless otherwise specified; but tolerance upto ± 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 Employer's Representative to make up required wall length or for bonding. Sample bricks shall be submitted to the Employer's Representative for approval and bricks supplied shall conform to approved samples. If required by the Employer's Representative, brick sample shall be tested as per IS : 3495 by Contractor. Bricks rejected by the Employer's Representative shall be removed from the Site within 24 hours.

5.14.5 Cement Mortar

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5.14.5.1 Mortar for brick masonry shall be prepared as per IS : 2250. Manholes shall be constructed in brick masonry with cement mortar (1:2) unless otherwise specified. 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, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be as approved by the Employer's Representative. If required by the Employer's Representative sand shall be thoroughly washed till it is free of any contamination.

5.14.5.2 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.

5.14.5.3 The Contractor shall arrange for tests on mortar samples if so required by Employer's Representative. Retempering of mortar shall not be permitted.

5.14.6 Brick Masonry

5.14.6.1 All bricks shall be thoroughly soaked in clean water for atleast one hour immediately before being laid. The cement mortar for brick masonry work of manholes shall be in the proportion specified in 5.14.5. Brick work 230 mm thick and over shall be laid in English Bond unless otherwise specified. 115 mm thick brick work shall be laid with stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable 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. Bricks shall be laid with frogs uppermost.

5.14.6.2 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.

5.14.6.3 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

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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.

5.14.7 Cement Plaster

5.14.7.1 All joints in masonry shall be raked to a depth of 12 mm with hooked tool made for the purpose when the mortar is still green and in any case within 48 hours 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.

5.14.7.2 The proportion of the cement mortar shall be as approved 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.

5.14.7.3 Curing of plaster shall be started as soon as the applied plaster has hardened enough so as not to be damaged. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

5.14.7.4 Plastering shall be done on both faces of brick masonry in cement mortar (1:2) and 20 mm thick unless otherwise specified.

5.14.7.5 Plastering work shall be carried out in two layers, the first layer being 14 mm thick and the second layer being 6 mm thick. The first layer shall be dashed against the prepared surface with a trowel to obtain an even surface. The second layer shall then be applied and finished leaving an even and uniform surface, trowel finished unless otherwise approved by the Employer's Representative.

5.14.8 Cement Concrete Channel

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5.14.8.1 The channel for the manhole shall be constructed in cement concrete of M15 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 and rendered in cement mortar (1:1) of 20 mm thickness and formed to a slope of 1 in 12 towards the channel.

5.14.9 Pipe Entering or Leaving Manhole

5.14.9.1 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.

5.14.10 Cast Iron Steps

5.14.10.1 Cast iron steps shall be as per IS : 5455. The steps shall be of grey cast iron of grade 15 as per IS : 210. The steps shall be clean, well cast and they shall be free from air and sand holes, cold shuts and warpings. The portion of the step which projects from the wall of the manhole shall have a raised chequered design to provide an adequate non-slip grip. C.I. steps shall weigh not less than 4.5 kg each and shall be of 150 mm x 375 mm overall dimensions. These steps shall be coated with a black bituminous composition. The coating shall be smooth and tenacious. It shall not flow when exposed to a temperature of 63 degrees C and shall not be brittle as to chip of at temperature of 0 degree C.

5.14.10.2 Where the depth of invert of manhole exceeds 800 mm, cast iron steps of approved pattern shall be fixed in the brick work at the interval of 300 mm vertically and staggered at 380 mm horizontally centre to centre. In case of pipe diameter greater than 600 mm, box type C.I. steps weighing 19 kg each shall be provided at 300 mm vertically in channel of manhole.

5.14.11 Frame and Covers

5.14.11.1 Frame and covers for manholes shall be of required type and dimensions as per the relevant drawings prepared by the Contractor. Following information shall be clearly marked on each cover.

Year of manufacture,

Identification mark of the Employer: EMPLOYER

Arrow showing direction of flow

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5.14.11.2 Cast Iron Frame and Cover

The cast iron frame and cover shall be of grey cast iron as per IS : 1726. The general requirements for casting and coating of CI frame and cover shall be as specified for CI steps in Clause 5.15.10. The covers shall have a raised chequered design to provide an adequate non-slip grip. The rise of the chequer shall be not less than 4 mm. The locking device for the cover shall be provided as approved by the Employer's Representative. The CI covers for the load test shall be selected at one for every lot of fifty or part thereof for each type and size manufactured and as approved by the Employer's Representative. The frame shall be fixed in cement concrete of M15 grade all round and finished with neat cement. The manhole frame shall have 560 mm diameter clear opening and shall weigh not less than 208 kg. including cover. In case of rectangular CI frame and cover of 900 mm x 600 mm clear opening, the total weight shall not be less than 275 kg. In case of scraper manhole the frame shall have clear opening of 1200 mm x 900 mm and shall weigh not less than 900 kg including cover. The manhole cover and frame shall be painted with three coats of anti-corrosive paint after fixing in position.

5.14.11.3 Fibre Reinforced Concrete Frame and Cover

Fibre reinforced concrete frame and cover shall be capable of withstanding load of 35 tonnes. The frame shall be fixed in cement concrete of M15 grade all around and finished with neat cement. The fibre reinforced frame shall have clear opening of 560 mm diameter and weighing 102 kg. The cover shall have a minimum thickness of 100 mm and weighing 78 kg. The fibres shall constitute 1% of the weight of the concrete in the form of 50 mm to 100 mm long high tensile steel wires. For the cover, MS sheet lapping of 18 gauge shall be provided to avoid damage to the edges. Similarly for frame, MS angle/flat shall be provided along the edge. Both MS sheet and angle shall be painted with black bituminous paint. The cover should have suitable lifting arrangement. The fibre reinforced frame and cover shall be manufactured as approved.

5.14.11.4 Reinforced Cement Concrete Frame and Cover

Reinforced cement concrete frame and cover for manholes shall be of required dimensions and shape as shown on the drawing prepared by the Contractor. The frame and cover shall be cast in cement concrete of M25 grade. Minimum cover to the reinforcement shall be 40 mm. The edges of frame and covers shall be provided with mild steel angles to avoid damages to the corners. These angles shall be painted with black bituminous paint. The covers should have suitable lifting arrangement.

5.14.12 Drop Manhole

5.14.12.1 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 lines is more than 600 mm, a drop of more than 60

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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. The pipe unless of cast iron should be surrounded with 150 mm thick concrete.

5.14.12.2 In the case of sewers over 450 mm in diameter the drop in level may be accomplished by one of the following approved methods:

A cascade;

A ramp;

(c) By drops in previous manholes.

5.14.13 RCC Manhole

5.14.13.1 M25 grade of concrete used for construction of RCC manhole shall have minimum cement content of 360 kg/cum of concrete. Minimum cover to the reinforcement shall be 50 mm.

5.14.14 Vent Shafts

5.14.14.1 General

Vent shafts shall be erected at such places as approved by the Employer's Representative.

5.14.14.2 Mild Steel Vent Shaft

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Mild steel vent shaft shall be of 150 mm diameter and 12.17 m height from ground level with C.I. ornamental cap. This shall be fixed firmly and encased in cement concrete of M15 grade as shown on relevant drawing with necessary mild steel bolts, plates etc. for foundation. The vent shaft shall be painted with one coat of silver paint over one coat of red lead oxide paint. The vent shaft shall be connected to manhole by 150 mm diameter glazed stoneware pipe encased by M10 concrete of 150 mm thickness all around as approved by the Employer's Representative.

5.14.14.3 RCC Vent Shaft

Reinforced cement concrete vent shaft shall be of M25 grade concrete, 200 mm diameter at bottom and tapered to 100 mm diameter at top (both inside clear openings) and 6 m height from ground level. The vent shaft shall be embedded in concrete of M10 grade and anchored by 2 nos. of 16 mm diameter and 600 mm long MS bars. The vent shaft shall be connected to manhole as specified in (b) above through a brick masonry flue chamber.

5.14.15 Miscellaneous

5.14.15.1 If any damage is caused to the other services such as water supply pipeline, sewer, cable, etc. during the construction of manholes and erection of vent shafts, the Contractor shall be held responsible for the same and shall replace the damaged services to the full satisfaction of the Employer's Representative.

5.14.15.2 The interior of manholes shall be cleared of all debris after construction and before testing the same for water tightness by the Contractor.

6.0 APPROACH AS WELL AS INTERNAL ROAD WORKS

6.1 Applicable Codes and Client's Requirements

The following specifications, standards and codes are referred to in this part.

IS : 73 : Specification for Paving Bitumen

IS : 215 : Specification for Road Tar

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IS : 217 : Specification for Cutback Bitumen

IS : 454 : Specification for Digboi type Cutback Bitumen

IS : 460 : Specification for Test sieves

(Parts 1 to 3)

IS : 1077 : Common burnt clay building bricks - Specification

IS : 1124 : Method of test for determination of water absorption, apparent specific gravity and porosity of building 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

(Part 5) Determination of Liquid and plastic limit

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

Ministry of : Specifications for road and bridge works

Surface

Transport

(Roads wing)

All earthwork shall be according to Employer's Requirements specified elsewhere.

6.1.1 Access to Abutting Propeties

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For the duration of the works the contractor shall at all times provide convenient acess to paths, steps, bridge or drives for all entrances to property abutting the site and maintain them clear, tidy, and free from mud and objectionable matter

6.2 Road Construction

6.2.1 Road shall consist of the following :

Well compacted sub-grade layer.

Providing and laying sub-base of 230 mm thick with 40 mm to 90 mm size aggregates compacted to 160 mm thick in two layers with watering, rolling etc., as per specification complete.

Providing and laying base course of 110 mm size with 40 mm to 60 mm size aggregates compacted to 80 mm thickness in one layer with watering, rolling etc., as per specifications.

Providing 85 mm compacted thickness of asphalt Macadam as per specification consisting of premixed asphaltic carpet and seal coat.

6.3 Materials

6.3.1 General

All materials shall be obtained from local sources and shall be subject to Employer’s Representative's approval prior to use.

6.3.2 Soling Stone

It shall be clean, sound, dense, hard, tough, durable stone of uniform quality free from unsound material, cracks, decay and weathering. Water absorption shall not be more than 5 percent. The stone shall be in the smallest dimension equal to thickness of the soling course specified with a tolerance of 25 mm. Soling Stone shall be sufficiently flat bedded. The height of the soling stone shall be equal to the specified thickness of soling. The length and breadth shall not exceed twice the specified thickness.

6.3.3 Stone Aggregate/Metal

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 Tables 7.1 or 6.2 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, dolerite are good in this respect; granite, quartzite are comparatively poor.

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Table – 6.1 Physical Requirements of Coarse Aggregate for Water Bound Macadam (Sub Base/ Base Course)

Sl. No.	Test	Requirements	Test Method
1.	Los Angeles Abrasion Value* Or Aggregate Impact Value*	50 percent (max.) 40 percent (max.)	IS:2386 (Part – IV) 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 – 6.2 Physical Requirements of Aggregates for Bituminous Wearing Course

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

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(**) Requirement of flakiness index shall be enforced only in case of crushed broken stone

The coarse aggregate for water bound Macadam shall conform to one of the gradings given in Table-6.3 below :

Table – 6.3 Grading Requirements Of Coarse Aggregates For Water Bound Macadam

Grading No.	Size Range	Sieve Designation	Percent by Weight Passing the Sieve
1.	90mm to 45mm	125 mm 90 mm 63 mm 40 mm 22.4 mm	100 90-100 25-60 0-15 0-5
2.	63mm to 45mm	90 mm mm mm mm 22.4 mm	100 90-100 25-75 0-15 0-5
3.	53mm to 22.4 mm	mm mm mm 22.4 mm 11.2 mm	100 95-100 65-90 0-10 0-5

6.3.4 Screenings for Water Bound Macadam

Screenings to fill voids in the coarse aggregate shall consist of the same materials as the coarse aggregate. However, where permitted, predominantly non-plastic material such as murum or gravel (other than river borne material) may be used for this purpose provided liquid limit and plasticity index of such material is below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 percent.

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Screenings shall conform to the gradings set forth in Table – 6.4. Screenings of Type-A in Table-6.4 shall be used with coarse aggregate of grading 1 in Table – 6.3. Screenings of Type A or B, as approved, shall be used with coarse aggregates of grading 2. Type-B screenings shall be used with coarse aggregates of grading 3.

Table –6.4 Gradings For Screenings

Grading No.	Size Range	Sieve Designation	Percent by Weight Passing the Sieve
A	12.5 mm	12.5 mm 10.0 mm 4.75 mm 150 micron	100 90-100 10-30 0-8
B	10 mm	10 mm 4.75 mm 150 micron	100 85-100 10-30

The use of screening shall be omitted in the case of soft aggregates such as brick metal, kankar, laterites etc. as they are likely to get crushed to a certain extent under rollers.

6.3.5 Binding Material

6.3.5.1 Binding material shall comprise of a suitable material, approved by Employer's Representative, have plasticity index value of less than 6 as determined in accordance with IS : 2720 (Part - V)

6.3.5.2 Application of binding material may not be necessary, when the screenings used are of crushable type such as murum or gravel.

6.3.6 Murum/Kankar/Gravel/Sand

6.3.6.1 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

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in every direction through a 63 mm ring. Murum shall not contain more than 5% to 8% of fines passing a 75 micron sieve.

6.3.6.2 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.

6.3.6.3 Sand used for blinding the bituminous road surface, 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.

6.3.7 Bituminous Materials

6.3.7.1 Bituminous materials shall conform to IS : 73, IS : 215, IS : 217 or IS : 454 as applicable and be of the grade specified.

6.4 Earth work

6.4.1 Earthwork in Excavation

6.4.1.1 In general the excavation shall be in accordance to Employer's Requirement specified elsewhere.

6.4.1.2 Profiles of road excavation shall be laid at 50 m intervals to conform to the required alignment, sections, grades and side slopes and the lines of cuts shall be clearly marked.

6.4.1.3 Contractor shall on no account excavate beyond the slopes or below the specified grade unless so approved by the Employer's Representative 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.

6.4.1.4 The excavation shall be finished neatly, smoothly and evenly to the correct lines, grades, sections and side slopes as shown in the drawings or approved by Employer's Representative.

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6.4.2 Earthwork in Embankment

6.4.2.1 The embankment shall be formed of earth obtained from approved source.

6.4.2.2 The ground over which embankment is to be formed shall be cleared of all brushwood, loose stones, vegetation, bushes, stumps, and all other objectionable matter and materials so removed shall be burnt off or disposed off as approved by Employer's Representative.

6.4.2.3 Profiles of embankment 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 strai

6.4.2.4 ght portions. Toe line may be marked with pick marks.

6.4.2.4 Before placing any embankment material the top 150 mm of soil strata receiving it shall be scarified and watered and compacted with one pass of 8-10T roller.

6.4.2.5 Embankment material shall be placed in successive horizontal layers of 200 mm depth extending to the full width of the embankment including the slopes at the level of the particular layer and 300 mm more on both sides to allow compaction of the full specified section. Before placing the next layer the surface of the underlayer shall be moistured and scarified with pick axes or spades to provide a satisfactory bond with the next layer. The extra loose stuff at the edges shall be trimmed later after completion of the bank work leaving the correct section fully compacted.

6.4.2.6 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, leveled, 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.

6.4.2.7 If the bank materials contains less than the optimum moisture, water shall be added to the loose layers of the embankment to bring the moisture uniformly upto 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.

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6.4.2.8 The moistured/dried loose layers shall be compacted with a power roller of 10 to 12 tonnes. The roller shall pass at least twice over the same area, once in the forward move and the second time in backward move.

6.4.2.9 To allow for subsequent settlement the finished level of the embankment shall be kept higher than the specified level by one centimetre for every metre of the height of the bank.

6.4.2.10 Embankment shall be finished and dressed smooth and even to conform to the alignment, levels, cross sections, and dimensions shown on drawings with due allowance for shrinkage. Any damage caused by rain, or due to any other reason shall be made good in the finishing operation.

6.5 Preparation of Subgrade

6.5.1 In general Earthwork in subgrade shall conform to Employer's Requirement specified elsewhere.

6.5.2 Immediately prior to the laying of the soling the subgrade shall be cleaned of all foreign substances, vegetation etc. Any ruts or soft yielding patches that appear shall be corrected and the subgrade dressed off parallel to the finished profile. The camber of subgrade shall conform in shape to that of the finished road surface. Camber boards shall be used to get the required section.

6.5.3 The prepared subgrade shall be lightly sprinkled with water, if necessary, and rolled with power roller of not less than 10 tonnes, till the soil is evenly compacted to 95% of Proctor density with 2% variation in optimum moisture content. Roller shall pass minimum 5 runs on the subgrade. Rolling shall commence at the edges and progress towards the centre longitudinally. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. Any undulations in the surface that develop due to rolling shall be made good with approved earth and subgrade rerolled.

6.6 Soling

6.6.1 Soling shall not be constructed on a wet subgrade.

6.6.2 Unless otherwise specified, the width of the soling shall be 230 mm more on either side than that of the waterbound macadam wearing course and the finished thickness of the soling course shall be 230 mm.

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6.6.3 The soling stones shall be laid with the largest face downwards and in contact with each other. The stones shall break joint as far as possible. The height of the soling stone shall be equal to specified thickness of soling.

6.6.4 As the laying of rubble advances the soling shall be hand packed by wedging and packing with 80 mm metal in the joints of the soling and driving them by hammers in place so as to fill the voids as completely as possible. This operation of hand packing shall closely follow the rubble laying. The soling shall be laid and hand packet true to grade and section and these shall be often checked by boning rods, template boards and fish line etc. The grades, sections etc. of the soling shall correspond to those of the surfacing coming on it. The soling thus laid shall be finished by knocking out projecting stones and filling depressions by chips to come up to the grade and camber.

6.6.5 The quality of the 80 mm metal shall be same as specified for the soling and the longest dimension shall not be more than 100 mm and the shortest dimension not less than 50 mm.

6.6.6 The soling after it is properly laid and hand packed including filling of voids with 80 mm metal shall be rolled dry with 10 - 12 T power roller to refusal i.e., till the stones in the soling course cease to move under the roller and no more compaction can be achieved. Rolling shall start at the edges and work towards the centre. The roller shall run over the same surface of rolling for at least 8 times till the soling course is well consolidated. The surface shall be checked by templates and in case of unevenness high spots shall be knocked out and depressions filled by spalls and recompacted fully. Bunds shall be laid along the edges and compacted before starting rolling on soling to prevent spreading of stones.

6.6.7 Gravel shall be spread in thin layers over the above prepared soling surface, swept into the interstices with brooms, watered lightly to assist the filling of voids. Spreading of gravel, sweeping and watering shall continue till the interstices are completely filled. At all times only enough water shall be sprinkled to force the gravel into the voids and never so much as to soften the subgrade. The process of gravel filling shall be accompanied by rolling as for dry rolling of soling with a power roller weighing not less than 10 tonnes starting at edge and working towards the centre. The roller shall run over the same surface for at least eight times. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The surface shall be checked with templates of approved design (to be provided by Contractor) and high and low spots corrected by removing soling and repacking.

6.7 Water Bound Macadam Course

The surface over which water bound Macadam 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

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in an approved manner and rolled until firm. To prevent the spreading of the course aggregate during rolling, if necessary, two parallel mud walls 200 mm wide and of height equal to uncompacted Macadam course shall be made along the outer edges of the Macadam course having a clear distance between them equal to the width to be metalled.

W.B.M. sub-base course of specified thickness shall be provided. The course aggregate for this shall conform to requirements of sub-base in Table-1 and its grading shall conform to Grading 1 of Table - 6.3 and screening to Type B of Table-6.4.

W.B.M. base course : The coarse aggregate for this shall normally conform to requirements for Base in Table-1 and its grading shall confirm to Grading 3 of Table – 6.3 and screening to Type-B of Table-6.4.

6.7.1 Spreading Coarse Aggregate

6.7.1.1 The coarse aggregate shall be spread uniformly and evenly upon the prepared surface in such quantities that the thickness of each compacted layer does not exceed 75 mm or as otherwise specified. In no case, however, shall the thickness of each compacted layer exceed 100 mm.

6.7.1.2 The spreading shall be done from stockpiles by raking the stacks with rakes so as to leave behind mud and dust. In no case shall the aggregate be dumped in heaps directly on the surface prepared to receive the aggregate nor shall hauling over uncompacted or partially compacted sub-base/base be permitted. The surface of the aggregates spread shall be fully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. No segregation of large or fine aggregates shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material. The surface shall be checked frequently with a straight edge while spreading and rolling so as to ensure a finished surface as per approved plan. The coarse aggregate shall not normally be spread in lengths exceeding 3 days' average work ahead of the rolling and bonding of the proceeding section.

6.7.2 Rolling

6.7.2.1 Following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of not less than 10 tonne capacity or tandem or vibratory roller of approved type. Rolling shall begin from the edges and gradually progress towards the centre. First the edges/edge shall be compacted with roller running forward and backward and then move inwards parallel to the centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half width. Rolling shall be discontinued when the aggregates are partially compacted with sufficient void space in them to permit application of screenings. During rolling slight sprinkling of water may be done, if necessary. Rolling shall not be done when the subgrade is soft or

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yielding or when it causes a wave-like motion in the subgrade or sub-base. The rolled surface shall be checked transversely and longitudinally with templates and all undulations shall be corrected by loosening the surface, adding or removing necessary amounts of aggregate and rerolling until the entire surface conforms to desired camber and grade. In no case shall the use of screenings be permitted to make up depressions. Material which crushed excessively during compaction or becomes segregated shall be removed and replaced with suitable aggregates. It shall be ensured that shoulders are also built-up simultaneously alongwith water bound macadam course.

6.7.3 Application of Screening

6.7.3.1 After the coarse aggregate has been rolled in accordance with Clause 6.9, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers. Screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all the voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand brooms or both. In no case shall screenings be applied so fast and thick as to form cakes and ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregate. Spreading, rolling and brooming of screenings shall be carried out in only such lengths of the road which could be completed within one day's operation.

6.7.4 Sprinkling and Grouting

6.7.4.1 After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued, with additional screenings applied as necessary, until the coarse aggregate has been thoroughly keyed, well bonded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to see that the sub-grade or sub-base does not get damaged due to the addition of excessive quantities of water during construction. In case the subgrade or sub-base gets damaged, the Contractor shall rectify the damaged portion.

6.7.5 Application of Binding Material

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6.7.5.1 After the application of screenings in accordance with Clauses 6.7.3 and 6.7.4, the binding material where it is required to be used (See Clause 6.3.5) shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms or mechanical brooms to fill the voids properly and rolled, during which water shall be applied to the wheels of the rollers, if necessary, to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller.

6.7.6 Setting and Drying

6.7.6.1 After the final compaction of water bound Macadam course it shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as approved, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the Macadam has set.

6.7.7 Multiple Layered Course

6.7.7.1 When the total consolidated thickness of the water bound Macadam course is more than 100 mm, it shall be constructed in layers. Each layer shall be constructed as per all the operations described above. The same degree of quality control and refinement shall be used for constructing each layer.

6.8 Premixed Asphaltic Carpet

This work shall consist of constructing in a single course of 50 mm thick Premixed Asphaltic Carpet to the following Employer's Requirements on a previously prepared base, to serve as a wearing coat.

6.8.1 Materials

(a) Binder

This shall be paving bitumen of penetration grade within the range S 35 to S 90 or A 35 to A 90 (30-40 to 80/100) as per Indian Standard for `Paving Bitumen' IS : 73. The actual grade of bitumen to be used shall be decided by the Employer's Representative appropriate to the region, traffic, rainfall and other environmental conditions.

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(b) Course Aggregate

It shall be crushed material retained on 2.36 mm (No. 8 ASTM) sieve and shall be crushed stone or gravel (shingle) and shall be as per Clause 6.3.3 and satisfy the physical requirements set forth in Table-6.2.

(c) Fine Aggregates

The fine aggregates shall be the fraction passing 2.8 mm sieve and retained on 90 micron sieve consisting of crusher run screenings, natural sand or mixture of both. These shall be clean, hard, durable, uncoated, dry and free form any injurious, soft or flaky pieces and organic or deleterious substances.

(d) Filler

The filler shall be an inert material, the whole of which passing 710 micron, sieve, at least 90 percent passing 180 micron sieve and not less than 70 percent passing 90 micron sieve. The filler shall be stone dust, cement, hydrated lime, fly ash or any other non-plastic mineral matter approved by the Employer's Representative.

6.8.2 Mineral Aggregate Gradation

The mineral aggregates including mineral filler shall be so graded or combined as to confirm to the either of the limits set forth in Table-6.5 below :

Table – 6.5 Mineral Aggregate Gradation for Bituminous Concrete

Sieve Size	Percent by Weight Passing the Sieve	
	GRADING - 1	GRADING - 2
20mm	---	-100
12.5 mm	-100	80-100
10 mm	80-100	70-90
4.75 mm (No.4 ASTM)	55-75	50-70
2.36 mm (No.8 ASTM)	35-50	35-50
600 micron (No.30 ASTM)	18-29	18-29
300 micron (No.50 ASTM)	13-23	13-23

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150 micron (No.100 ASTM)	8-16	8-16
75 micron (No.200 ASTM)	4-10	4-10

6.8.3 Mix Design

Apart from conformity with the grading and quality requirements of individual ingredients, the asphaltic concrete mix shall meet the requirements set forth in Table-6.6 hereunder.

6.8.4 Weather and Seasonal Limitations

Asphalt concrete shall not be laid during rainy weather or when the base course is damp or wet.

Table – 6.6 Requirement of Asphaltic Concrete Mix

Sr.No.	Description	Requirements
1.	Number of compaction blows, each end of Marshalling specimen	50
2.	Marshall stability (ASTM Designation-D-1559) determined on Marshal specimen	340 Kg. (min.)
3.	Marshall flow (mm)	2-4
4.	Percent Voids in mix	3-5
5.	Percent voids in mineral aggregate filled with bitumen	75-85
6.	Binder content percent by weight of mix	5-7.5

The contractor shall intimate to the Employer's Representative in writing, well in advance of the start of work, the job- mix formula proposed to be used by him for the work and shall give following details to the Employer's Representative for his approval.

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i) Source and location of all materials

ii) Proportions of all materials expressed as follows where each is applicable :

Binder	As percentage by weight of total mix
Course aggregate	As percentage by weight of total aggregate including mineral filler
Fine aggregate	
Mineral filler	

iii) A single definite percentage passing each sieve for the mixed aggregate.

iv) The results of the best enumerated in Table-6.6 as obtained by the Contractor.

v) Test results of physical characteristics of aggregates to be used.

Should a change in the source of material be proposed, a new job mix formula shall be established and got approved from the Employer's Representative before actual using of the materials.

6.8.5 Preparation of Base

6.8.5.1 The base on which premix carpet is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross section by repairing all potholes or patches and ruts. The potholes shall be drained of water and cut to regular shape with vertical sides. All loose and disintegrated material shall be removed. The pothole shall then be filled either with (i) Coarse aggregate and screenings conforming to Clause 3.0 and compacted with heavy hand rammers or approved mechanical tempers or (ii) premixed chippings binders (bitumen grade 80/100) content of 3 percent by weight of total mix, after painting the sides and bottom of the holes with a thin application of bitumen, or a combination of both (i), (ii) as approved by Employer/Employer's Representative. The surface shall be thoroughly swept and scraped clean and free of dust and other foreign matter.

6.8.6 Tack Coat

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6.8.6.1 The binder used for tack coat shall be bitumen of suitable penetration grade within 80/100 confirming to IS:73. The actual grade of bitumen to be used shall be decided by the Employer's Representative, appropriate to the region, traffic, rainfall and other environmental conditions. Binder shall be heated to the temperature appropriate to its grade and as approved by the Employer's Representative. The binder shall be sprayed on the prepared base at the rate of 1.0 kg/sq.m. The binder shall applied uniformly with the aid of either self propelled or towed bitumen pressure sprayer with self heating arrangement and spraying nozzle arrangement capable of spraying bitumen at the above specified rate and temperature so as to provide uniform unbroken spread of bitumen. The tack coat shall be applied just ahead of oncoming premixed asphalt carpet.

6.8.7 Preparation of Mix and Laying

6.8.7.1 Hot mix plant of adequate capacity and capable of producing a proper and uniform quality mix shall be used for preparing the mix. The plant may be either a weigh batch type or volumetric proportioning continuous or drum mix type. The stone aggregate shall be surface dry and contain not more than 2 percent moisture before use. It shall be first screened of dust and measured in boxes, heated to 155 deg.C - 163 deg. C and then loaded into the drum mixer according to the capacity of the mixing drum in the proportion specified. The binder shall be heated to 140 deg. C to 177 deg. C in boilers and maintained at that temperature. At no time shall the difference in temperature between the aggregate and binder exceed 14 deg. C. The heated binder shall be drawn from the boiler into a suitable container or in a bucket gauged to show the weight of bitumen in it.

6.8.7.2 Mixing shall be done in two stages. The coarse aggregate of the correct standard size and in the proportion as specified shall be fed into the mixer to which 2/3rd of the total specified quantity of bitumen heated to the appropriate temperature shall be added. When the coarse aggregate is well coated, the fine aggregate in the specified proportion followed by the balance 1/3rd quantity of total bitumen shall be fed into the mixer. Mixing shall be continued until a homogeneous mix is produced and all particles are uniformly coated with bitumen.

6.8.7.3 The hot mix shall be discharged from the mixer carried to the point of use in suitable tipper vehicles and shall be spread by means of a self propelled mechanical paver with a suitable screeds capable of spreading, tamping and finishing the mix to specified lines and levels to a thickness sufficient to achieve after consolidation the specified thickness. Temperature of the mix at the time of laying shall be in the range of 120 deg. C - 160 deg. C. However, in restricted locations and in narrow width where available equipment can not be operated in the opinion of the Employer's Representative, he may permit manual laying of the mix. Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. Longitudinal joints shall be offset by at least 150 mm from those in the binder course (tack coat). All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

6.8.8 Rolling

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6.8.8.1 Immediately after the spreading of mix it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not more than 5 km per hour. The initial or break down rolling shall be with 8-12 ton three wheel roller and the surface finished by final rolling with the 8-10 ton tendem roller. Preferably before finishing with tendem, breakdown rolling shall be followed by an intermediate rolling with a fixed wheel pneumatic roller of 15 to 30 ton having a tyre pressure of 7 kg. per sq.m. The joints and edges shall be rolled with a 8 to 12 ton three wheel roller. Any high spots or depressions which become apparent shall be corrected by addition of removal of mix material. The roller shall uniformly overlap not less than a third of the track made in the preceding pass. The wheels of the roller shall be moistened with gunny bags to prevent the mix sticking to the wheels while rolling, but in no case shall fuel lubricating oil be used for this purpose. Rolling shall be continued till the mix is thoroughly compacted and all roller marks are eliminated.

6.8.9 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.

6.9 Seal Coat

This work shall consist of application of a seal coat sealing the voids in a bituminous surface laid to the specified levels, grade and camber. Seal coat shall be either of the two types below :

Type A : Liquid seal coat comprising of an application of a layer of bituminous binder followed by a cover of stone chippings.

Type B : Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder.

6.9.1 Materials

6.9.1.1 Binder

This shall be 30/40, 60/70 or 80/100 grade straight run bitumen conforming to IS:73. The actual grade of bitumen to be used shall be approved by the Employer's Representative, appropriate to the region, traffic,

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rainfall and other environmental conditions. The quantity of binder to be utilized, shall be 9.8 kg and 6.8 kg per 10 sq.m. of area for Type A and Type B seal coat respectively.

6.9.1.2 Stone Chippings for Type A Seal Coat

These shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They should be free of elongated or flaky pieces, soft or disintegrated stone, vegetable or other deleterious matter. Stone chippings shall be of 10 mm size defined as 100 percent passing through 12.5 mm sieve and retained on 2.36 mm sieve. The quantity used for spreading shall be 0.09 cum per 10 sq.m.

6.9.1.3 Fine Aggregate for Type B Seal Coat

The fine aggregate shall be sand or fine grit and shall consist of clean, hard, durable, uncoated dry particles and shall be free from dust, soft or flaky material organic matter or other deleterious substances. The aggregate shall pass 1.7 mm sieve and be retained on 180 micron sieve. The quantity used for premixing shall be 0.06 cu.m. per 10 square metre area.

6.9.2 Preparation of Base

The seal coat shall be applied immediately after the laying of bituminous course which is required to be sealed. Before application of seal coat materials the surface shall be cleaned free of any dust or other extraneous matter.

6.9.3 Construction of Type A Seal Coat

6.9.3.1 Application of Binder

Binder shall be heated in boilers to 163 deg. C to 171 deg. C, maintained at the temperature and sprayed on the dry surface in a uniform manner with the help of mechanical sprayers. Excessive deposits of binder caused by stopping or starting of the sprayer through leakage or any other reason shall be suitably corrected before the stone chippings are spread.

6.9.3.2 Application of Stone Chipping

Immediately after the application of the binder, stone chippings in a dry and clean state shall be spread uniformly on the complete surface. If necessary the surface shall be broomed to ensure uniform spread of chippings. The

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surface shall be checked by means of a camber board laid across the road and a 3 metre straight edge laid parallel to the centre line of the road and undulations if any, shall be corrected by addition or removal of blindage.

6.9.3.3 Rolling

Immediately after the application of the cover the material, the entire surface shall be rolled with a 8 to 10 tonne smooth wheeled roller. While rolling is in progress additional material shall be spread by hand in whatever quantities required to make up irregularities. Rolling shall continue until all material is firmly bedded in the binder and presents a uniform closed surface. Generally five to six passes shall be made for thorough compaction of the surface or as approved by the Employer's Representative. Along kerbs, manholes and at all places not accessible to roller, thorough compaction shall be secured by means of steel rammers or hand rollers. Traffic shall be allowed after 24 hours. After a period of seven days, surplus grit shall be swept and collected and shall be used for binding the spots where bleeding occurs.

6.9.4 Construction of Type B Seal Coat

6.9.4.1 Preparation of Mix and Laying

The aggregate shall be surface dry and contain not more than 2 percent moisture before use, and shall be heated to 155 deg. C - 163 deg. C and then loaded into the drum mixer according to the capacity of the mixing drum in the proportion specified. The binder shall be heated to 149 deg. C to 177 deg. C in boilers and maintained at that temperature. At no time shall the difference in temperature between the aggregate and binder exceed 14 deg. C. The heated binder shall be drawn from the boiler into a suitable container or in a bucket gauged to show the weight of bitumen in it. The mix shall be immediately transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to be sealed.

6.9.4.2 Rolling

As soon as sufficient length has been covered with the premixed material, the surface shall be rolled with 8 to 10 tonne smooth wheeled power rollers. Rolling shall be continued till the premixed material completely seals the voids in bituminous course and a smooth uniform surface is obtained.

6.9.4.3 Opening to traffic

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Traffic may be allowed soon after final rolling when, the premixed material has cooled down to the surrounding temperature.

6.10 Quality Control

6.10.1 General

6.10.1.1 All materials incorporated and all works performed shall be strictly in conformity with the Specification requirements. All works shall conform to the lines, grades, cross sections and dimensions shown on the drawings or as approved by the Employer's Representative subject to the permitted tolerances described hereinafter. The contractor shall be fully responsible for the quality of the work in the entire construction within the Contract. He shall, therefore, have his own independent and adequate set-up for ensuring the same.

6.10.1.2 The Contractor shall carry out quality control tests on the materials and work to the frequency specified. In the absence of clear indications about method and/or frequency of tests for any item, the approval of the Employer's Representative shall be obtained and he shall provide necessary co-operation and assistance in obtaining the samples for test and carrying out the field test as required by the Employer's Representative from time to time. This may include provision of Labour, attendance, assistance in packing and dispatching and any other assistance considered necessary in connection with the test.

6.10.1.3 For the work of embankment, subgrade and construction of subsequent layer of same or other material over the finished layer shall be done after obtaining approval from the Employer's Representative. Similar approval from the Employer's Representative shall be obtained in respect of all other items of works prior to proceeding with the next stage of construction.

6.10.1.4 The Contractor shall carry out modification in the procedure of work, if found necessary, as approved by the Employer's Representative during inspection. Works falling short of quality shall be rectified by the Contractor as approved by the Employer's Representative.

6.10.2 Permitted Tolerances

6.10.2.1 Horizontal Alignments

Horizontal alignments shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of ±25 mm therefrom. The corresponding tolerance for edges of the roadway and lower layers of pavement shall be ±50 mm.

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6.10.2.2 Longitudinal Profile

The levels of the subgrade and different pavement courses as constructed, shall not vary from those calculated with reference to the longitudinal and cross- profile of the road shown on the drawings or as approved by the Employer's Representative beyond the tolerances mentioned below :

Subgrade	± 15 mm
Sub-base	± 20 mm
Base Course	± 15 mm
Wearing Course	± 10 mm

Provided, however, that the negative tolerance for wearing course shall not be permitted in conjunction with the positive tolerance for base course if the thickness of the former is thereby reduced by more than 6 mm.

6.10.2.3 Surface Regularity

The surface regularity of completed subgrade, sub-bases, base courses and wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table 6.7.

The longitudinal profile shall be checked with a 3 metre long straight edge, at the middle of each traffic lane along a line parallel to the centre line of the road. The transverse profile shall be checked with a set of three camber boards at intervals of 10 metres.

6.10.2.4 Rectification

Where the surface irregularity of subgrade and the various courses fall outside the specified tolerances, the Contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Employer's Representative.

i) Subgrade

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Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by adding fresh material. The degree of compaction and the type of material to be used shall conform to the Clause 6.4.

ii) Water Bound Macadam

here the surface is high or low, the top 75 mm shall be scarified, reshaped with added material as necessary and recompacted. The area treated at a place shall not be less than 5 metres long and 2 metres wide.

iii) Bituminous Constructions

For bituminous construction other than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material and recompacting to Employer's Requirements. Where the surface is high, the full depth of the layer shall be removed and replaced with fresh material and compacted to Employer's Requirements.

For wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh material and compacted to Employer's Requirements. In all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 metre long and not less than 1 lane wide.

Table 6.7 Permitted Tolerance of Surface Regularity for Subgrade and Pavement Courses

Sl. No	Type of Construction	Longitudinal profile with 3 Cross profile metre straight edge					
		Maximum permissible undulation	Maximum number of undulations permitted in any 300 metres length exceeding : mm				Maximum permissible variation from specified profile under comber template : mm
1	2	3	4	5	6	7	8
1.	Earthen subgrade	24	30	-	-	-	15
2.	Granular/Lime/Cement /stabilised subbase	15	-	30	-	-	12

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Sl. No	Type of Construction	Longitudinal profile with 3 Cross profile metre straight edge					
		Maximum permissible undulation	Maximum number of undulations permitted in any 300 metres length exceeding : mm				Maximum permissible variation from specified profile under comber template : mm
3.	Water bound macadam with over size metal (45-90 mm size)	15	-	30	-	-	12
4.	Water Bound Macadam with normal size metal (22-4-53 mm and 45-63 mm size)	12	-	-	30	-	8
5.	Bituminous concrete	8	-	-	-	10@@	4

Notes :

1. @@ These are for machine laid surfaces. If laid manually due to unavoidable reasons, tolerance upto 50 percent above these values in this column may be permitted at the discretion of the Employer's Representative. However, this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 on the table.

2. Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied.

6.11 Tests

6.11.1 General

6.11.1.1 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 Employer's Representative 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 Employer's Requirement.

6.11.1.2 Test procedures for the various quality control tests are indicated in the respective Sections of these Employer's Requirements 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 Employer's Representative.

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6.11.2 Tests on earthwork for Embankment and Subgrade Construction

(a) Borrow material

(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(Part XXVII)]

As and when required by the Employer's Representative.

(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 m3 at least or closer as and when required by the Employer's Representative.

(b) Compaction control : Control shall be exercised by taking at least one measurement of density for each 1000 square metres of compacted area, or closer as required to yield the minimum number of test results for evaluation a days work on statistical basis. The determination of density shall be in accordance with IS:2720 (part XXVIII). Tests 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 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 shoulders (earthen) and in top 500 mm portion of the embankment below the subgrade, at least one density measurement shall be taken for every 50 square metres of the compacted area

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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.

6.11.3 Tests on Sub-bases and Bases

(Excluding bitumen bound bases)

The tests and their frequencies for the different types of bases and sub-base shall be as given in Table 6.8. The evaluation of density results for compaction control shall be on lines similar to those set out in clause 6.18.2

Table –6.8 Control Tests and Their Frequencies for Sub-Bases and Bases

(Excluding Bitumen Bound Bases)

Sl.No	Types of Construction	Test	Frequency
1.	Granular sub-base	Gradation	One test per 200 m3
		Atterbergs limit	One test per 200 m3
		Moisture content prior to compaction	One test per 250 m2
		Density of compacted layer	One test per 500 m2
		Deleterious constituents	As required
		C.B.R	As required
2.	Lime/Cement Stabilised	Purity of lime (for lime-soil stabilization	One test for each consignment subject to

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Sl.No	Types of Construction	Test	Frequency
		Lime/Cement content Degree of pulverisation CBR test on a set of 3 specimens Moisture content prior to compaction Density of compacted layer Deleterious constituents	a minimum of one test per 5 tonnes of lime. Regularly, through procedural checks. Periodically as considered necessary. As required One test per 250 m3. One test per 500 m2 As required
3	Water Bound Macadam	Aggregate Impact Value Grading Flakiness Index Atterbergs limits of binding material.	One test per 200m3 of aggregate One test per 100 m3 of aggregate One test per 200 m3 of aggregate One test per 25 m3 of binding material

6.11.4 Tests on Bituminous Constructions

The tests and their frequencies for the different types of bituminous works shall be as given Table 6.9 hereunder.

Table – 6.9 Control Tests and Their Frequency for Bituminous Works

Sl.No.	Types of Construction	Test	Frequency
1.	Prime Coat/Track Coat	Quality of binder	As Required

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Sl.No.	Types of Construction	Test	Frequency
		Binder temperature for a application iii) Rate of spread of binder	As regular close intervals Two tests per day
2.	Seal Coat/Surface Dressing	Quality of binder Aggregate Impact Value Flakiness Index Stripping value of aggregates Water absorption of aggregates Grading of aggregates Temperature of binder of application Rate of spread of materials	As required One test per 50 m3 of aggregate One test per 50 m3 of aggregate Initially, one set of 8 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregate One test per 25 m3 of aggregate At regular close intervals One test per 500 m3 of aggregate
3	Bituminous Concrete	Quality of binder Aggregate impact value, flakiness index and stripping value of aggregates Mix-grading	As required One test per 50-100m3 of aggregate One set of test on individual constituents and mixed aggregates from the dryer for each 100 tonnes of mix subject

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Sl.No.	Types of Construction	Test	Frequency
		Control of temperature of binder in boiler, aggregate in the dryer and mix at the time of laying and rolling	to a maximum of two sets per plant per day.
		Stability of mix (vide ASTM:D-1559)	At regular close interval. For each 100 tonnes of mix produced, a set of three Marshall specimens to be prepared and tested for stability, flow value density, and void content, subject to a minimum of two sets being tested per plant per day.
		Binder content and gradation in the mix (Binder content test vide ASTM:D-2172)	One test for each 100 tonnes of mix subject to a minimum of two tests per day per plant.
		Rate of spread of mixed material	Regular control through checks on the weight of mixed material and layer thickness.
		Density of compacted layer	One test per 500 m3 area

7.0 BUILDING DETAILS

7.1 Applicable Codes and Specifications

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The following codes and standards are included in this section, as part of these specifications. However, respective IS codes for the works not mentioned here shall also be applicable for those particular items of work.

IS:110 - Ready mixed paint, brushing, grey filler, for enamels for use over primers

IS:269 - Specification for 33 grade ordinary portland cement

IS:280 - Specification for mild steel wire for general engineering purposes

IS:287 - Recommendations for maximum permissible moisture content of timber used for different purposes

IS:304 - High Tensile Brass Ingots and Castings.

IS:337 - Varnish, finishing interior

IS:348 - French polish

IS:383 - Specification for coarse and fine aggregates from natural sources for concrete

IS:412 - Expanded metal steel sheets for general purposes

IS:419 - Specification for putty for use on window frames

IS:428 - Distemper, oil emulsion, colour as required

IS:459 - Specification for unreinforced corrugated and semi-corrugated asbestos cement sheets

IS:702 - Specification for industrial bitumen

IS:710 - Specification for marine plywood

IS:712 - Specification for building limes

IS:730 - Specification for hook bolts for corrugated sheet roofing

IS:733 - Wrought aluminium and aluminium alloys, bars, rods and sections for general engineering purposes

IS:777 - Specification for glazed earthenware tiles

IS:1003 - Specification for timber panelled and glazed shutters (Parts 1 & 2)

IS:1038 - Specification for steel doors, windows and ventilators

IS:1077 - Specification for common burnt clay building bricks

IS:1081 - Code of practice for fixing and glazing of metal (steel & aluminium) doors, windows and ventilators

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IS:1124 - Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones

IS:1237 - Specification for cement concrete flooring tiles

IS:1322 - Bitumen felts for water proofing and damp proofing

IS:1346 - Code of practice for water proofing of roofs with bitumen felts

IS:1361 - Specification for steel windows for industrial buildings

IS:1397 - Specification for kraft paper

IS:1443 - Code of practice for laying and finishing of cement concrete flooring tiles

IS:1477 - Code of practice for painting of ferrous metals in buildings (Parts 1 & 2)

IS:1542 - Specification for sand for plaster

IS:1580 - Specification for bituminous compounds for water-proofing and caulking purposes

IS:1597 - Code of practice for construction of stone masonry : Part 1 Rubble stone masonry

IS:1659 - Specification for block boards

IS:1661 - Code of practice for application of cement and cement-lime plaster finishes

IS:1834 - Specification for hot applied sealing compound for joint in concrete

IS:1838 - Specification for preformed fillers for expansion joint in concrete pavements and structures (non extruding and resilient type) : Part 1 Bitumen impregnated fibre

IS:1948 - Specification for aluminium doors, windows and ventilators

IS:1949 - Specification for aluminium windows for industrial buildings

IS:2074 - Ready mixed paint, air drying, red oxide- zinc chrome, priming

IS:2098 - Asbestos cement building boards

IS:2114 - Code of practice for laying in-situ terrazzo floor finish

IS:2116 - Specification for sand for masonry mortars

IS:2185 - Specification for concrete masonry units (Parts 1,2 & 3)

IS:2202 - Specification for wooden flush door shutters (Solid core type) : Parts 1 & 2

IS:2212 - Code of practice for brickwork

IS:2250 - Code of practice for preparation and use of masonry mortars

IS:2338 - Code of practice for finishing of wood and wood based materials (Parts 1 & 2)

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IS:2339 - Aluminium paint for general purposes, in dual container

IS:2395 - Code of practice for painting concrete, masonry and plaster surfaces (Parts 1 & 2)

IS:2402 - Code of practice for external rendered finishes

IS:2571 - Code of practice for laying in-situ cement concrete flooring

IS:2572 - Code of practice for construction of hollow concrete block masonry

IS:2645 - Specification of integral cement waterproofing compounds

IS:2690 - Specification for burnt clay flat terracing tiles : Part 1 Machine made

IS:2691 - Specification for burnt clay facing bricks

IS:2750 - Specification for steel scaffoldings

IS:2835 - Flat transparent sheet glass

IS:2932 - Specification for enamel, synthetic, exterior type (a) undercoating, (b) finishing

IS:3007 - Code of practice for laying of asbestos cement sheets - corrugated and (Part 1 & 2) semi-corrugated sheets

IS:3036 - Code of practice for laying lime concrete for a water-proofed roof finish

IS:3067 - Code of practice of general design details and preparatory work for damp-proofing and water-proofing of buildings

IS:3068 - Specification for broken brick (burnt clay) coarse aggregates for use in lime concrete

IS:3384 - Specification for bitumen primer for use in water-proofing and damp-proofing

IS:3461 - Specification for PVC-asbestos floor tiles

IS:3462 - Specification for unbacked flexible PVC flooring

IS:3495 - Method of test for burnt clay building bricks: Part 1 to 4

IS:3536 - Specification for ready mixed paint, brushing, wood primer, pink

IS:3564 - Specification for door closures (hydraulically regulated)

IS:3614 - Specification for fire checks doors : Part –I Plate metal covered and

(Part - 1) rolling type

IS:3614 - Specification for metallic and non-metallic fire check doors : Part-2

(Part – 2) Resistance test and performance criteria

IS:3696 - Safety code of scaffolds and ladders (Parts 1 & 2)

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IS:4020 - Methods of test for wooden flush door : Type test

IS:4021 - Specification for timber door, window and ventilator frames

IS:4351 - Specification for steel door frames

IS:4443 - Code of practice for use of resin type chemical resistant mortars

IS:4457 - Specification for ceramic unglazed vitreous acid resisting tile

IS:4631 - Code of practice for laying epoxy resin floor toppings

IS:4832 - Specification for chemical resistant mortars (Part II)

IS:4860 - Specification for acid resistant bricks

IS:4948 - Specification for welded steel wire fabric for general use

IS:5318 - Code of practice for laying of flexible PVC sheet and tile flooring

IS:5410 - Cement paint, colour as required

IS:5411 - Specification for plastic emulsion paint (Parts 1 & 2)

IS:5437 - Wired and figured glass

IS:5491 - Code of practice for laying of in-situ granolithic concrete floor topping

IS:6041 - Code of practice construction of autoclaved cellular concrete block masonry

IS:6042 - Code of practice for construction of light weight concrete block masonry

IS:6248 - Specification for metal rolling shutters and rolling grilles

IS:7193 - Specification for glass fibre base coal tar pitch and bitumen felts

IS:7452 - Specification for hot rolled steel sections for doors, windows and ventilators

IS:8042 - Specification for white portland cement

IS:8543 - Methods of testing plastics

IS:8869 - Specification for washers for corrugated sheet roofing

IS:9197 - Specification for epoxy resin, hardeners and epoxy resin composites for floor topping

IS:9862 - Specification for ready mixed paint, brushing, bituminous, black, lead-free, acid, alkali, water and chlorine resisting

IS:12200- Code of practice for provision of waterstops at transverse contraction joints in masonry and concrete dams

BS : 476 - Methods for determination of the fire resistance of elements of

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(Part – 20) construction (General Principles)

BS : 476 - Methods for determination of the fire resistance of load bearing

(Part – 21) elements of construction

BS : 476 - Methods for determination of the fire resistance of non-load

(Part – 22) bearing elements of construction

Part – IV - National Building code of India

Fire Protection

7.2 Brickwork

7.2.1 Materials

7.2.1.1 Bricks used in the works shall conform to the requirements laid down in IS: 1077. The class of the bricks shall be as specifically indicated in the respective items of work prepared by the Contractor.

7.2.1.2 The nominal size of the modular brick shall be 200mmx100mmx100mm with the permissible tolerances over the actual size of 190mmx90mmx90mm as per IS: 1077. The nominal thickness of one brick and half brick walls using modular bricks shall be considered as 200 mm and 100 mm respectively. In the event of use of traditional bricks of nominal size 230 mmx115mmx75mm with tolerance upto ±3 mm in each dimension, one brick and half brick walls shall be considered as 230 mm and 115 mm respectively.

7.2.1.3 Bricks shall be sound, hard, homogenous in texture, well burnt in kiln without being vitrified, hand/machine moulded, deep red, cherry or copper coloured, of regular shape and size & shall have sharp and square edges with smooth rectangular faces. The bricks shall be free from pores, cracks, flaws and nodules of free lime. Hand moulded bricks shall be moulded with a frog and those made by extrusion process may not be provided with a frog. Bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 5N/sq.mm unless otherwise specified in the Items of work prepared by the Contractor.

7.2.1.4 The average water absorption shall not be more than 20 percent by weight upto class 12.5 and 15 percent by weight for higher classes. Bricks which do not conform to this requirement shall be rejected. Over or under burnt bricks are not acceptable for use in the works.

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7.2.1.5 Sample bricks shall be submitted to the JDA for approval and bricks supplied shall conform to approved samples. If demanded by JDA, brick samples shall be got tested as per IS: 3495 by Contractor. Bricks rejected by JDA shall be removed from the site of works within 24 hours.

7.2.1.6 Mortar for brick masonry shall consist of cement and sand and shall be prepared as per IS: 2250. Mix shall be in the proportion of 1:5 for brickwork of thickness one brick or above and 1:4 for brickwork of thickness half brick or below, unless otherwise specified in the respective items of work prepared by the Contractor. Sand for masonry mortar shall conform to IS:218. The sand shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by JDA. If so directed by the JDA, sand shall be screened and washed till it satisfies the limits of deleterious materials.

7.2.1.7 For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Mixing shall be done thoroughly in a mechanical mixer, unless hand mixing is specifically permitted by the JDA. The mortar thus mixed shall be used as soon as possible, preferably within 30 minutes from the time water is added to cement. Incase, the mortar has stiffened due to evaporation of water, this may be re-tempered by adding water as required to restore consistency, but this will be permitted only upto 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and shall be removed forthwith from the site. Droppings of mortar shall not be re-used under any circumstances. The Contractor shall arrange for test on mortar samples if so directed by the JDA.

7.2.2 Workmanship

7.2.2.1 Workmanship of brick work shall conform to IS: 2212. All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work shall be as specified in the respective item of work prepared by the Contractor. Brick work 200mm/230mm thick and over shall be laid in English Bond unless otherwise specified. 100mm/115mm thick brickwork shall be laid with stretchers. 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 slightly pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Only full size bricks shall be used for the works and cut bricks utilised only as closers to make up required wall length or for bonding. Bricks shall be laid with frogs on top.

7.2.2.2 All brickwork shall be plumb, square 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. In case of one brick thick or half brick thick wall, at least one face should be kept smooth and plane, even if the other is slightly rough due to variation in size of bricks. For walls of thickness greater than one brick both faces shall be kept smooth and plane. 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 [illegible]

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But in no case the level difference between adjoining walls shall exceed one metre. Brick work shall not be raised more than one metre per day.

7.2.2.3 Bricks 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 10mm/15mm by raking tools during the progress of work when the mortar is still green, so as to provide a proper key for the plastering/ pointing respectively to be done later. When plastering or pointing 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.

7.2.2.4 During inclement weather conditions, newly built brick masonry works shall be protected by tarpaulin or other suitable covering to prevent mortar being washed away by rain.

7.2.2.5 Brickwork shall be kept constantly moist on all the faces for at least seven days after 24 hrs of laying. The arrangement for curing shall be got approved from the JDA.

7.2.2.6 Double scaffolding having two sets of vertical supports shall be provided to facilitate execution of the masonry works. The scaffolding shall be designed adequately considering all the dead, live and possible impact loads to ensure safety of the workmen, in accordance with the requirements stipulated in IS:2750 and IS:3696 (Part I). Scaffolding shall be properly maintained during the entire period of construction. Single scaffolding shall not be used on important works and will be permitted only in certain cases as decided by the JDA. Where single scaffolding is adopted, only minimum number of holes, by omitting a header shall be left in the masonry for supporting horizontal scaffolding poles. All holes in the masonry shall be carefully made good before plastering/pointing.

7.2.2.7 In the event of usage of traditional bricks of size 230 mm x115mm x75mm, the courses at the top of the plinth and sills as well as at the top of the wall just below the roof/floor slabs and at the top of the parapet shall be laid with bricks on edge.

7.2.2.8 All brickwork shall be built tightly against columns, floor slabs or other structural members.

7.2.2.9 To overcome the possibility of development of cracks in the brick masonry following measures shall be adopted.

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7.2.2.10 For resting RCC slabs, the bearing surface of masonry wall shall be finished on top with 12 mm thick cement mortar 1:3 and provided with 2 layers of Kraft paper Grade 1 as per IS:1397 or 2 layers of 50 micron thick polyethylene sheets.

7.2.2.11 RCC/ steel beams resting on masonry wall shall be provided with reinforced concrete bed blocks of 50 mm thickness, projecting 50mm on either sides of the beam, duly finished on top with 2 layers of Kraft paper Grade 1 as per IS:1397 or 2 layers of 50 micron thick polyethylene sheets.

7.2.2.12 Steel wire fabric shall be provided at the junction of brick masonry and concrete before taking up plastering work.

7.2.2.13 Bricks for partition walls shall be stacked adjacent to the structural member to pre-deflect the structural member before the wall is taken up for execution. Further, the top most course of half or full brick walls abutting against either a deshuttered slab or beam shall be built only after any proposed masonry wall above the structural member is executed to cater for the deflection of the structural element.

7.2.2.14 Reinforced cement concrete transomes and mullions of dimensions as indicated in the construction Drawings to be prepared by the Contractor are generally required to be provided in the half brick partition walls.

7.2.2.15 Where the drawings prepared by the Contractor indicate that structural steel sections are to be encased in brickwork, the brickwork masonry shall be built closely against the steel section, ensuring a minimum of 20mm thick cement-sand mortar 1:4 over all the steel surfaces. Steel sections partly embedded in brickwork shall be provided with bituminous protective coating to the surfaces at the point of entry into the brick masonry.

7.2.2.15 Facing bricks of the type specified conforming to IS:2691 shall be laid in the positions indicated on the Drawings prepared by the Contractor and all facing brickwork shall be well bonded to the backing bricks/RCC surfaces. The level of execution of the facing brick work shall at any time be lower by at least 600 mm below the level of the backing brickwork.

7.2.2.16 Facing bricks shall be laid over 10 mm thick backing of cement mortar. The mortar mix, thickness of joint and the type of pointing to be carried out shall be as specified in the item of works prepared by the Contractor. The pattern of laying the bricks shall be as specifically indicated in the Drawings prepared by the Contractor. For facing brickwork, double scaffolding shall be used. Faced works shall be kept clean and free from damage, discoloration etc., at all times.

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7.3 Uncoursed Random Rubble Masonry, in Foundation, Plinth and Superstructure

7.3.1 Materials

7.3.1.1 Stones for the works shall be of the specified variety which are hard, durable, fine grained and uniform in colour (for superstructure work) free from veins, flaws and other defects. Quality and work shall conform to the requirements specified in IS:1597 (Part-I). The percentage of water absorption shall not exceed 5 percent as per test conducted in accordance with IS:1124. The Contractor shall supply sample stones to the JDA for approval. Stones shall be laid with its grains horizontal so that the load transmitted is always perpendicular to the natural bed.

7.3.1.2 Cement-sand mortar for stone masonry works shall be in the proportion of 1:6. Materials and preparation of mortar shall be as specified in clause 7.2.1.

7.3.2 Workmanship

7.3.2.1 For All Works below ground level the masonry shall be random rubble uncoursed with ordinary quarry dressed stones for the hearting and selected quarry dressed stones for the facing.

7.3.2.2 For all works above ground level and in superstructure the masonry shall be random rubble uncoursed, well bonded, faced with hammer dressed stones with squared quoins at corners. The bushings on the face shall not be more than 40 mm on an exposed face and on the face to be plastered it shall not project by more than 12 mm nor shall it have depressions more than 10 mm from the average wall surface.

7.3.2.3 Face stones shall extend back sufficiently and bond well with the masonry. The depth of stone from the face of the wall inwards shall not be less than the height or breadth at the face. The length of the stone shall not exceed three times the height and the breadth on base shall not be greater than three-fourths the thickness of wall nor less than 150 mm. The height of stone may be upto a maximum of 300 mm. Face stones or hearting stones shall not be less than 150 mm in any direction.

7.3.2.4 Chips and spalls shall be used wherever necessary to avoid thick mortar joints and to ensure that no hollow spaces are left in the masonry. The use of chips and spalls in the hearting shall not exceed 20 percent of the quantity of stone masonry. Spalls and chips shall not be used on the face of the wall and below hearting stones to bring them to the level of face stones.

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7.3.2.5 The maximum thickness of joints shall not exceed 20 mm. All joints shall be completely filled with mortar. When plastering or pointing is not required to be done, the joints shall be struck flush and finished as the work proceeds. Otherwise, the joints shall be raked to a minimum depth of 20 mm by a raking tool during the progress of the work while the mortar is still green.

7.3.2.6 Through or bond stones shall be provided in walls upto 600 mm thick and in case of walls above 600 mm thickness, a set of two or more bond stones overlapping each other by at least 150 mm shall be provided in a line from face to back. In case of highly absorbent types of stones (porous lime stone and sand stone, etc.) the bond stone shall extend about two-thirds into the wall and a set of two or more bond stones overlapping each other by at least 150 mm shall be provided. Each bond stone or a set of bond stones shall be provided for every 0.5 sq.m of wall surface.

7.3.2.7 All stones shall be sufficiently wetted before laying to prevent absorption of water from the mortar. All connected walls in a structure shall be normally raised uniformly and regularly. However if any part of the masonry is required to be left behind, the wall shall be raked back (and not saw toothed) at an angle not exceeding 45deg. Masonry work shall not be raised by more than one metre per day.

7.3.2.8 Green work shall be protected from rain by suitable covering. Masonry work shall be kept constantly moist on all the faces for a minimum period of seven days for proper curing of the joints.

7.3.2.9 Type of scaffolding to be used shall be as specified in clause 7.2.2.

7.4 Coursed Rubble Masonry (First Sort) for Superstructure

7.4.1 Materials

7.4.1.1 The Material specification for the work shall be as per clause 7.3.1.

7.4.2 Workmanship

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7.4.2.1 All Courses shall be laid truly horizontal and shall be of the same height in any course. The height of course shall not be less than 150 mm and not more than 300 mm. The width of stone shall not be less than its height.

7.4.2.2 Face stones shall tail into the work for not less than their height and atleast 1/3rd the number of stones shall tail into the work for a length not less than twice their height but not more than three-fourths the thickness of the wall whichever is smaller. These should be laid as headers and stretchers alternately to break joints by atleast 75 mm.

7.4.2.3 The face stones shall be squared on all joints and beds; the bed joints being hammer or chisel dressed true and square for at least 80 mm back from the face and the side joints for atleast 40 mm. The face of the stone shall be hammer dressed so that the bushing shall not be more than 40 mm on an exposed face and 10 mm on a face to be plastered. No portion of the dressed surface shall show a depth of gap more than 6 mm from a straight edge placed on it. The remaining unexposed portion of the stone shall not project beyond the surface of bed and side joints.

7.4.2.4 No spalls or pinnings shall be allowed on the face. All bed joints shall be horizontal and side joints shall be vertical and no joints shall be more than 10 mm in thickness. When plastering or pointing is not required to be done, the joints shall be struck flush and finished as the work proceeds. Otherwise, the joints shall be raked to a minimum depth of 20 mm by a raking tool, during the progress of the work while the mortar is still green.

7.4.2.5 Hearting shall consist of flat bedded stones carefully laid on their proper beds and solidly bedded in mortar. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearting and these shall not exceed 10 percent of the quantity of the stone masonry. Care shall be taken so that no hollow spaces are left anywhere in the masonry.

7.4.2.6 The requirement regarding through or bond stones shall be as specified in clause 7.3.2 with the further stipulation that these shall be provided at 1.5 m to 1.8m apart clear in every course but staggered at alternate courses.

7.4.2.7 The quoins which shall be of the same height as the course in which they occur, shall not be less than 450 mm in any direction. Quoin stones shall be laid as stretchers and headers alternately. They shall be laid square on their beds, which shall be rough chisel dressed to a depth of at least 100 mm from the face. These stones shall have a minimum uniform chisel drafts of 25mm width at four edges, all the edges being in the same plane.

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7.4.2.8 Type of scaffolding to be used shall be as per Clause 7.2.2. Requirements of execution of the work and curing shall be as stipulated in clause 7.3.2 .

7.5 Concrete Block Masonry

7.5.1 Materials

7.5.1.1 Masonry units of hollow and solid concrete blocks shall conform to the requirements of IS : 2185 (Part I).

7.5.1.2 Masonry units of hollow and solid light-weight concrete blocks shall conform to the requirements of IS : 2185 (Part 3).

7.5.1.3 Masonry units of autoclaved cellular concrete blocks shall conform to the requirements of IS:2185 (Part 3).

7.5.1.4 The height of the concrete masonry units shall not exceed either its length or six times its width.

7.5.1.5 The nominal dimensions of concrete block shall be as under.

Length 400, 500 or 600 mm

Height 100 or 200 mm

Width 100 to 300 mm in 50 mm increments

7.5.1.6 Half blocks shall be in lengths of 200, 250 or 300mm to correspond to the full length blocks.

7.5.1.7 Actual dimensions shall be 10mm short of the nominal dimensions.

7.5.1.8 The maximum variation in the length of the units shall not be more than ±5 mm and maximum variation in height or width of the units shall not be more than ± 3mm.

7.5.1.9 Concrete blocks shall be either hollow blocks with open or closed cavities or solid blocks.

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7.5.1.10 Concrete blocks shall be sound, free of cracks, chipping or other defects which impair the strength or performance of the construction. Surface texture shall as specified. The faces of the units shall be flat and rectangular, opposite faces shall be parallel and all arises shall be square.

7.5.1.11 The bedding surfaces shall be at right angles to the faces of the block.

7.5.1.12 The concrete mix for the hollow and solid concrete blocks/light weight concrete blocks shall not be richer than one part of cement to six parts of combined aggregates by volume.

7.5.1.13 Concrete blocks shall be of approved manufacture, which satisfy the limitations in the values of water absorption, drying shrinkage and moisture movement, as specified for the type of block as per relevant IS code. Contractor shall furnish the test certificates and also supply the samples for the approval of JDA.

7.5.2 Workmanship

7.5.2.1 The type of the concrete block, thickness and grade based on the compressive strength for use in load bearing and/or non-load bearing walls shall be as specified. The minimum nominal thickness of non-load bearing internal walls shall be 100mm. The minimum nominal thickness of external panel walls in framed construction shall be 200 mm.

7.5.2.2 The workmanship shall generally conform to the requirements of IS:2572 for concrete block masonry, IS:6042 for light weight concrete block masonry and IS:6041 for autoclaved cellular concrete block masonry works.

7.5.2.3 From considerations of durability, generally concrete block masonry shall be used in superstructure works above the damp-proof course level.

7.5.2.4 Concrete blocks shall be embedded with a mortar which is relatively weaker than the mix of the blocks in order to avoid the formation of cracks. Cement mortar of proportion 1:6 shall be used for the works. Preparation of mortar shall be as specified in clause 7.2.1.

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7.5.2.5 The thickness of both horizontal and vertical joints shall be 10mm. The first course shall be laid with greater care, ensuring that it is properly aligned, levelled and plumb since this will facilitate in laying succeding courses to obtain a straight and truly vertical wall. For the horizontal (bedding) joint, mortar shall be spread over the entire top surface of the block including front and rear shells as well as the webs to a uniform layer of 10mm. For vertical joints, the mortar shall be applied on the vertical edges of the front and rear shells of the blocks. The mortar may be applied either to the unit already placed on the wall or on the edges of the succeeding unit when it is standing vertically and then placing it horizontally, well pressed against the previously laid unit to produce a compacted vertical joint. In case of two cell blocks with slight depression on the vertical sides these shall also be filled up with mortar to secure greater lateral rigidity. To assure satisfactory bond, mortar shall not be spread too far ahead of actual laying of the block as the mortar will stiffen and lose its plasticity Mortar while hardening shrinks slightly and thus pulls away from the edges of the block. The mortar shall be pressed against the units with a jointing tool after it has stiffened to effect intimate contact between the mortar and the unit to obtain a weather tight joint. The mortar shall be raked to a depth of 10mm as each course is laid to ensure good bond for the plaster.

7.5.2.6 Dimensional stability of hollow concrete blocks is greatly affected by variations of moisture content in the units. Only well dried blocks should be used for the construction. Blocks with moisture content more than 25% of maximum water absorption permissible shall not be used. The blocks should not be wetted before or during laying in the walls. Blocks should be laid dry except slightly moistening their surfaces on which mortar is to be applied to obviate absorption of water from the mortar.

7.5.2.7 As per the design requirements and to effectively control cracks in the masonry, RCC bound beams/studs, joint reinforcement shall be provided at suitable locations. Joint reinforcement shall be fabricated either from mild steel wires conforming to IS:280 or welded wire fabric/high strength deformed basis.

7.5.2.8 For jambs of doors, windows and openings, should concrete blocks shall be provided. If hollow units are used, the hollows shall be filled with concrete of mix 1:3:6. Hold fasts of doors/windows should be arranged so that they occur at block course level.

7.5.2.9 At intersection of walls, the courses shall laid up at the same time with a true masonry bond between atleast 50% of the concrete blocks. The sequence for construction of partition walls and treatment at the top of load bearing walls for the RCC slab shall be as detailed under clause 7.2 for the brick work.

7.5.2.10 Curing of the mortar joints shall be carried out for atleast 7 days. The walls should only be lightly moistened and shall not be allowed to become excessively wet.

7.5.2.11 Double scaffolding as per clause 7.2.2 shall be adopted for execution of block masonry work.

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7.5.2.12 Cutting of the units shall be restricted to a minimum. All horizontal and vertical dimensions shall be in respectively, adopting modular co-ordination for walls, opening locations for doors, windows etc.

7.5.2.13 Concrete blocks shall be stored at site suitably to avoid any contact with moisture from the ground and covered to protect against wetting.

7.6 Damp - Proof Course

7.6.1 Materials and Workmanship

7.6.1.1 Where Specified, all the walls in a building shall be provided with damp-proof course cover plinth to prevent water from rising up the wall. The damp-proof course shall run without a break throughout the length of the wall, even under the door or other openings. Damp-proof course shall consist of 50 mm thick cement concrete of 1:2:4 nominal mix with approved water-proofing compound admixture conforming to IS: 2645 in proportion as directed by the manufacturer. Concrete shall be with 10 mm down graded coarse aggregates.

7.6.1.2 The surface of brick work/stone masonry work shall be levelled and prepared before laying the cement concrete. Side shuttering shall be properly fixed to ensure that slurry does not leak through and is also not disturbed during compaction. The upper and side surface shall be made rough to afford key to the masonry above and to the plaster.

Damp-proof course shall be cured properly for atleast seven days after which it shall be allowed to dry for taking up further work.

7.7 Miscellaneous Inserts, Bolts etc.

7.7.1 All the miscellaneous inserts such as bolts, pipes, plate embedments etc., shall be accurately installed in the building works at the correct location and levels, all as detailed in the construction Drawings to be prepared by the Contractor prepared by the Contractor. Contractor shall prepare and use templates for this purpose, if so directed by the JDA. In the event, of any of the inserts are improperly installed, Contractor shall make necessary arrangements to remove and reinstall at the correct locations/levels, all as directed by the JDA.

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7.8 Wood Work for Doors, Windows, Ventilators & Partitions

7.8.1 Materials

7.8.1.1 Timber To be used shall be first class Teak wood as per IS:4021. Timber shall be of the best quality and well seasoned by a suitable process before being planed to the required sizes. The maximum permissible moisture content shall be from 10 to 16 percent for timber 50mm and above in thickness and 8 to 14 percent of timber less than 50mm in thickness for different regions of the country as stipulated in IS:287. Timber shall be close grained, of uniform colour and free from decay, fungal growth, boxed heart, pitch pockets or streaks on the exposed edges, borer holes, splits and cracks.

7.8.1.2 Flush door shutters of the solid core type with plywood face panels shall conform to IS:2202 (Part 1) and with particle board/hard board face panels shall conform to IS:2202 (Part 2).

7.8.1.3 Transparent sheet glass shall conform to the requirements of IS:2835. Wired and figured glass shall be as per IS:5437.

7.8.1.4 Builder's hardware for fittings and fixtures shall be of the best quality from approved manufacturers.

7.8.2 Workmanship

7.8.2.1 The workmanship and finish of wood work in doors, windows, ventilators and partitions shall be of a very high order. Contractor shall ensure that work is executed in a professional manner by skilled carpenters for good appearance, efficient and smooth operation of the shutters.

7.8.2.2 All works shall be executed as per the detailed Drawings prepared by the Contractor and/or as directed by the JDA.

7.8.2.3 All members of the door, window, and ventilator shall be straight without any warp or bow and shall have smooth well planed faces. The right angle shall be checked from the inside surfaces of the respective members of the frame. Frames shall have mortice and tenon joints which shall be treated with an approved adhesive and provided with metal or wood pins. The vertical members of the door frame shall project 50 mm below the finished floor level. The finished dimension of frames shall be rebated on the solid for keying with the

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plaster and for receiving the shutters. The depth of rebate for housing the shutter shall be 15 mm. The size of the frames shall be as specified in the respective items of work prepared by the Contractor. The workmanship shall generally conform to the requirements specified in IS:4021.

7.8.2.4 The face of the frames abutting the masonry or concrete shall be provided with a coat of coal tar.

7.8.2.5 Three hold fasts using 25 mm x 6 mm mild steel flats 225 mm long with split ends shall be fixed on each side of door and window frames, one at the centre and the other two at 300 mm from the top and bottom of the frame. For window and ventilator frames less than 1 m in height, two hold fasts on each side shall be fixed at quarter points.

7.8.2.6 Timber panelled shutters for doors, windows and ventilators shall be constructed in the form of framework of stiles and rails with panel insertion. The panels shall be fixed by either providing grooves in the stiles and rails or by beading. Glazing bars shall be as detailed in the Drawings prepared by the Contractor. The stiles and rails shall be joined by mortice and tenon joints at right angles. All members of the shutter shall be straight without any warp or bow and shall have smooth, well planed faces at right angles to each other. The right angle for the shutter shall be checked by measuring the diagonals and the difference shall not be more than $\pm$ 3 mm. Timber panels made from more than one piece shall be jointed with a continuous tongued and grooved joint, glued together and reinforced with metal dowels. The workmanship shall generally conform to the requirements specified in IS:1003 (Parts 1 & 2). The thickness of the shutter, width/thickness of the stiles/rails/panel type shall be as specified. Marine plywood panels conforming to IS:710 shall be used for doors where specified.

7.8.2.7 Details of the wooden flush door shutters, solid core type with specific requirement of the thickness, core, face panels, viewing glazed panel, venetian louvre opening, teak wood lipping etc. shall be as specified. Panels of shutter shall be of marine plywood conforming to IS:710. Flush door shutters shall be from reputed manufacturers and Contractor shall submit test results as per IS:4020, if so desired by the JDA.

7.8.2.8 Glazing of door, window, ventilator and partitions shall be with either flat transparent sheet glass, wired or figured glass. Transparent sheet glass shall be of 'B' quality as per IS:2835.The thickness and type of glazing to be provided shall be as specified.

7.8.2.9 The material of the fittings and fixtures either of chromium plated steel, cast brass, copper oxidised or anodised aluminum shall be as specified. The number, size and type of the fittings and fixtures shall be as specified.

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7.8.2.10 Woodwork shall not be provided with the finishes of painting/varnishing etc. unless it has been approved by the JDA. The type of finish and the number of coats shall be as stipulated in the respective items of work prepared by the Contractor. Preparation of the wood surfaces and application of the finishes shall be in accordance with clause 7.32.

7.8.2.11 Wooden hand railing and architrave's shall be of the size and shape with the fixing arrangement as indicated in the Drawings prepared by the Contractor.

7.8.2.12 The framework of the partitions with mullions and transoms shall be with the sections of dimensions as specified. Panels of double/single glazing/plywood shall be fixed as per details specified. Partitions shall be fixed rigidly between the floor and structural columns/beams including provision of necessary shims for wedging etc. Finished work shall be of rigid construction, erected truly plumb to the lines and levels, at locations as per the construction Drawings prepared by the Contractor.

7.8.2.13 Any carpentry work which show defects due to inadequate seasoning of the timber or bad workmanship shall be removed and replaced by Contractor with work as per Specifications.

7.9 teel Doors, Windows and Ventilators

7.9.1 Materials

7.9.1.1 Hot rolled steel sections for the fabrication of steel doors, windows and ventilators shall conform to IS: 7452, which are suitable for, single glazing.

7.9.1.2 Pressed steel door frames for steel flush doors shall be out of 1.25mm thick mild steel sheets of profiles as per IS : 4351.

7.9.1.3 Transparent sheet glass shall conform to the requirements of IS : 2835. Wired and figured glass shall be as per IS : 5437.

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7.9.1.4 Builder's hardware of fittings and fixtures shall be of the best quality from the approved manufacturers.

7.9.2 Workmanship

7.9.2.1 All steel doors, windows and ventilators shall be of the type as specified in the respective items of work prepared by the Contractor and of sizes as indicated in the Drawings prepared by the Contractor prepared by the Contractor. Steel doors, windows and ventilators shall conform to the requirements as stipulated in IS : 1038. Steel windows shall conform to IS : 1361, if so specified.

7.9.2.2 Doors, windows and ventilators shall be of an approved manufacture. Fabrication of the unit shall be with rolled section, cut to correct lengths and metered. Corners shall be welded to form a solid fused welded joint conforming to the requirements of IS : 1038. Tolerance in overall dimensions shall be within ±1.5mm. The frames and shutters shall be free from wrap or buckle and shall be square and truly plain. All welds shall be dressed flush on exposed and contact surfaces. Punching of holes, slots and other provisions to install fittings and fixtures later shall be made at the correct locations as per the requirements. Samples of the units shall be got approved by the JDA before further manufacture/purchase by the Contractor.

7.9.2.3 Type and details of shutters, hinges, glazing bar requirement, couplings, locking arrangement, fittings and fixtures shall be as described in the respective items of work and / or as shown in the Drawings prepared by the Contractor for single or composite units.

7.9.2.4 For windows with fly proof mesh as per the item of work prepared by the Contractor, rotor operator arrangement, for the operation of the glazed shutters from the inside shall be provided.

7.9.2.5 Pressed steel door frames shall be provided with fixing lugs at each jamb, hinges, lock-strike plate, mortar guards, angle threshold, shock-absorbers of rubber or similar material as per the requirements of IS : 4351. Pressed steel doorframes shall be fixed as `built-in' as the masonry work proceeds. After placing it plumb at the specified location, masonry walls shall be built up solid on either side and each course grouted with mortar to ensure solid contact with the doorframe, without leaving any voids. Temporary struts across the width shall be fixed, during erection to prevent bow/sag of the frame.

7.9.2.6 Door shutters of flush welded construction shall be 45mm thick, fabricated with two outer skills of 1.25mm thick steel sheets, 1mm thick steel sheet stiffeners and steel channels on all four edges. Double shutters shall have meeting stile edge beveled or rebated. Provision of glazed viewing panel, louvers shall be

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made as per the items of works and/or Drawings prepared by the Contractor. Shutters shall be suitably reinforced for lock and other surface hardware and to prevent sagging/twisting. Single sheet steel door shutters shall be fabricated out of 1.25mm thick steel sheets, mild steel angles and stiffeners as per the Drawings prepared by the Contractor.

7.9.2.7 Doors, windows and ventilators shall be fixed into the prepared openings. They shall not be 'built-in' as the masonry work proceeds, to avoid distortion and damage of the units. The dimensions of the masonry opening shall have 10mm clearance around the overall dimensions of the frame for this purpose. Any support of scaffolding members on the frames/glazing bars is prohibited.

7.9.2.8 Glazing of the units shall be either with flat transparent glass or wired / figured glass of the thickness as specified in the items of works prepared by the Contractor. All glass panels shall have properly squared corner and straight edges. Glazing shall be provided on the outside of the frames.

7.9.2.9 Fixing of the glazing shall be either with spring glazing clips and putty conforming to IS:419 or with metal beads. Pre-formed PVC or rubber gaskets shall be provided for fixing the beads with the concealed screws. The type of fixing the glazing shall be as indicated in the items of work and/or in Drawings prepared by the Contractor.

7.9.2.10 Steel doors, windows and ventilators shall be provided with finish of either painting as specified or shall be hot dip galvanised with thickness of the zinc coating as stipulated all as described in the respective items of works prepared by the Contractor.

7.9.2.11 The material of the Builders hardware of fittings and fixtures of chromium plated steel, cast brass, brass copper oxidised or anodised aluminium shall be as specified in the items of works prepared by the Contractor. The number , size and type of fittings and fixtures shall be as in the Drawings /items of works prepared by the Contractor.

7.9.2.12 Installation of the units with fixing lugs, screws, mastic caulking compound at the specified locations shall generally conform to the requirements of IS:1081. Necessary holes etc required for fixing shall be made by the Contractor and made good after installation. Workmanship expected is of a high order for efficient and smooth operation of the units.

7.10 Aluminum Doors, Windows, Ventilators & Partitions

7.10.1 Materials

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7.10.1.1 Aluminum alloy used in the manufacture of extruded sections for the fabrication of doors, windows, ventilators shall conform to designation HE9-WP of IS:733.

7.10.1.2 Transparent sheet glass shall conform to the requirements of IS:2835. Wired and figured glass shall be as per IS:5437.

7.10.1.3 Builder's hardware of fittings & fixtures shall be of the best quality from approved manufacturers.

7.10.2 Workmanship

7.10.2.1 All aluminum doors, windows, ventilators and partitions shall be of the type and size as specified. The doors, windows, ventilators shall conform to the requirements of IS:1948. Aluminum windows, shall conform to IS:1949, if so specified.

7.10.2.2 All aluminum units shall be supplied with anodized finish. The minimum anodic film thickness shall be 0.015 mm.

7.10.2.3 Doors, windows and ventilators shall be of an approved manufacture. Fabrication of the units shall be with the extruded sections, cut to correct lengths, mitred and welded at the corners to a true right angle conforming to the requirements of IS:1948. Tolerance in overall dimensions shall be within ± 1.5mm. The frames and shutters shall be free from warp or buckle and shall be square and truly plane. Punching of holes, slots and other provisions to install fittings or fixtures later shall be made at the correct locations, as per the requirements.

7.10.2.4 Aluminium swing type doors, aluminum sliding windows, partitions shall be as specified.

7.10.2.5 IS:1948 and IS:1949 referred to incorporates the sizes, shapes, thicknesses and weight per running metre of extruded sections for the various components of the units. However, new sizes, shapes, thicknesses with modifications to suit snap-fit glazing clips etc. are being continuously being added by various leading manufacturers of extruded sections, which are available in the market. As such, the sections of the various components of the unit proposed by the Contractor, will be reviewed by the JDA and will be accepted only if they are equal to or marginally more than that given in the codes/as specified.

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7.10.2.6 The framework of the partitions with mullions and transomes shall be with anodised aluminium box sections. Anodised aluminium box sections shall be in-filled with timber of class 3 (silver oak or any other equivalent) as per IS:4021. Panels of double/single glazing/plywood shall be fixed as per details indicated in the Drawings to be prepared by the Contractor. Partitions shall be fixed rigidly between the floor and the structural columns/beams including provision of necessary shims for wedging etc. Finished work shall be of rigid construction, erected truly plumb to the lines and levels, at locations as per the construction Drawings to be prepared by the Contractor.

7.10.2.7 Specific provisions as stipulated for steel doors, windows, ventilators under clause 7.9.2 shall also be applicable for this item work. Glazing beads shall be of the snap-fit type suitable for the thickness of glazing proposed as indicated in the items of works prepared by the Contractor. A layer of clear transparent lacquer shall be applied on aluminium sections to protect them from damage during installation. This lacquer coating shall be removed after the installation is completed.

7.11 Steel Rolling Shutters

7.11.1 Materials and Workmanship

7.11.1.1 Rolling shutters shall be of an approved manufacture, conforming to the requirements specified in IS:6248.

7.11.1.2 The type of rolling shutter shall be self coiling type (manual) for clear areas upto 12 sq.m, gear operated type (mechanical) for clear areas upto 35 sq.m and electrically operated type for areas upto 50 sq.m. Mechanical type of rolling shutters shall be suitable for operation from both inside and outside with the crank handle or chain gear operating mechanism duly considering the size of wall/column. Electrical type of rolling shutter shall also be provided with a facility for emergency mechanical operation.

7.11.1.3 Rolling shutters shall be supplied duly considering the type, specified clear width/height of the opening and the location of fixing as indicated in the Drawings prepared by the Contractor.

7.11.1.4 Shutters shall be built up of interlocking laths 75 mm width between rolling centres formed from cold rolled steel strips. The thickness of the steel strip shall not be less than 0.90 mm for shutters upto 3.50 m width and not less than 1.20 mm for shutters above 3.50 m width. Each lath section shall be continuous single piece without any welded joint.

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7.11.1.5 The guide channels out of mild steel sheets of thickness not less than 3.15 mm shall be of either rolled, pressed or built up construction. The channel shall be of size as stipulated in IS:6248 for various clear widths of the shutters.

7.11.1.6 Hood covers shall be of mild steel sheets not less than 0.90 mm thick and of approved shape.

7.11.1.7 Rolling shutters shall be provided with a central hasp and staple safety device in addition to one pair of lever locks and sliding locks at the ends.

7.11.1.8 All component parts of the steel rolling shutter (excepting springs and insides of guide channels) shall be provided with one coat of zinc chrome primer conformity to IS:2074 at the shop before supply. These surfaces shall be given an additional coat of primer after erection at the site along with the number of coats and type of finish paint as specified in the respective items of works prepared by the Contractor. Painting shall be carried out as per clause 7.33.

7.11.1.9 In case of galvanised rolling shutter, the lath sections, guides, lock plate, bracket plates, suspension shaft and the hood cover shall be hot dip galvanised with a zinc coating containing not less than 97.5 percent pure zinc. The weight of the zinc coating shall be atleast 610gms/sq.m.

7.11.1.10Guide channels shall be installed truly plumb at the specified location. Bracket plate shall be rigidly fixed with necessary bolts and holdfasts. Workmanship of erection shall ensure strength and rigidity of rolling shutter for trouble free and smooth operation.

7.12 Rubble Sub-Base

7.12.1 Materials

7.12.1.1 Stones used for rubble packing under floors on grade, foundations etc., shall be clean, hard, durable rock free from veins, flaws, laminations, weathering and other defects. Stones shall generally conform to the requirements stipulated in IS: 1597 (Part I).

7.12.1.2 Stones shall be as regular as can be obtained from quarries. Stones shall be of height equal to the thickness of the packing proposed with a tolerance of ±10 mm. Stones shall not have a base area less than 250

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sq cm nor more than 500 sq.cm, and the smallest dimension of any stone shall not be less than half the largest dimension. The quality and size of stones shall be subject to the approval of the JDA.

7.12.2 Workmanship

7.12.2.1 Stones shall be hand packed carefully and laid with their largest base downwards resting flat on the prepared sub-grade and with their height equal to the thickness of the packing. Stones shall be laid breaking joints and in close contact with each other. All interstices between the stones shall be wedged-in by small stones of suitable size, well driven in by crow bars and hammers to ensure tight packing and complete filling-in of the interstices. The wedging shall be carried out simultaneously with the placing in position of rubble packing and shall not lag behind. After this, any interstices between the smaller wedged stones shall be infilled with clean hard sand by brooming so as to fill the joints completely.

7.12.2.2 The laid rubble packing shall be sprinkled with water and compacted by using suitable rammers.

7.13 Base Concrete

7.13.1 The thickness and grade of concrete and reinforcement shall be as specified in items of works prepared by the contractor.

7.13.2 Before placing the blinding concrete, the sub-base of rubble packing shall be properly wetted and rammed. Concrete for the base shall then be deposited between the forms, thoroughly tamped and the surface finished level with the top edges of the forms. Two or three hours after the concrete has been laid in position, the surface shall be roughened using steel wire brush to remove any scum or laitance and swept clean so that the coarse aggregates are exposed. The surface of the base concrete shall be left rough to provide adequate bond for the floor finish to be provided later.

7.14 Terrazzo and Plain Cement Tiling Work

7.14.1 Materials

7.14.1.1 Terrazzo tiles and cement tiles shall generally conform in all respects to standards stipulated in IS:1237. Tiles shall be of the best quality manufactured adopting hydraulic pressure of not less than 14N/mm2 or

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7.14.1.2 The type, quality, size, thickness colour etc, of the tiles for flooring/dado/skirting shall be as specified.

7.14.1.3 The aggregates for terrazzo topping shall consist of marble chips which are hard, sound and dense. Cement to be used shall be either ordinary portland cement or white cement with or without colouring pigment. The binder mix shall be with 3 parts of cement to 1 part of marble powder by weight. The proportion of cement shall be inclusive of any pigments. For every one part of cement-marble powder binder mix, the proportion of aggregates shall be 1.75 parts by volume, if the chips are between 1mm to 6mm and 1.50 parts by volume if the chips are between 6mm to 25mm.

7.14.1.4 The minimum thickness of wearing layer of terrazzo tiles shall be 5mm for tiles with chips of size varying from 1mm upto 6mm or from 1mm upto 12mm. This shall be 6mm for tiles with chips varying from 1mm upto 25mm. The minimum thickness of wearing layer of cement/coloured cement tiles shall be 5mm. This shall be 6mm for heavy duty tiles. Pigment used in the wearing layer shall not exceed 10 percent of the weight of cement used in the mix.

7.14.2 Workmanship

7.14.2.1 Laying and finishing of tiles shall conform to the requirements of workmanship stipulated in IS:1443.

7.14.2.2 Tiling work shall be commenced only after the door and window frames are fixed and plastering of the walls/ ceiling is completed. Wall plastering shall not be carried out upto about 50mm above the level of proposed skirting/dado.

7.14.2.3 The base concrete shall be finished to a reasonably plane surface about 40 to 45mm below the level of finished floor. Before the tiling work is taken up, the base concrete or structural slab shall be cleaned of all loose materials, mortar droppings, dirt, laitance etc. using steel wire brush and well wetted without allowing any water pools on the surface.

7.14.2.4 A layer of 25mm average thickness of cement mortar consisting of one part of cement to 6 parts of sand shall be provided as bedding for the tiles over the base concrete. The thickness of bedding mortar shall not be less than 10mm at any place. The quantity of water to be added for the mortar shall be just adequate to obtain the workability for laying. Sand for the mortar shall conform to IS:2116 and shall have minimum fineness

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modulus of 1.5. The surface shall be left rough to provide a good bond for the tiles. The bedding shall be allowed to harden for a day before laying of the tiles.

7.14.2.5 Neat cement slurry using 4.4 kg of cement per sq.m of floor area shall be spread over the hardened mortar bedding over such an area at a time as would accommodate about 20 tiles. Tiles shall be fixed in this slurry one after the other, each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be in straight lines and shall normally be 1.5mm wide. On completion of laying of the tiles in a room, all the joints shall be cleaned and washed fairly deep with a stiff broom/wire brush to a minimum depth of 5mm. The day after the tiles have been laid, the joints shall be filled with cement grout of the same shade as the colour of the matrix of the tile. For this purpose white cement or grey cement with or without pigments shall be used. The flooring should be kept moist and left undisturbed for 7 days for the bedding/joints to set properly. Heavy traffic shall not be allowed on the floor for atleast 14 days after fixing of the tiles.

7.14.2.6 About a week after laying the tiles, each and every tile shall be lightly tapped with a small wooden mallet to find out if it gives a hollow sound; if it does, such tiles along with any other cracked or broken tiles shall be removed and replaced with new tiles to proper line and level. The same procedure shall be followed again after grinding the tiles and all damaged tiles replaced, properly jointed and finished to match. For the purpose of ensuring that such replaced tiles match with those laid earlier, it is necessary that the Contractor shall procure sufficient quantity of extra tiles to meet this contingency.

7.14.2.7 Wherever a full tile cannot be provided, tiles shall be cut to size and fixed. Floor tiles adjoining the wall shall go about 10mm under the plaster, skirting or dado.

7.14.2.8 Tile skirting and dado work shall be executed only after laying tiles on the floor. For dado and skirting work, the vertical wall surface shall be thoroughly cleaned and wetted. Thereafter it shall be evenly and uniformly covered with 10mm thick backing of 1:4 cement sand mortar. For this work the tiles as obtained from the factory shall be of the size required and practically full polished. The back of each tile to be fixed shall be covered with a thin layer of neat cement paste and the tile shall then be gently tapped against the wall with a wooden mallet. Fixing shall be done from the bottom of the wall upwards. The joints shall be in straight lines and shall normally be 1.5mm wide. Any difference in the thickness of the tiles shall be evened out in the backing mortar or cement paste so that the tile faces are in conformity & truly plumb. Tiles for use at the corners shall be suitably cut with bevelled edges to obtain a neat and true joint. After the work has set, hand polishing with carborundum stones shall be done so that the surface matches with the floor finish.

7.14.2.9 Wall plastering of the strip left out above the level of skirting/dado shall be taken up after the tiles are fixed.

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7.14.2.10Chequered terrazzo tiles for flooring and for stair treads shall be delivered to site after the first machine grinding.

7.14.2.11Machine grinding and polishing shall be commenced only after a lapse of 14 days of laying. The sequence and three numbers of machine grinding operations, usage of the type of carborundum stones, filling up of pin holes, watering etc. shall be carried out all as specified in IS:1443.

7.14.2.12Tiles shall be laid to the levels specified. Where large areas are to be tiled the level of the central portion shall be kept 10mm higher than that at the walls to overcome optical illusion of a depression in the central portion. Localised deviation of ±3mm in any 3m length is acceptable in a nominally flat floor.

7.15 In-Situ Terrazzo Work

7.15.1 Materials

7.15.1.1 The requirements of marble aggregates for terrazzo topping shall be as per clause 7.14.1.

7.15.1.2 Cement shall first be mixed with the marble powder in dry state. The mix thus obtained shall be mixed with the aggregates in the specified proportions. Care shall be taken not to get the materials into a heap which results in the coarsest chips falling to the edges and cement working to the centre at the bottom. Materials shall be kept, as far as possible, in an even layer during mixing. After the materials have been thoroughly mixed in the dry state, water shall be added, just adequate to obtain plastic consistency for the desired workability for laying. The mix shall be used in the works within 30 minutes of the addition of water to the cement.

7.15.2 Workmanship

7.15.2.1 The thickness, type, quality, size and colour of chips etc. for the in-situ terrazzo finish for flooring/dado/ skirting shall be as specified in the respective items of works prepared by the Contractor. Laying and finishing of in-situ work shall conform to the requirements of workmanship stipulated in IS: 2114.

7.15.2.2 In-situ terrazzo finish shall be laid over hardened concrete base. The finish layer consists of an under layer and terrazzo topping. The underlayer shall be of cement concrete of mix 1:2:4 using 10mm down

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graded coarse aggregates. The combined thickness of under layer and topping shall not be less than 30 mm for flooring and 20mm for dado/skirting work.

7.15.2.3 The minimum thickness of topping shall be 6mm if chips used are between 1mm to 4mm, 9mm if chips are between 4mm to 7mm and 12mm if chips are between 7mm to 10mm. If chips larger than 10mm size are used, the minimum thickness shall be one and one third the maximum size of chips.

7.15.2.4 Both the underlayer and later the topping shall be divided into panels not exceeding 2 sq.m for laying so as to reduce the possibility of development of cracks. The longer dimension of any panel shall not exceed 2m. Dividing strips shall be used to separate the panels. When the dividing strips are not provided, the bays shall be laid alternately, allowing an interval of atleast 24 hours between laying adjacent bays.

Dividing strips shall be either of aluminium, brass or other material as indicated in the items of works prepared by the Contractor. Aluminum strips should have a protective coating of bitumen. The thickness of the strips shall be not less than 1.5mm and width not less than 25mm for flooring work.

Concrete base shall be finished to a reasonably plane surface to a level below the finished floor elevation equal to the specified thickness of terrazzo finish. Before spreading the unde rlayer, the base concrete surface shall be cleaned of all loose materials, mortar droppings, dirt, laitance etc. and well wetted without allowing any water pools on the surface. Dividing strips or screed strips, if dividing strips are not provided shall be fixed on the base and levelled to the correct height to suit the thickness of the finish. Just before spreading the under layer the surface shall be smeared with cement slurry at 2.75 Kg/sq.m. Over this slurry, the under layer shall be spread and levelled with a screeding board. The top surface shall be left rough to provide a good bond for the terrazzo topping.

7.15.2.7 Terrazzo topping shall be laid while the under layer is still plastic and normally between 18 to 24 hours after the under layer is laid. Cement slurry of the same colour as the topping shall be brushed on the surface immediately before laying is commenced. The terrazzo mix shall be laid to a uniform thickness and compacted thoroughly by tamping and with a minimum of troweling. Straight edge and steel floats shall be used to bring the surface true to the required level in such a manner that the maximum amount of marble chips come up and spread uniformly all over the surface.

7.15.2.8 The surface shall be left dry for air-curing for a period of 12 to 18 hours. Thereafter it shall be cured by allowing water to stand in pools for a period of not less than 4 days.

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7.15.2.9 Machine grinding and polishing shall be commenced only after a lapse of 7 days from the time of completion of laying. The sequence and four numbers of machine grinding operations, usage of the type of carborundum stones, filling up of pinholes, wet curing, watering etc shall be carried out all as specified in IS: 2114.

7.16 Shahabad / Tandur/ Kota Stone Slab work

7.16.1 Materials

7.16.1.1 The slabs shall be of approved selected quality, hard, sound, dense and homogenous in texture, free from cracks, decay, weathering and flaws. The percentage of water absorption shall not exceed 5 percent as per test conducted in accordance with IS : 1124.

7.16.1.2 The slabs shall be hand or machine cut to the required thickness. Tolerance in thickness for dimensions of tile more than 100mm shall be ±5mm. This shall be ±2mm on dimensions less than 100mm.

7.16.1.3 Slabs shall be supplied to the specified size with machine cut edges or fine chisel dressed to the full depth. All angles and edges of the slabs shall be true and square, free from any chipping giving a plane surface. Slabs shall have the top surface machine polished (first grinding) before being brought to site. The slabs shall be washed clean before laying.

7.16.2 Workmanship

7.16.2.1 The type, size, thickness and colour/shade etc. of the slabs for flooring/dado/skirting shall be as specified in the respective items of works prepared by the Contractor.

7.16.2.2 Preparation of the concrete base, laying and curing shall be as per clause 7.14.2.

7.16.2.3 Dado / skirting work shall be as per clause 7.14.2. The thickness of the slabs for dado/skirting work shall not be more than 25mm. Slabs shall be so placed that the back surface is at a distance of 12mm. If necessary, slabs shall be held in position temporarily by suitable method. After checking for verticality, the gap shall be filled and packed with cement sand mortar of proportion 1:3. After the mortar has acquired sufficient strength, the temporary arrangement holding the slab shall be removed.

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7.16.2.4 Grinding and polishing shall be as per clause 7.14.2 except that first grinding with coarse grade carborundum shall not be done and cement slurry with or without pigment shall not applied before polishing.

7.17 Carborundum Tile Finish

7.17.1 Materials

7.17.1.1 Carborundum tiles shall generally conform in all respects to the standards stipulated in IS:1237 for heavy duty tiles. Tiles shall be of the best quality manufactured adopting hydraulic pressure of not less than 14 N/mm2.

7.17.1.2 The topping shall be uniform and of thickness not less than 6mm. The quantity of carborundum grit shall be not less than 1.35 kg/sq.m used with cement with or without pigment. The carborundum grit shall pass through 1.18mm mesh and shall be retained on 0.60 mm mesh.

7.17.2 Workmanship

7.17.2.1 Requirements as detailed for terrazzo/cement tile finish under clause 7.14.2 shall be applicable for carborundum tile flooring.

7.18 Glazed Tile Finish

7.18.1 Materials

7.18.1.1 Glazed earthenware tiles shall conform to the requirements of IS: 777. Tiles shall be of the best quality from an approved manufacturer. The tiles shall be flat, true to shape and free from flaws such as crazing, blisters, pinholes, specks or welts. Edges and underside of the tiles shall be free from glaze and shall have ribs or indentations for a better anchorage with the bedding mortar. Dimensional tolerances shall be as specified in IS: 777.

7.18.2 Workmanship

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7.18.2.1 The total thickness of glazed tile finish including the bedding mortar shall be 20 mm in flooring/dado/skirting. The minimum thickness of bedding mortar shall be 12mm for flooring and 10mm for dado/skirting work.

7.18.2.2 The bedding mortar shall consist of 1 part of cement to 3 parts of sand mixed with just sufficient water to obtain proper consistency for laying. Sand for the mortar shall conform to IS: 2116 and shall have minimum fineness modulus of 1.5.

7.18.2.3 Tiles shall be soaked in water for about 10 minutes just before laying. Where full size tiles cannot be fixed, tiles shall be cut to the required size using special cutting device and the edges rubbed smooth to ensure straight and true joints.

7.18.2.4 Coloured tiles with or without designs shall be uniform and shall be preferably procured from the same batch of manufacture to avoid any differences in the shade.

7.18.2.5 Tiles for the flooring shall be laid over hardened concrete base. The surface of the concrete base shall be cleaned of all loose materials, mortar droppings etc well wetted without allowing any water pools on the surface. The bedding mortar shall then be laid evenly over the surface, tamped to the desired level and allowed to harden for a day. The top surface shall be left rough to provide a good bond for the tiles. For skirting and dado work, the backing mortar shall be roughened using a wire brush.

7.18.2.6 Neat cement slurry using 3.3 kg cement per sq.m of floor area shall be spread over the hardened mortar bed over such an area as would accommodate about 20 tiles. Tiles shall be fixed in this slurry one after the other, each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. For skirting and dado work, the back of the tiles shall be smeared with cement slurry for setting on the backing mortar. Fixing of tiles shall be done from the bottom of the wall upwards. The joints shall be in perfect straight lines and as thin as possible but shall not be more than 1mm wide. The surface shall be checked frequently to ensure correct level/required slope. Floor tiles near the walls shall enter skirting/dado to a minimum depth of 10mm. Tiles shall not sound hollow when tapped.

7.18.2.7 All the joints shall be cleaned of grey cement with wire brush to a depth of at least 3mm and all dust, loose mortar etc. shall be removed. White cement with or without pigment shall then be used for flush pointing the joints. Curing shall then be carried out for a minimum period of 7 days for the bedding and joints to set properly. The surface shall then be cleaned using a suitable detergent, fully washed and wiped dry.

7.18.2.8 Specials consisting of coves, internal and external angles, cornices, heads and their corner pieces shall be of thickness not less than the tiles with which they are used.

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7.19 In-Situ Cement Concrete Floor Topping

7.19.1 Materials

7.19.1.1 The mix proportion for the in-situ concrete floor topping shall be 1:2.5:3.5 (one part cement : two and half parts sand : three and half parts coarse aggregates) by volume unless otherwise specified.

7.19.1.2 The aggregates shall conform for the requirements of IS:383.

7.19.1.3 Coarse aggregates shall have high hardness surface texture and shall consist of crushed rock of granite, basalt, trap or quartzite. The aggregate crushing valve shall not exceed 30 percent. The grading of the aggregates of size 12.5mm and below shall be as per IS:2571.

7.19.1.4 Grading of the sand shall be within the limits indicated in IS:2571.

7.19.2 Workmanship

7.19.2.1 The thickness of the floor topping shall be as specified in the items of work prepared by the Contractor. The minimum thickness of the floor topping shall be 25mm.

7.19.2.2 Preparation of base concrete/structural slab before laying the topping shall be as per clause 7.13. The surface shall be rough to provide adequate bond for the topping.

7.19.2.3 Mixing of concrete shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the JDA. The concrete shall be as stiff as possible and the amount of water added shall be the minimum necessary to give just sufficient plasticity for laying and compacting. The mix shall be used in the work within 30 minutes of the addition of water for its preparation.

7.19.2.4 Floor finish shall be laid in suitable panels to reduce the risk of cracking. No dimension of a panel shall exceed 2 meters and the length of a panel shall not exceed one and a half times its breadth. Topping shall be

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be laid in alternate panels, the intermediate panels being cast after a gap of at least one day. Construction joints shall be plain vertical butt joints.

7.19.2.5 Screed strips shall be fixed dividing the area into suitable panels. Immediately before depositing the concrete topping, neat cement slurry at 2.75 kg/sq.m of area shall be thoroughly brushed into the prepared surface. Topping shall then be laid, very thoroughly tamped, struck off level and floated with wooden float. The surface shall then be tested with a straight edge and mason's spirit level to detect any inequalities and these shall be made good immediately.

7.19.2.6 Finishing of the surface by troweling shall be spread over a period of one to six hours depending upon the temperature and atmospheric conditions. The surface shall be trowelled 3 times at intervals so as to produce a smooth uniform and hard surface. Immediately after laying, the first trowelling just sufficient to give a level surface shall be carried out avoiding excessive trowelling at this stage. The surface shall be re- trowelled after sometime to close any pores and to scrap off excess water or laitance, which shall not be trowelled back into the topping. Final trowelling shall be done well before the concrete has become too hard but at a time when considerable pressure is required to make any impression on the surface. Sprinkling of dry cement or cement-sand mixture for absorbing moisture shall not be permitted.

7.19.2.7 Immediately after the surface is finished, it shall be protected suitably from rapid drying due to wind/ sunlight. After the surface has hardened sufficiently to prevent any damage to it, the topping shall be kept continuously moist for a minimum period of 10 days.

7.19.2.8 It is preferable to lay the topping on hardened base concrete, as against being laid monolithically with a lesser thickness, since proper levels and slopes with close surface tolerances is achievable in practice, owing to its greater thickness. Further, as this would be laid after all other building operations are over, there will be no risk of any damages or discoloration to the floor finish which are difficult to repair satisfactorily.

7.20 In-Situ Granolithic Concrete Floor Topping

7.20.1 Materials and Workmanship

7.20.1.1 The Requirements of materials and workmanship shall be all as per clause 7.19 for in-situ cement concrete floor topping except that the mix proportion of the concrete shall be 1:1:2 (cement: sand : coarse aggregates) by volume.

7.20.1.2 The minimum thickness of granolithic floor topping on hardened concrete base shall be 40mm.

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7.21 Floor Hardener Topping

7.21.1 Materials & Workmanship

7.21.1.1 Floor Hardener topping shall be provided either as integrally finished over the structural slab/grade slab or laid monolithically with the concrete/granolithic floor finish on top of hardened concrete base.

7.21.1.2 Floor hardener of the metallic or non-metallic type suitable for the performance of normal / medium/ heavy duty function of the floor, the quantum of ingredients and the thickness of topping shall be as specified in the respective items of work prepared by the Contractor.

7.21.1.3 For monolithic application with the floor finish/slab the thickness of the layer shall be 15mm. The topping shall be laid within 2 to 3 hours after concrete is laid when it is still plastic but stiffened enough for the workmen to tread over it by placing planks. The surface of the concrete layer shall be kept rough for providing adequate bond for the topping. Laitance shall be removed before placing the topping. The topping shall be screeded and thoroughly compacted to the finished level. Trowelling to a smooth finish shall be carried out as per clause 7.19.2. After the surface has hardened sufficiently, it shall be kept continuously moist for at least 10 days.

7.21.1.4 The procedure for mixing the floor hardener topping shall be as per manufacturer's instructions.

7.21.1.5 Surface shall be prevented from any damages due to subsequent building operations by covering with 75 mm thick layer of sand.

7.22 PVC Sheet/Tile Flooring

7.22.1 Materials

7.22.1.1 PVC floor covering shall be of either unbacked homogeneous flexible type in the form of sheets/tiles conforming to IS:3462 or homogeneous PVC asbestos tiles conforming to IS:3461.

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7.22.1.2 The surface of the sheets/tiles shall be free from any physical defects such as pores, blisters, cracks etc. which affects the appearance and serviceability. Tiles/ sheets shall meet with the tolerance limits in dimensions specified in the IS. Contractor shall submit the test certificates, if so desired by the JDA.

7.22.1.3 Each tile/sheet shall be legibly and indelibly marked with the name of the manufacturer or his trade mark, IS certificate mark, and batch number.

7.22.1.4 The adhesive to be used for laying the PVC flooring shall be rubber based and of the make as recommended and approved by the manufacturer of PVC sheets/tiles.

7.22.1.5 The type, size, colour, plain or mottled and the pattern shall be as specified in the respective items of work prepared by the Contractor.

7.22.2 Workmanship

7.22.2.1 PVC Floor covering shall be provided over an under bed of cement concrete floor finish over the base concrete or structural slab. It is essential that the sub-floor and the under bed are perfectly dry before laying the PVC flooring. This shall be ensured by methods of testing as stipulated in Appendix-A of IS:5318.

7.22.2.2 The surface of the under bed shall have trowelled finish without any irregularities, which creates poor adhesion. Surface shall be free of oil or grease and thoroughly cleaned of all dust, dirt and wiped with a dry cloth.

7.22.2.3 PVC sheets/tiles shall be brought to the temperature of the area in which they are to be laid by stacking in a suitable manner within or near the laying area for a period of about 24 hours. Where air-conditioning is installed, the flooring shall not be laid on the under bed until the A/C units have been in operation for at least 7 days. During this period, the temperature range shall be between 20deg.C and 30deg.C and this shall be maintained during the laying operations and also for 48 hours thereafter.

7.22.2.4 Layout of the PVC flooring shall be marked with guidelines on the under bed and PVC tiles/sheets shall be first laid for trial, without using the adhesive, according to the layout.

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7.22.2.5 The adhesive shall be applied by using a notched trowel to the surface of the under bed and to the backside of PVC sheets/tiles. When the adhesive has set sufficiently for laying, it will be tacky to the touch, which generally takes about 30 minutes. The time period need be carefully monitored since a longer interval will affect the adhesive properties. Adhesive shall be uniformly spread over only as much surface area at one time which can be covered with PVC flooring within the stipulated time.

7.22.2.6 PVC sheet shall be carefully taken and placed in position from one end onwards slowly so that the air will be completely squeezed out between the sheet and the background surface and no air pockets are formed. It shall then be pressed with a suitable roller to develop proper contact. The next sheet shall be laid edge to edge with the sheet already laid, so that there is minimum gap between joints. The alignment shall be checked after each row of sheet is completed and trimmed if considered necessary.

7.22.2.7 Tiles shall be laid in the same manner as sheets and preferably, commencing from the centre of the area. Tiles should be lowered in position and pressed firmly on to the adhesive with minimum gap between the joints. Tiles shall not be slided on the surface. Tiles shall be rolled with a light wooden roller of about 5kg to ensure full contact with the underlay. Work should be constantly checked to ensure that all four edges of adjacent tiles meet accurately.

7.22.2.8 Any excess adhesive which may squeeze up between sheets/tiles shall be wiped off immediately with a wet cloth. Suitable solvents shall be used to remove hardened adhesive.

7.22.2.9 A minimum period of 24 hours shall be given after laying for the development of proper bond of the adhesive. When the flooring is thus completed, it shall be cleaned with a wet cloth soaked in warm soap solution.

7.22.2.10Metallic edge strips shall be used to protect the edges of PVC sheets/tiles which are exposed as in doorways/ stair treads.

7.22.2.11Hot sealing of joints between adjacent PVC sheet flooring to prevent creeping of water through the joints shall be carried out, using special equipment as per manufacturer's instructions.

7.23 Acid Resisting Brick/Tiling Work

7.23.1 Materials

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7.23.1.1 The ceramic unglazed vitreous acid resisting tiles shall conform to the requirements of IS:4457. Acid resistant bricks shall conform to the requirements of IS:4860.

7.23.1.2 The finished tile/brick when fractured shall appear fine grained in texture, dense and homogeneous. Tile/brick shall be sound, true to shape, flat, free from flaws and any manufacturing defects affecting their utility. Tolerance in dimensions shall be within the limits specified in the respective IS.

7.23.1.3 The tiles/bricks shall be bedded and jointed using chemical resistant mortar of the resin type conforming to IS:4832 (Part II). Method of usage shall generally be as per the requirements of IS:4443.

7.23.2 Workmanship

7.23.2.1 The resin shall have viscosity for readily mixing with the filler by manual methods. The filler shall have graded particles which permit joint thickness of 1.5 mm.

7.23.2.2 The base concrete surface shall be free from dirt and thoroughly dried. The surface shall be applied with a coat of bitumen primer conforming to IS:3384. The primed surface shall then be applied with a uniform coat of bitumen conforming to IS:1580. Tiles or bricks shall be laid directly without the application of bitumen, if epoxy or polyester resin is used for the mortar.

7.23.2.3 Just adequate quantity of mortar which can be applied within the pot life as specified by the manufacturer shall be prepared at one time for bedding and jointing. Rigid PVC/Stainless steel/chromium plated tools shall be used for mixing and laying.

7.23.2.4 For laying the floor 6 to 8 mm thick mortar shall be spread on the back of the tile/brick. Two adjacent sides of the tile/brick shall be smeared with 4 to 6 mm thick mortar. Tile/brick shall be pressed into the bed and pushed against the floor and with the adjacent tile/ brick, until the joint in each case is 2 to 3 mm thick. Excess mortar shall then be trimmed off and allowed to harden fully. Similar procedure shall be adopted for the work on walls by pressing the tile/brick against the prepared wall surfaces and only one course shall be laid at a time until the initial setting period.

7.23.2.5 The mortar joints shall be cured for a minimum period of 72 hours with 20 to 25% hydrochloric acid or 30 to 40% sulphuric acid. After acid curing, the joints shall be washed with water and allowed to

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thoroughly dry. The joints shall then be filled with mortar to make them smooth and plane. Acid curing is not required to be carried out if epoxy or polyester resin is used for the mortar.

7.23.2.6 Resin mortars are normally self curing. The area tiled shall not be put to use before 48 hours in case epoxy, polyester and furane type of resin is used for the mortar. If phenolic or cashewnut shell liquid resin is used for the mortar, the area tiled shall not be put to use for 7 to 28 days respectively, without heat treatment. This period shall be 2 to 6 days respectively, if heat treatment is given with infrared lamp.

7.24 Epoxy Lining Work

7.24.1 Materials

7.24.1.1 The epoxy resin and hardener formulation for laying of jointless lining work in floors and walls of concrete tanks/trenches etc shall be as per the requirements of IS:9197.

7.24.1.2 The epoxy composition shall have the chemical resistance to withstand the following conditions of exposure:

a) Hydrochloric acid upto 30% concentration

b) Sodium hydroxide upto 50% concentration

c) Liquid temperature upto 60deg.C

d) Ultraviolet radiation

e) Alternate wetting and drying

7.24.1.3 Sand shall conform to grading zone III or IV of IS:383.

7.24.1.4 The hardener shall be of the liquid type such as Aliphatic Amine or an Aliphatic/Aromatic Amine Adduct for the epoxy resin. The hardener shall react with epoxy resin at normal ambient temperature.

7.24.1.5 Contractor shall furnish test certificates for satisfying the requirements of the epoxy formulation if so directed by the JDA.

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7.24.2 Workmanship

7.24.2.1 The minimum thickness of epoxy lining shall be 4 mm. It is essential that the concrete elements are adequately designed to ensure that water is excluded to permeate to the surface, over which the epoxy lining is proposed.

7.24.2.2 The epoxy lining shall be of the trowel type to facilitate execution of the required thickness for satisfactory performance.

7.24.2.3 The concrete surfaces over which epoxy lining is to be provided shall be thoroughly cleaned of oil or grease by suitable solvents, wire brushed to remove any dirt/dust and laitance. The surfaces shall then be washed with dilute hydrochloric acid and rinsed thoroughly with plenty of water or dilute ammonia solution. The surfaces shall then be allowed to dry. It is essential to ensure that the surfaces are perfectly dry before the commencement of epoxy application.

7.24.2.4 Just adequate quantity of epoxy resin which can be applied within the pot life as specified by the manufacturer shall be prepared at one time for laying and jointing.

7.24.2.5 Rigid PVC/stainless steel/chromium plated tools shall be used for laying. Trowelling shall be carried out to obtain uniformly the specified thickness of lining.

7.24.2.6 Lining shall be allowed to set without disturbance for a minimum period of 24 hours. The facility shall be put to use only after a minimum period of 7 days of laying of the lining.

7.25 Water-Proofing

7.25.1 General

7.25.1.1 The work shall include waterproofing for the building roofs, terraces, toilets, floor slabs, walls, planters, chajjas, sills and any other areas and at any other locations and situations as directed by the Employers Representative.

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7.25.1.2 The waterproofing treatment shall be carried out on top of lime concrete (brick bat coba) laid to slope on roof surfaces. The brick bat coba shall be covered as specified below.

7.25.1.3 The work shall be carried out by an experienced specialist Sub-Contractor who shall be appointed only after prior approval of the JDA.

7.25.2 Modified Bituminous Membrane

7.25.2.1 Modified Bituminous Membrane shall be "SUPER THERMOLAY" 4 mm thick weighing 4 Kg/sqm, manufactured using APP Polymer modified bitumen with a central core of non-woven polyester reinforcement (200 gms/sqm) and with top and bottom layers of thermofusible film (top layer could also be sand finished) made by STP Limited in collaboration with Bitumat Company Limited. "PLYFLEX" of Bitumat Company Limited, Saudi Arabia supplied by STP Limited shall also be acceptable or other equivalent specification.

7.25.3 Waterproofing of Roofs with Lime Concrete

7.25.3.1 Materials

Broken brick coarse aggregates prepared from well/over burnt bricks shall be well graded having a maximum size of 25mm and shall generally conform to IS:3068.

Lime shall be class C lime (fat lime) or factory made hydrated lime conforming to IS:712.

7.25.3.2 Workmanship

7.25.3.2.1 Lime concrete shall be prepared by thoroughly mixing the brick aggregates inclusive of brick dust obtained during breaking with the slaked lime in the proportions of 2 1/2 (two and a half) parts of brick aggregates to 1 part of slaked lime by volume. Water shall be added just adequate to obtain the desired workability for laying. Washing soap and alum shall be dissolved in the water to be used. The quantity of these materials required per cum of lime concrete shall be 12kg of washing soap and 4kg of alum. Brick aggregates shall be soaked thoroughly in water for a period of not less than six hours before use in the concrete mix. Lime concrete shall be used in the works within 24 hours after mixing.

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7.25.3.2.2 The roof surface over which the water-proof treatment is to be carried out shall be cleaned of all foreign matter by wire brushing, dusting and made thoroughly dry. Preparation of surfaces shall be as stipulated in IS:3067.

7.25.3.2.3 The slope of the finished waterproofing treatment shall be not less than 1 in 60 for efficient drainage. This shall be achieved either wholly in the lime concrete layer.

7.25.3.2.4 The average thickness of lime concrete, slope and the finish on top of machine made burnt clay flat terracing tiles conforming to IS:2690 (part I) shall be as specified in the items of work to be prepared by the Contractor. Cement concrete flooring tiles in lieu of clay terracing tiles shall be provided if so specified in the items of work prepared by the Contractor, duly considering the traffic the terrace will be subjected to.

7.25.3.2.5 The minimum compacted thickness of lime concrete layer shall be 75mm and average thickness shall not be less than 100mm. In case, the thickness is more than 100mm, it shall be laid in layers not exceeding 100mm to 125mm.

7.25.3.2.6 Laying of lime concrete shall be commenced from a corner of the roof and proceeded diagonally towards centre and other sides duly considering the slopes specified for effectively draining the rain-water towards the downtake points.

7.25.3.2.6 Lime concrete fillet for a minimum height of 150mm shall be provided all along the junction of the roof surface with the brick masonry wall/parapet/column projections. These shall then be finished on top with provision of clay terracing tiles/cement concrete tiles.

7.25.3.2.7 After the lime concrete is laid it shall be initially rammed with a rammer weighing not more than 2 Kg and the finish brought to the required evenness and slope. Alternatively, bamboo strips may be used for the initial ramming. Further consolidation shall be done using wooden THAPIES with rounded edges. The beating will normally have to be carried on for at least seven days until the THAPI makes no impression on the surface and rebounds readily from it when struck. Special care shall be taken to properly compact the lime concrete at its junction with parapet walls or column projections.

7.25.3.2.8 During compaction by hand-beating, the surface shall be sprinkled liberally with lime water (1 part of lime putty and 3 to 4 parts of water) and a small proportion of sugar solution for obtaining improved water-proofing quality of the lime concrete. On completion of beating, the mortar that comes on the top shall be

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smoothened with a trowel or float, if necessary, with the addition of sugar solution and lime putty. The sugar solution may be prepared in any one of the following ways as directed by the JDA.

a) By mixing about 3 Kg of Jaggery and 1.5 Kg of BAEL fruit to 100 litres of water.

b) By mixing about 600 gm of KADUKAI (the dry nuts shall be broken to small pieces and allowed to soak in water), 200 gm of jaggery and 40 litres of water for 10 sq.m of work. This solution shall be brewed for about 12 to 24 hours and the resulting liquor decanted and used for the work.

7.25.3.2.9 The lime concrete after compaction shall be cured for a minimum period of seven days or until it hardens by covering with a thin layer of straw or hessian which shall be kept wet continuously.

7.25.3.2.10Machine made flat terracing tiles shall be of the size and thickness as specified. Tiles shall be soaked in water for at least one hour before laying. Bedding for the tiles shall be 12mm thick in cement mortar 1:3. Tiles shall be laid, open jointed with 4 to 6 mm wide joints, flat on the mortar and lightly pressed and set to plane surface true to slope, using a trowel and wooden straight edge. They shall be laid with their longitudinal lines of joints truly parallel and generally at right angles to the direction of run-off gradient. Transverse joints in alternate rows shall come directly in line with each other. Transverse joints in adjacent courses shall break joints by at least 50 mm. The joints shall be completely filled and flush pointed with cement mortar 1:2 mixed with water proofing compound as per manufacturer's instructions. Curing shall be carried out for a minimum period of seven days.

7.25.3.2.11Finishing on top with cement concrete tiles or in-situ cement concrete floor topping shall be carried out in similar fashion as described for clay tiles in above paragraph. Tiles to be used shall be supplied after the first machine grinding of the surface.

7.25.4 Waterproofing of Roofs/Terraces etc.

(a) Water proofing of Horizontal Surfaces

7.25.4.1 The waterproofing shall be applied as follows:

7.25.4.2 A coat of Blown Bitumen 85/25 shall be applied at the rate of 1.45 kg/sq.km

7.25.4.3 A roll of Modified Bituminous Membrane shall be unrolled over the primed surface and completely bonded to the substrate by pressing down evenly for the full width of the roll using a wooden roller.

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Torching shall be done, where recommended by the manufacturer and where directed by the JDA, as the unrolling progresses.

7.25.4.4 The side overlaps shall be minimum 100 mm whereas the end overlaps shall be minimum 150 mm; both shall be bonded and sealed by flame torching.

7.25.4.5 Care shall be taken that the membrane is lapped with the treatment along the vertical surface and roof gutter treatment for at least 500 mm.

7.25.4.6 The membrane shall be properly overlapped/terminated at all openings, rainwater down takes etc. to ensure that such junctions do not become sources of leakage.

7.25.4.7 Top of membrane finally shall be painted with antiglouse reflective paint.

(b) Waterproofing of Vertical Surfaces at Roof Level and Gutters

7.25.4.8 The Water proofing shall be applied as described in (a) above.

7.25.4.9 Modified Bituminous membrane shall be unrolled and bonded to the substrate after applying a coat of bitumen and by pressing down evenly for the full width of the roll. Light torching shall be done to ensure complete bonding.

7.25.4.10 The membrane shall be overlapped with treatment for the horizontal surface by at least 500 mm.

7.25.4.11 The membrane shall be taken upto a pre-cut chase anchored and sealed.

7.25.5 Khurras and Rainwater Down Pipes

7.25.5.1 Down pipes shall be isolated from RCC work with 6 mm polyethylene foam fixed with adhesive (Araldite) and sealed with silicone sealant prior to laying membrane. A water proofing flashing composed of one layer of Hessian based self finished felt Type 3 Grade 1 and two layers of aluminium foil of 0.075 mm thickness shall be provided. This flashing shall be carried into the down take pipes for at least 250 mm and sealed with P.V.C

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bitumen. The Contractor shall closely coordinate the work with the agency providing and fixing the rainwater down take pipes.

7.25.6 Testing

7.25.6.1 The treated area (flat and horizontal only) shall be tested by allowed water to stand on the treated areas to a depth of 150 mm for a minimum period of 72 hours.

7.25.6.2 The treated area (flat and horizontal) shall have continuous slope towards the rainwater outlets and no water shall pond any where on the surface.

7.26 Cement Plastering Work

7.26.1 Materials

7.26.1.1 The proportions of the cement mortar for plastering shall be 1:3 (one part of cement to three parts of sand). Cement and sand shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water and cement shall be as per relevant IS standards. The quality and grading of sand for plastering shall conform to IS:1542. The mixing shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the JDA. If so desired by the JDA sand shall be screened and washed to meet the Specifications. The mortar thus mixed shall be used as soon as possible preferably within 30 minutes from the time water is added to cement. In case the mortar has stiffened due to evaporation of water this may be re- tempered by adding water as required to restore consistency but this will be permitted only upto 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and removed forthwith from the site. Droppings of plaster shall not be re-used under any circumstances.

7.26.2 Workmanship

7.26.2.1 Preparation of surfaces and application of plaster finishes shall generally conform to the requirements specified in IS:1661 and IS:2402.

7.26.2.2 Plastering operations shall not be commenced until installation of all fittings and fixtures such as door/window panels, pipes, conduits etc. are completed.

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7.26.2.3 All joints in masonry shall be raked as the work proceeds to a depth of 10mm/20mm for brick/stone masonry respectively with a tool made for the purpose when the mortar is still green. The masonry surface to be rendered shall be washed with clean water to remove all dirt, loose materials, etc., Concrete surfaces to be rendered shall be roughened suitably by hacking or bush hammering for proper adhesion of plaster and the surface shall be evenly wetted to provide the correct suction. The masonry surfaces should not be too wet but only damp at the time of plastering. The dampness shall be uniform to get uniform bond between the plaster and the masonry surface.

7.26.2.4 Interior plain faced plaster - This plaster shall be laid in a single coat of 13mm thickness. The mortar shall be dashed against the prepared surface with a trowel. The dashing of the coat shall be done using a strong whipping motion at right angles to the face of the wall or it may be applied with a plaster machine. The coat shall be trowelled hard and tight forcing it to surface depressions to obtain a permanent bond and finished to smooth surface. Interior plaster shall be carried out on jambs, lintel and sill faces, etc. as shown in the drawing and as directed by the JDA.

7.26.2.5 Plain Faced Ceiling plaster - This plaster shall be applied in a single coat of 6mm thickness. Application of mortar shall be as stipulated in above paragraph.

7.26.2.6 Exterior plain faced plaster - This plaster shall be applied in 2 coats. The first coat or the rendering coat shall be approximately 14mm thick. The rendering coat shall be applied as stipulated above except finishing it to a true and even surface and then lightly roughened by cross scratch lines to provide bond for the finishing coat. The rendering coat shall be cured for at least two days and then allowed to dry. The second coat or finishing coat shall be 6 mm thick. Before application of the second coat, the rendering coat shall be evenly damped. The second coat shall be applied from top to bottom in one operation without joints and shall be finished leaving an even and uniform surface. The mortar proportions for the coats shall be as specified in the respective item of work. The finished plastering work shall be cured for at least 7 days.

7.26.2.7 Interior plain faced plaster 20mm thick if specified for uneven faces of brick walls or for random/coursed rubble masonry walls shall be executed in 2 coats similar to the procedure stipulated in above paragraph.

7.26.2.8 Exterior Sand Faced Plaster- This plaster shall be applied in 2 coats. The first coat shall be approximately 14mm thick and the second coat shall be 6mm thick. These coats shall be applied as stipulated above. However, only approved quality white sand shall be used for the second coat and for the finishing work. Sand for the finishing work shall be coarse and of even size and shall be dashed against the surface and sponged. The mortar proportions for the first and second coats shall be as specified in the respective items of work.

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7.26.2.9 Wherever more than 20mm thick plaster has been specified, which is intended for purposes of providing beading, bands, etc. this work shall be carried out in two or three coats as directed by the JDA duly satisfying the requirements of curing each coat (rendering/floating) for a minimum period of 2 days and curing the finished work for at least 7 days.

7.26.2.10 In the case of pebble faced finish plaster, pebbles of approved size and quality shall be dashed against the final coat while it is still green to obtain as far as possible a uniform pattern all as directed by the JDA.

7.26.2.11 Where specified in the Drawings to be prepared by the Contractor prepared by the Contractor, rectangular grooves of the dimensions indicated shall be provided in external plaster by means of timber battens when the plaster is still in green condition. Battens shall be carefully removed after the initial set of plaster and the broken edges and corners made good. All grooves shall be uniform in width and depth and shall be true to the lines and levels as per the Drawings to be prepared by the Contractor prepared by the Contractor.

7.26.2.12 Curing of plaster shall be started as soon as the applied plaster has hardened sufficiently so as not to be damaged when watered. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

7.26.2.13 For waterproofing plaster, the Contractor shall provide the water-proofing admixture as specified in manufacturers instruction while preparing the cement mortar.

7.26.2.14 For external plaster, the plastering operations shall be commenced from the top floor and carried downwards. For internal plaster, the plastering operations for the walls shall commence at the top and carried downwards. Plastering shall be carried out to the full length of the wall or to natural breaking points like doors/windows etc. Ceiling plaster shall be completed first before commencing wall plastering.

7.26.2.15 Double scaffolding to be used shall be as specified in clause 7.2.2.

7.26.2.16 The finished plaster surface shall not show any deviation more than 4mm when checked with a straight edge of 2m length placed against the surface.

7.26.2.17 To overcome the possibility of development of cracks in the plastering work following measures shall be adopted.

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a) Plastering work shall be deferred as much as possible so that fairly complete drying shrinkage in concrete and masonry works takes place.

b) Steel wire fabric shall be provided at the junction of brick masonry and concrete to overcome reasonably the differential drying shrinkage/thermal movement.

c) Ceiling plaster shall be done, with a trowel cut at its junction with wall plaster. Similarly trowel cut shall be adopted between adjacent surfaces where discontinuity of the background exists.

7.27 Cement Pointing

7.27.1 Materials

7.27.1.1 The cement mortar for pointing shall be in the proportion of 1:3 (one part of cement to three parts of fine sand). Sand shall conform to IS: 1542 and shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by JDA and if so directed it shall be washed/screened to meet specification requirements.

7.27.2 Workmanship

7.27.2.1 Where pointing of joints in masonry work is specified, the joints shall be raked at least 15mm/20mm deep in brick/stone masonry respectively as the work proceeds when the mortar is still green.

7.27.2.2 Any dust/dirt in the raked joints shall be brushed out clean and the joints shall be washed with water. The joints shall be damp at the time of pointing. Mortar shall be filled into joints and well pressed with special steel trowels. The joints shall not be disturbed after it has once begun to set. The joints of the pointed work shall be neat. The lines shall be regular and uniform in breadth and the joints shall be raised, flat, sunk or 'V' as may be specified in the respective items of work. No false joints shall be allowed.

7.27.2.3 The work shall be kept moist for at least 7 days after the pointing is completed. Whenever coloured pointing has to be done, the colouring pigment of the colour required shall be added to cement in such proportions as recommended by the manufacturer and as approved by the JDA.

7.28 Water-Proofing Admixtures

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7.28.1 Water-proofing admixture shall conform to the requirements of IS:2645 and shall be of approved manufacture. The admixture shall not contain calcium chloride. The quantity of the admixture to be used for the works and method of mixing etc. shall be as per manufacturer's instructions and as directed by the JDA.

7.29 Painting of Concrete, Masonry & Plastered Surfaces

7.29.1 Materials

7.29.1.1 Oil bound distemper shall conform to IS:428. The primer shall be alkali resistant primer of the same manufacture as that of the distemper.

7.29.1.2 Cement paint shall conform to IS:5410. The primer shall be a thinned coat of cement paint.

7.29.1.3 Lead free acid, alkali and chlorine resisting paint shall conform to IS:9862.

7.29.1.4 Colour wash shall be made by addition of a suitable quantity of mineral pigment, not affected by lime, to the prepared white wash to obtain the shade/tint as approved by the JDA.

7.29.1.5 All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the JDA for the brand of manufacture and the colour/shade. All materials shall be brought to the site of works in sealed containers.

7.29.2 Workmanship

2.29.2.1 Contractor shall obtain the approval of the JDA regarding the readiness of the surfaces to receive the specified finish, before commencing the work on painting.

2.29.2.2 Painting of new surfaces shall be deferred as much as possible to allow for thorough drying of the sub- strata.

2.29.2.3 The surfaces to be treated shall be prepared by thoroughly brushing them free from dirt, mortar droppings and any loose foreign materials. Surfaces shall be free from oil, grease and efflorescence.

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Efflorescence shall be removed only by dry brushing of the growth. Cracks shall be filled with Gypsum. Workmanship of painting shall generally conform to IS:2395.

2.29.2.4 Surfaces of doors, windows etc. shall be protected suitably to prevent paint finishes from splashing on them.

7.29.3 White Wash

7.29.3.1 The prepared surfaces shall be wetted and the finish applied by brushing. The operation for each coat shall consist of a stroke of the brush first given horizontally from the right and the other from the left and similarly, the subsequent stroke from bottom upwards and the other from top downwards, before the first coat dries. Each coat shall be allowed to dry before the next coat is applied. Minimum of 2 coats shall be applied unless otherwise specified. The dry surface shall present a uniform finish without any brush marks.

7.29.4 Colour Wash

7.29.4.1 Colour wash shall be applied in the same way as for white wash. A minimum of 2 coats shall be applied unless otherwise specified. The surface shall present a smooth and uniform finish without any streaks. The finished dry surface shall not show any signs of peeling/powdery and come off readily on the hand when rubbed.

7.29.5 Cement Paint

7.29.5.1 The prepared surfaces shall be wetted to control surface suction and to provide moisture to aid in proper curing of the paint. Cement paint shall be applied with a brush with stiff bristles. The primer coat shall be a thinned coat of cement paint. The quantity of thinner shall be as per manufacturer's instructions. The coats shall be vigorously scrubbed to work the paint into any voids for providing a continuous paint film free from pinholes for effective water proofing in addition to decoration. Cement paint shall be brushed in uniform thickness and the covering capacity for two coats on plastered surfaces shall be 3 to 4 kg/sq.m. A minimum of 2 coats of the same colour shall be applied. At least 24 hours shall be left after the first coat to become sufficiently hard before the second coat is applied. The painted surfaces shall be thoroughly cured by sprinkling with water using a fog spray at least 2 to 3 times a day. Curing shall commence after about 12 hours when the paint hardens. Curing shall be continued for at least 2 days after the application of final coat. The operations for brushing each coat shall be as detailed above.

7.29.6 Oil bound Distemper

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7.29.6.1 The prepared surfaces shall be dry and provided with one coat of alkali resistant primer by brushing. The surface shall be finished uniformly without leaving any brush marks and allowed to dry for at least 48 hours. A minimum of two coats of oil bound distemper shall be applied, unless otherwise specified. The first coat shall be of a lighter tint. At least 24 hours shall be left after the first coat to become completely dry before the application of the second coat. Broad, stiff, double bristled distemper brushes shall be used for the work. The operations for brushing each coat shall be as detailed above.

7.29.7 Acid, Alkali Resisting Paint

7.29.7.1 A minimum of 2 coats of acid/alkali resisting paint shall be applied over the prepared dry surfaces by brushing. Primer coat shall be as per manufacturer's instructions.

7.29.8 Plastic Emulsion Paint

7.29.8.1 The prepared surface shall be dry and provided with one coat of primer which shall be a thinned coat of emulsion paint. The quantity of thinner shall be as per manufacturer's instructions. The paint shall be laid on evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off constitutes one coat. The next coat shall be applied only after the first coat has dried and sufficiently become hard which normally takes about 2 to 3 hours. A minimum of 2 finishing coats of the same colour shall be applied unless otherwise specified. Paint may also be applied using rollers. The surface on finishing shall present a flat velvety smooth finish and uniform in shade without any patches.

7.29.9 Acrylic Emulsion Paint

7.29.9.1 Acrylic emulsion paint shall be applied in the same way as for plastic emulsion paint. A minimum of 2 finishing coats over one coat of primer shall be provided unless otherwise specified.

7.30 Painting & Polishing of Wood Work

7.30.1 Materials

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Wood primer shall conform to IS:3536.

Filler shall conform to IS:110.

Varnish shall conform to IS:337.

French polish shall conform to IS:348.

Synthetic enamel paint shall conform to IS:2932.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the JDA for the brand of manufacture and the colour/shade. All materials shall be brought to the site of works in sealed containers.

7.30.2 Workmanship

7.30.2.1 The type of finish to be provided for woodwork of either painting or polishing, the number of coats, etc. shall be as specified in the respective items of work to be prepared by the Contractor.

7.30.2.2 Primer and finish paint shall be compatible with each other to avoid cracking and wrinkling. Primer and finish paint shall be from the same manufacturer.

7.30.2.3 Painting shall be either by brushing or spraying. Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer. The workmanship shall generally conform to the requirements of IS:2338 (Part I).

7.30.2.4 All the wood surfaces to be painted shall be thoroughly dry and free from any foreign matter. Surfaces shall be smoothened with abrasive paper using it across the grains and dusted off. Wood primer coat shall then be applied uniformly by brushing. The number of primer coats shall be as specified in the item of work to be prepared by the Contractor. Any slight irregularities of the surface shall then be made- up by applying an optimum coat of filler conforming to IS:110 and rubbed down with an abrasive paper for obtaining a smooth surface for the undercoat of synthetic enamel paint conforming to IS:2932. Paint shall be applied by brushing evenly and smoothly by means of crossing and laying off in the direction of the grain of wood. After drying, the coat shall be carefully rubbed down using very fine grade of sand paper and wiped clean before the next coat is applied. At least 24 hours shall elapse between the application of successive coats. Each coat shall vary slightly in shade and this shall be got approved by the JDA. The number of coats of paint to be applied shall be as specified in the item of work to be prepared by the Contractor.

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7.30.2.5 All the wood surfaces to be provided with clear finishes shall be thoroughly dry and free from any foreign matter. Surfaces shall be smoothened with abrasive paper using it in the direction of the grains and dusted off. Any slight irregularities of the surface shall be made up by applying an optimum coat of transparent liquid filler and rubbed down with an abrasive paper for obtaining a smooth surface. All dust and dirt shall be thoroughly removed. Over this prepared surface, varnish conforming to IS:337 shall be applied by brushing. Varnish should not be retouched once it has begun to set. Staining if required shall be provided as directed by the JDA. When two coats of varnish is specified, the first coat should be a hard-drying undercoat or flatting varnish which shall be allowed to dry hard before applying the finishing coat. The number of coats to be applied shall be as specified. For works where clear finish of French polish is specified the prepared surfaces of wood shall be applied with the polish using a pad of woolen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles to give an even finish over the entire area. The surface shall be allowed to dry before applying the next coat. Finishing shall be carried out using a fresh clean cloth over the pad, slight dampening with methylated spirit and rubbing lightly and quickly in circular motions. The finished surface shall have a uniform texture and high gloss. The number of coats to be applied shall be as specified.

7.31 Painting of Steel Work

7.31.1 Materials

Red-oxide – zinc chrome primer shall conform to IS:2074.

Synthetic enamel paint shall conform to IS : 2932.

Aluminium paint shall conform to IS:2339.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the JDA for the brand of manufacture and the colour/shade. All the materials shall be brought to the site in sealed containers.

7.31.2 Workmanship

7.31.2.1 Painting work shall be carried out only on thoroughly dry surfaces. Painting shall be applied either by brushing or by spraying. Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer. The workmanship shall generally conform to the requirement of IS:1477 (Part 2).

7.31.2.2 The type of paint, number of coats etc. shall be as specified in the respective items of work.

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7.31.2.3 Primer and finish paint shall be compatible with each other to avoid cracking and wrinkling. Primer and finish paint shall be from the same manufacturer.

7.31.2.4 All the surfaces shall be thoroughly cleaned of oil, grease, dirt, rust and scale. The methods to be adopted using solvents, wire brushing, power tool cleaning etc., shall be as per IS:1477 (Part – I) and as indicated in the item of work.

7.31.2.5 It is essential to ensure that immediately after preparation of the surfaces, the first coat of red oxide-zinc chrome primer shall be applied by brushing and working it well to ensure a continuous film without holidays. After the first coat becomes hard dry, a second coat of primer shall be applied by brushing to obtain a film free from `holidays'.

7.31.2.6 After the second coat of primer is hard dry, the entire surface shall be wet rubbed cutting down to a smooth uniform surface. When the surface becomes dry, the undercoat of synthetic enamel paint of optimum thickness shall be applied by brushing with minimum of brush marks. The coat shall be allowed to hard-dry. The under coat shall then be wet rubbed cutting down to a smooth finish, taking adequate care to ensure that at no place the undercoat is completely removed. The surface shall then be allowed to dry.

7.31.2.7 The first finishing coat of paint shall be applied by brushing and allowed to hard-dry. The gloss from the entire surface shall then be gently removed and the surface dusted off. The second finishing coat shall then be applied by brushing.

7.31.2.8 At least 24 hours shall elapse between the application of successive coats. Each coat shall vary slightly in shade and this shall be got approved by the JDA.

7.32 Flashing

7.32.1 Materials

7.32.1.1 Anodised Aluminium sheets shall be 1.00mm thick with anodic film thickness of 0.025 mm.

7.32.1.2 Galvanised mild steel sheets shall be 1.00mm thick with zinc coating of 800 gms/sq.m.

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7.32.1.3 Bitumen felt shall be either Hessian base self finished bitumen felt Type-3 Grade I conforming to IS:1322 or glass fibre base self finished felt Type-2 Grade 1 conforming to IS:7193.

7.32.2 Workmanship

7.32.2.1 The type of the flashing and method of fixing shall be as specified.

7.32.2.2 Flashing shall be of the correct shape and size as indicated in the construction Drawings to be prepared by the Contractor and they shall be properly fixed to ensure their effectiveness.

7.32.2.3 Flashing shall be of long lengths so as to provide minimum number of joints. The minimum overlap at joints shall be 100mm.

7.32.2.4 Fixing of the flashing shall be either by bolting with bitumen washers or by tucking into the groove 75 mm wide x 65 mm deep in masonry/concrete along with cement mortar 1:4 filletting as indicated in the Drawings to be prepared by the Contractor. Curing of the mortar shall be carried out for a minimum period of 4 days.

7.32.2.5 Bitumen felt flashing of the type as specified shall be provided with 2 coats of bituminous paint at the rate of 0.10 litre/sq.m after the installation.

7.33 Thermal Insulation For Ceiling

Thermal insulation shall be “Thermocole” TF type or similar approved or Resin bonded fibre glass boards.

7.33.1 Fixing

7.33.2 “Thermocole” Boards

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7.33.2.1 Soffit of R.C.Slab shall be thoroughly cleaned with wire brush and 85/25 industrial grade hot bitumen conforming to IS:702 shall be applied uniformly over the surface at the rate of 1.5 Kg/m2.

7.33.2.2 Thermocole boards (T.F. variety) of 50mm thickness shall be stuck by means of the same grade of hot bitumen.

7.33.2.3 The boards shall be further secured with screws, washers and plugs.

7.33.2.4 The joints of the boards shall be sealed with bitumen.

7.33.3 Fibre Glass Boards

7.33.3.1 Timber pegs 50mm x 50mm x 50mm shall be fixed to the slab at 600mm centres with 6mm x 65mm long wood screws. 20 gauge G.I. lacing wire shall be tied to the pegs.

7.33.3.2 `Crown' 200 fibre glass boards 50mm thick shall be stuck to the pegs with CPRX compound or any other suitable adhesive and be held in position by the 20 gauge G.I. lacing wires.

7.33.3.3 The insulation boards shall be covered with 20mm – 24 gauge hexagonal G.I. chicken wire mesh, nailed to the timber pegs and 30 gauge aluminium sheets shall be fixed over the chicken wire mesh with 50mm overlap and secured to the timer pegs by screws.

7.33.3.4 If the insulation is specified to rest on top of the false ceiling, it shall be properly installed and anchored to the framework. In case additional battens are required for proper installation, Contractor shall include its cost in the rate for insulation.

7.34 Plaster of Paris Board for False Ceiling

7.34.1 Materials

7.34.1.1 Plaster of Paris Boards

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The plaster of paris boards to be used in the false ceiling shall be of an approved manufacture or manufactured at site by methods and materials approved by JDA.

The plaster of paris shall be of the calcium-sulphate hemi-hydrate variety and shall contain not less than 35 percent sulphur trioxide and other requirements as per IS:2547 (Part I) However, its fineness shall be such that the residue, after drying, and sieving on I.S. sieve designation 3.35mm for 5 minutes shall not be more than 1 percent by weight. Initial setting time shall not be less than 13 minutes. The average compressive strength of plaster determined by testing 5 cm cubes 24 hours after removal from moulds and drying in an oven at 40 Deg. C till the weight of the cubes is constant, shall not be less than 84 Kg per sq.cm.

The plaster of paris boards reinforced with hessian cloth or coir shall be prepared in suitable sizes as shown on the drawings or as directed by JDA. Wooden forms of height equal to the thickness of boards shall be placed on truly level and smooth surface such as a glass sheet. The edges of the boards shall be truly square. The glass sheet or surface on which form is kept and the form sides shall be given a thin coat of non-staining oil to facilitate the easy removal of the board. Plaster of paris shall be evenly spread into the form upto about half the depth and hessian cloth or coir shall be pressed over the plaster of paris layer. The weight of hessian cloth or coir in the board shall be 250 gm per sq.m. The ends of the hessian/coir reinforcement shall be turned over at all edges to form a double layer for a width of 50mm. The hessian cloth shall be of an open web texture so as to allow the plaster below and above to intermix with each other and form an integral board. The form shall then be filled with plaster of paris which shall be uniform pressed and then wire cut to an even and smooth surface. The board shall then be allowed to set initially for an hour or so and then removed from the form and allowed to dry and harden for about a week. The board after drying and hardening shall give a ringing sound when struck. The boards shall be true and exact to shape and size and the exposed face shall be truly plane and smooth.

The size of boards shall generally be 600mm x 600 mm x 12 mm thick. Boards shall be kept dry in transit and stored flat in a clean dry place and shall not be exposed to moisture. The boards shall always be carried on edges.

7.34.2 Timber Frame Work

7.34.2.1 Timber for frame work of false ceiling grid and hangers shall be of good quality and well seasoned. It shall have uniform colour, reasonably straight and close grains and shall be free from knots, cracks and sapwood. It shall be treated with approved anti-termite preservative as directed by the JDA. Extreme care shall be taken so that the preservative treatment does not stain the ceiling boards. In case metal hangers are used, these shall be M.S. flats or bars, having two coats of red oxide zinc chromate paint primer, as shown on drawings or as approved by JDA.

7.34.3 Metal Frame Work

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7.34.3.1 The metal frame work may be made of sections of light metal, such as anodised aluminium, mild steel or as shown on the drawings. The shape of cross-section shall be such as to facilitate proper suspension and proper fixing of the ceiling boards covering them and shall be structurally sound and rigid.

7.35 Construction

Contractor shall ensure that the frame to support the ceiling is designed for structural strength and the sizes, weight and strength of ceiling boards to be fixed and other loads due to live load, air-conditioning ducts, grills, electrical wiring and lighting fixtures, thermal insulation, etc. as shown on the drawings. Contractor shall also submit a detailed drawing to show the grid work, sizes of grid members, method of suspension, position of openings for air-conditioning and lighting, access doors, etc.

Structural design of timber member for the frame shall be in accordance with IS : 883, and metal sections shall be of appropriate size and thickness and shall be of approved manufacture, all as approved by JDA.

The false ceiling grid work shall be carried out as per the approved drawings or as directed by JDA. In case of timber grid work, the grid work shall consist of teak wood runners of minimum size 60mm deep x 40mm wide along one direction at 1.2m centre to centre and secondary runners of size 50mm deep x 40 mm wide at 60mm centre to centre perpendicular to the main runners.

The timber grid work shall be suspended with the help of wooden hangers or metal hangers at 1.2m centre to centre in both the directions. Wooden hangers shall be adopted for flat R.C. roof slab structures whereas metal hangers for flat R.C. roof or structural steel floors / tresses. Metal hangers shall be fabricated from mild steel / galvanised flats of 35mm x 6mm size or bars of 10mm dia. Threaded at the lower end and anchored securely in the roof concrete or welded to inserts provided on the underside of slabs, beams etc. All M.S. hangers shall be given two coats of red oxide zinc chromate paint primer. In case the roof work is of A.C. sheeting supported on purlins and trusses, hangers shall be suspended from roof steel work. The arrangement of metal hangers shall be such that the level of false ceiling can be adjusted during fixing of the ceiling frame work. The ceiling frame work shall be secured to hangers by means of washers and nuts. The ends of main runners shall preferably be embedded into the masonry work.

The metal frame work when it is anodised aluminium false ceiling grid system shall consist of aluminium main member of special T-Profile of 38mm x 38mm x 1.5mm thick, interlocking with each other to form frames of various sizes, 600mm x 600 mm or as shown on the drawing. The main members shall be suspended from the roof structures by means of steel hangers as described for timber frame work and supported at the walls by means of anodised aluminium wall angles.

In the case of timber frame work, all the edges of the plaster of paris board shall be fixed to frame members by means of counter sunk and rust less screws of 2.74 mm size, 40mm long at a spacing of 100mm to 150 mm c/c and 12mm from the edge of the board. Holes for screws shall be drilled and screws slightly countersunk into the boards. The boards shall be fixed to wooden framework with a joint clearance of about 3mm. The joints shall always be in perfect line and plane.

In case of aluminium grid system, boards shall be just placed into the frames formed by the main `T' members and the cross members fitted with the clips for locking boards. Contractor shall take utmost care so as not to

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force the boards in position and a slight gap shall be provided so as not to make a tight joint. The boards shall be cut with a saw, if required, to any shape and size.

As the work of false ceiling may be inter-connected with the work of air-conditioning ducts and lighting, Contractor shall fully co-operate with the other agencies entrusted with the above work, who may be working simultaneously . Contractor shall provide necessary openings in the false ceiling work for air-conditioning, lighting and other fixtures. Additional framing, if required, for the above opening shall also be provided at no extra cost to Employer. Removable or hinged type inspection or access trap doors shall be provided at locations specified by JDA.

7.35.1 Finishing

7.35.1.1 It is essential that false ceiling work should be firm and in perfect line and level and all boards free from distortion, bulge, and other defects. All defective boards and other material shall be removed from site immediately and replaced, and ceiling restored to original finish to the satisfaction of JDA.

7.35.1.2 The workmanship shall be of highest order and all joinery work for timber work shall be in the best workmanship manner. The joints for aluminium frame work shall be of inter-locking type so that when the cross member is in place, it cannot be lifted out.

7.35.1.3 The countersunk heads of screws and all joints shall be filled with plaster of paris and finished smooth. After filling the joints, a thick skin of the finishing material shall be spread about 50mm wide on either side of the joint and on to it shall be trowelled dry a reinforcing scrim cloth about 10mm wide. If metal scrim is used, a stiffer plaster will be necessary to enable the trowelling of the scrim down to the board.

7.35.2 Fire Stopping

7.35.2.1 In case of fire protective ceilings, fire resisting barriers at suitable intervals shall be provided. These shall completely close the gap between the false ceiling and soffit of the structural slab. The material of the barrier shall be as indicated by JDA (Reference may be made to the British Standards Institutions CP 290: Code of Practice for suspended ceiling and lining of dry construction using metal fixing system, `for guidance).

7.36 False or Cavity Floor

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7.36.1 Frame Work

7.36.1.1 The false floor shall consist of a framework of suitable structural member designed to carry the loads specified. This frame work shall be supported on suitably designed stools placed at 600mm centre to centre in both directions. The stools shall consist of a mild steel base plate with a mild steel stud having adjustable lock nut and coupling at the centre and another mild steel plate at top serving as a prophead. The above framework shall be suitably designed to accommodate 35mm thick, 600mm square panels. The base plate shall be fixed to the reinforced concrete floor with an approved adhesive compound or with 4 Nos. 6mm dia. anchor fasteners. Bedding of 1:2 or richer cement sand mortar shall be provided locally under the base plates of stools to provide a level surface.

7.36.1.2 The prophead shall be provided with mild steel lugs welded on top and each placed perpendicular to the other for proper positioning and supporting the main and cross members. The stools shall be capable of adjustment to accommodate concrete floor level irregularities upto plus or minus 15mm. The framing members shall be completely removable and shall remain in position without screwing or bolting to the propheads. All steel framework including steel stools shall be given a coat of zinc chromate primer and two coats of enamel paint of approved colour and shade.

7.36.2 Floor Panels

7.36.2.1 The floor panels shall be made of 600mm x 600mm x 35 mm thick medium density unveneered/ non-prelaminated teak wood particle boards having a density of not more than 800 kg/cu.m bonded with boiling water proof phenol formaldehyde synthetic resin and shall be of fire resistant, termite resistant and moisture proof quality, generally conforming to IS:3087-specification for wood particle boards (Medium Density)for general purposes.

7.36.2.2 The thermal conductivity of the boards shall not exceed 0.12 kCal/hr/sq.m/deg./C/m.

7.36.2.3 The panel size given above may be suitably modified near electrical panel/equipment and also to suit room dimensions with panel size not more than 600mm under any circumstances. Exposed 2mm thick vinyl edging shall be provided on all edges of individual panels. Each panel shall be given a coat or primer and two coats of approved fire resistant paint from underside.

7.36.2.4 The particle boards shall be faced with 600mm x 600 mm x 2mm thick approved make flooring tiles conforming to IS:3462 – “Specification for unbacked flexible PVC flooring” and of approved colour and shade. The completed panel shall be completely removable and shall remain in position without screwing or bolting to the on the inner side with stickers for easy identification and reassembly whenever required.

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7.36.2.5 Suitable backing material shall be provided on the underside of the particle board to prevent warping and / or to cater to specified loading.

7.36.2.6 Suitable removable covers shall be provided to serve as outlets for the cables.

7.36.3 Imposed Loading

7.36.3.1 The finished floor shall be capable of supporting a uniformly distributed load of 500 to 1000 Kg. per sq.metre of floor area as specified in data sheet. A point load of 450 Kg on 600 sq.mm on any part of the panel or a line load of 725 Kg on 100mm strip across the panel length shall not result in a deflection greater than 2.5mm.

7.36.4 Finish

7.36.4.1 The finished floor shall be true to lines and levels and present a neat flush surface.

7.36.5 Vendor Drawing

7.36.5.1 Vendor shall prepare and submit a layout drawing for false floor giving all details including supporting system for approval. If so called for, vendor shall also submit his calculations for the supporting system with all relevant data assumed, to the JDA for his approval. Work shall be carried out on approved drawings only.

7.37 Fire Proof Doors

7.37.1 Material and Workmanship

7.37.1.1 The design of fire proof doors and the materials to be used in their fabrication have to be such that they shall be capable of providing the effective barrier to the spread of fire. The materials, fabrication and erection of fire proof doors shall confirm to IS:3614 (Part – I). The fire proof doors shall be obtained from an approved manufacturer. Specific approval for such purchase shall be obtained before hand. Sample approval

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shall also be obtained from testing authority as per the standard IS : 3614 (Part – 2) for the specified degree of fire rating in hours. All fire proof doors shall have specified sizes and confirm to the description in the respective items of work.

Fire proof door shutters shall be of zinc coated weldable steel (confirming to BS:6687) or stainless steel (conforming to IS:304) sheet (18G minimum) fixed in a frame work of rolled channel. The shutter shall consist of an insulating material like mineral wool in required thickness to satisfy the specified fire rating. Normally the thickness of door shutter shall not be less than 35mm for two hour fire rating and 46 mm for four hour fire rating.

The shutter with the required insulating material shall be mounted on angle iron frame or the special made frame from zinc coated (16G minimum) weldable steel sheet. The shutter shall be fixed to frame by means of suitable hinges and shall have a three way latching system. All the doors shall be provided with a coat of primer and one coat of synthetic enamel paint to attain the specified fire rating. All other accessories like hinges, door lock, hold fasts, etc. shall be provided as approved by TAC (Tariff Advisory Committee). All these accessories shall be compatible with the material used for door and shutter.

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3) TECHNICAL SPECIFICATION FOR MECHANICAL WORK (SEWAGE TREATMENT PLANT) (PART B)

1.8 General Requirements

1.8.1 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.

1.8.2 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 Employer's representative not consider any material acceptable, it shall be replaced.

1.8.3 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

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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.

1.8.4 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 Employer'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.

1.8.5 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 Employer'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.

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1.8.6 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.

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 Employer'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/Woodlas/Neroalc

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1.8.7 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.

1.8.8 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.

1.8.9.1 Mechanical & Manual Coarse Screens

1. Purpose & Scope:

a. Mechanized Coarse Screens (Screen Angle ~ 70 to 75) 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 shall be provided to sense the head loss through the bar and give the signal to the traveling raking mechanism to start its

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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.

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.

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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.

3. Specifications :

- 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.

- 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.

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- Screen Construction:

- The bars shall be designed to have a tear drop/trapezoidal 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/trapezoidal profile shall be 12 mm wide in the front and 10 mm wide at the back and the depth of bars should be at least 50 mm.

- The bar rack shall be firmly anchored to the channel floor and supported by a dead plate at the top.

- 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 (SS 304) 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.

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- Level controller

  The level controller shall be of ultrasonic differential type / level switch.

- 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%.

- 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.

- 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.

5.0 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 with in the scope of this specification and shall be provided by tenderer with out any extra price to Purchaser.

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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).

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 550 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.

1.8.9.1.1 Mechanical fine Screens

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 on the belt conveyor & finally into discharge burrow on ground.

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.

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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 (SS304) 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.

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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 65 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

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 NDA 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.

1.8.10 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 stainless 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.

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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 of Vertical Propeller type with wetted parts in SS304 shall be provided

1.8.11 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. Minimum turndown of 50% shall be achieved at lowest operating pressure as per process requirement.

Each set of Air Blowers shall have dedicated standby. All Air Blowers shall operate via VFD.

Air Blower shall be Single Stage, Direct Drive, CE/UL certified, Centrifugal type Turbo Blower consisting of Air Bearings, Impeller, high-speed PMSM Motor, Inverter, Controller and Cooling System. Blower RPM shall be minimum 20,000. It shall be able to operate under varying pressure and flow conditions as per process requirement. The maximum idle time between OFF and ON shall not exceed 30 seconds.

It shall be composed of Casing, Suction Filter, Reducer, Acoustic Hood, Blow-Off Valve, Inverter, Electrical Panel and Controller etc. Noise level should be less than 85 dBA at 1.00 m from Blower whereas Vibration level should be less than 2 mm/sec.

Casing shall be of high-quality Aluminium Alloy and able to resist thermal expansion, vibration and air leakage.

Air Bearings shall be non-contact type, bump type foil air bearings with oil free lubrication, low noise and no vibration. The wearing surfaces shall be made of Inconel. Air Bearings should be able to withstand minimum of 20,000 On/Off in its life time.

The bearing consists of top foil and bump foil. Top foil material is nickel alloy coated with Teflon and bump foil is nickel alloy. It is designed to maintain high load bearing capability to sustain the weight of the rotating assembly.

Impeller shall be of high strength Aluminium Alloy (AL7075). It shall have high compression efficiency, high surge stability and wide flow range. It shall be capable to keep dynamic balance in high speed revolution and shall be

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suitable for transmission of power and safety factor at critical speed. It shall be directly connected with the motor shaft without any coupling. The inlet to the Impeller Compartment shall be open without any restrictions like fins etc.

Integral Variable Frequency Drive shall be air cooled.

Control panel for air blower shall be separate from blower assembly and be placed in separate air-conditioned room.

Motor shall be high-speed Permanent Magnet Synchronous Motor (PMSM). The Shaft of the Motor shall be of Titanium and shall be directly connected to the Impeller.

Motor, being high-speed, shall be provided with the best suited Cooling System to ensure consistent motor output and longevity. All motors shall be air cooled, with an insulation class-H.

Blower shall be equipped with Blow-Off Valve with Silencer.

Controller shall have 16-bit color touch screen with convenient user interface to support various operation modes such as Auto Flow Mode, Auto power mode, Auto RPM Mode, Auto Pressure Mode, Proportional Mode, DO-Link Mode and Failure, Check and Reset Option. Following measurements and operating data are shown on the Controller Screen:

Operating State of the Turbo Blower:

Ready

Run

Stop

Wait

Error

Measurement and Display Data:

Suction Filter Differential Pressure

Suction Temperature

Discharge Temperature

Discharge Pressure

Suction Flow Rate

Revolution per Minute

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Power

(c) Warning and Error Message:

Filter differential Pressure Over

Motor overheating

Compressor Surge

Discharge under pressure

Discharge Over pressure

Suction Over temperature

Inverter Error

Material of construction of various parts of Blowers shall be as follows:

Bearing : Inconel

Casing : Aluminium Alloy

Impeller : Aluminium Alloy (AL7075)

Shaft : Titanium Alloy

Blower &

Control panel : SPHC

Enclosure

PLC Hardware : Conformal Coated

Head for blowers shall be decided on the basis of S.O.R. of diffusers and maximum liquid depth in Basin duly considering the losses governing point of delivery (diffusers) and the blowers

The operation of Aeration System shall include PLC based control. The operation and speed of Air Blowers shall be automatically adjusted using parameters like Oxygen Uptake Rate, Dissolved Oxygen and Temperature and Liquid Level in the Basin such that the DO is supplied as per demand and power utilisation for operation of Air Blowers is optimised.

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The main Air Header/Ring Main shall be in MS as per relevant IS Code, painted with corrosion resistant paint as per Manufacture's recommendations. The Air Header/Ring Main shall be supported on saddles at suitable intervals or shall be protected against external corrosion in case laid below ground. The Sub-header shall have Auto Valves to facilitate switch over of Aeration Cycle from one Basin to other by PLC. The Sub-header shall supply air to fixed type Diffuser Grid through vertical Air Supply Pipes. These Air Supply Pipes above water level shall be in MS, painted with corrosion resistant paint and below water shall be in SS 304. All under water Lateral Pipes shall be of UPVC. Junctions between horizontal Sub-header and vertical Air Supply Pipes shall be suitably protected against corrosion due to dissimilar materials.

The Air Blower House shall have perforated Rolling Shutter, Windows with aluminium louvers covered with Velcro net, Exhaust Fans, Safety Equipment with sufficient Ventilation, Lighting and Working Space. It shall be equipped with Forklift of suitable capacity or Electrical Hoist with Travelling Trolley to facilitate lifting / removal / transportation of Air Blower for repair and maintenance, if required.

All other accessories, whether specified or not, but required for completeness shall form part of Contractors scope.

1.8.13 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 Employer’s Representative. The max of zinc rich epoxy primer shall be prepared at work site not earlier then 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 Employers’ 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.

1.8.14 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.

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The maximum design travel rate shall be 60 mm/min with proven hydraulic discharge capacity of the decanter proportional to the selected Basin area.

There should be maximum one (1) Decanter per Basin.

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 floatables 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 1.0m/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

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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 Technology provider has provided specified type of decanters in at least 10 Number of STP's in India on his ow design, and successful operation for at least one (1) years as on date.

1.8.15 Submersible Pumps for Wet well, Return and Excess sludge

Raw sewage pumps shall pump sewage from wet well at sewage pumping station to inlet chamber of STP. 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 1500 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

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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 (Upper (Secondary): C vs SiC & Lower (Primary): SiC vs SiC) 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 SS 304 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

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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.

1.8.16 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 thro 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.

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The 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

Casing CI IS FG 260

Screw Alloy Steel-HCP

Base plate CI / MS Epoxy painted

Fastener SS AISI 304

Pump Speed 960 rpm (maximum)

Ball passing size 10 mm for Hard Solid, 40 mm for Soft Solids

Applicable code

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

1.8.17 Dosing Tank Agitators

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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 out put 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

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The circulating element of the each agitator will consist of a single, axial flow design, Four number of blades on the impeller.

Fasteners & Anchor bolts

All fasteners and anchor bolts shall be of such metallurgy that shall be compatible with the duty conditions shall be used.

1.8.18 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 Mechanically/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.

1.8.19 COTDM (Combined Thickening & Dewatering Machine)

A combination of sludge thickener mechanism and mechanical sludge dewatering using belt filter press shall be provided for sludge dewatering.

(i) Sludge Dewatering Units using COTDM

The dewatering facility shall comprise of: Mechanical Belt Thickener + Belt Filter Press Machine or Volute Press +Polyelectrolyte Dosing System Sludge flow from the sludge sump is directed to the combined thickening and dewatering unit. The machine has a simple structure with easy maintenance and high output solids content rate. The sludge will be dewatered from inlet consistency of 0.8% solids to 20% solids in the belt press. The filtrate from belt press will be sent to terminal sewage pumping station and dewatered sludge shall be used for many different purposes (as manure). A standby unit will be provided. The poly dosing system shall also be there to enhance the thickening and dewatering process.

Mechanical Dewatering of the sludge is contemplated after sludge thickening. Belt Filter Press or Volute Press machine has to be provided for Mechanical Sludge Dewatering.

Thickened sludge from the thickener flows to the Belt filter press or Volute Press Dewatering polyelectrolyte solution of strength 0.1% W/V is added to the incoming sludge. By chemical conditioning, the sludge is dewatered at a desired consistency of about 20%. The BFP/Volute Press shall be housed in an elevated building so that the dewatered sludge is collected directly in a container from where it is removed periodically and carted away for further processing and disposal or reuse.

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The building shall also house the ancillary equipment for BFP such as DWPE dosing system. The filtrate from BFP shall be directed to the filtrate sump. The filtrate along with the supernatant from thickener cum sludge holding tank shall be recirculated to supernatant sump and then to SBR distribution channel.

The dewatering system should be so located that the dewatered sludge can be loaded into trolleys/ drums/ bins directly – preferably the dewatering unit shall be so located that the dewatered sludge falls into the containers/ bins without requirement of another material handling unit.

The dewatered sludge should be truck-able & be suitable for disposal by open body truck and should have a minimum solid concentration of 20% w/w (measured as dry solids w/w basis). The dewatering unit should have a 95% solid recovery.

Material of Construction

Main Components	SS 304 wetted parts

Mixing arrangement of

Polyelectrolyte and sludge : online-mixing.

Dewatering polyelectrolyte Dosing system is to be provided to dose Poly Electrolyte solution to the incoming sludge at entrance to the COTDM.

1.8.21 Valves

1.8.21.1 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.

1.8.21.2 Sluice Valves

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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

1.8.21.3 Knife Gate Valves

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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 SS304, 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 in built stuffing box to seal the rear opening. The stuffing box should have internal tappers for pushing the seals on to the gate. The seals should be of non-asbestos PTFE to reduce the friction and offer higher life. Provision shall be made to enable tighten the stuffing seals by means of a pusher arrangement to minimize the leakage through the back of the valve. Replacement of stuffing seals should be done in installed condition of the valve.

The spindle should be double start threaded and non-rising type for compact & safe operation. The gate movement area should be covered by protection shields. Gate opening indicating arrangement should be provided to find out the extent of gate opening /closing.

Flange drilling suitable to mount between flanges as per IS 1538 -1993.

Body: Cast Iron FG 260 as per IS 210

Knife gate: AISI:304 Gr. ASTM A240

Retainer ring: SS:304 ASTM A351 Gr. CF:8

Inlet Seal: EPDM

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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

1.8.21.4 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 304
Spring	SS AISI 304
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

1.8.21.5 Butterfly Valves

Butterfly valve shall be of centric type resilient seated. End connection for butterfly valve shall be wafer type. Design standard for butterfly valve shall be IS 13095 or equivalent.

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Material of construction

Body	C.I. IS:210 Gr. FG-260
Disc	SS AISI 304
Bearing Bushes	Bronze with EPDM 'O' ring
Body Seal	Nitrile rubber or suitable for 120 dgree max.
Internal Fasteners	S.S. to AISI-304
Drive Shaft & Stub Shaft	S.S. to AISI-304
External Fasteners	Carbon Steel, IS:1367
Hand wheel	C.I. IS:210 Gr. FG-200 - For 200mm dia

Other Parameters

Type of Valve	Moulded rubber lined Wafer Type centric Butterfly Valve
Pressure Rating	PN 10
Operation	Lever operated upto 150 NB/ Gear operated for 200 NB & above

Non Return Valves

End connection for NRV shall be wafer type. Design standard for butterfly valve shall be API 594.

Material of construction

Body	C.I. IS:210 Gr. FG-260
Disc/Plate	SS AISI 304
Hinge Pin	S.S. 304
Retainer	S.S. AISI-304
Spring	S.S. 304
Disc Seal	EPDM rubber

1.8.21.6 Ball Valves

End connection for ball valve shall be screwed / flanged end based on valve size.

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Material of construction for Cast Steel Valves

Body	ASTM A 216 Gr WCB
Ball	ASTM A 276 Type 304
Stem	AISI-410
Seat Ring	PTFE
Seat	PTFE
Lever	Steel with PVC sleeve
Studs	A 193 Gr.B7

Material of construction for Stainless Steel Valves

Body	ASTM A 351 Gr CF8
Ball	ASTM A 276 Type 304
Stem	ASTM A 276 Type 304
Seat Ring	PTFE
Seat	PTFE
Lever	Steel with PVC sleeve
Studs	A 193 Gr.B7

Actuator

Type	Motorized type
Power Supply	415 +/- 10% / 3 / 50 +/- 5%
Actuator stator	Non Integral type
Motor type	AC electric motor with engage/ disengage clutch mechanism of the dry type & weather proof.
Motor rating	As per design
Limit switch mechanism	2 Nos. for valve open & close position, 2 Nos additional contacts, cable entry (3/4" electrical treading), 2 NO + 2 NC of 3A, 230 V AC with mounting bracket
Torque switch mechanism	2 Nos. - One for closing direction and one for opening direction

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Torque rating	1.5 times of Max valve torque
Accessories	Local OFF remote switch with pad locking facility 3 set of auxiliary limit switch for each direction
Contact Ratings	Continuous
Position indicator	Required
Manual Over ride	Lever up to 150 NB/ Gear for 200 NB & above.
Lockable cover	For local controls
Make	As per approved vendor list
Opening Time /Closing Time (Gate)	Max. 1.5 to 2.0 min.
Opening Time /Closing Time (Valves)	100 NB to 400 NB = 30 sec. 500 NB to 600 NB = 60 sec More than 600 NB = 90 sec.

1.8.22 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 Employer's representative. All underground-buried mild steel piping unless found otherwise necessary, shall be protected by the application of hot coal tar enamel and fibreglass wrapping. The coating shall consist of one coal` tar primer one coat, wrapping of fibre glass one more coat of enamel and the final wrap of enamel impregnated fibre glass. However, all water supply plumbing pipelines shall be of GI class B and either anchored externally with SS AISI fasteners or appropriately buried below the ground with a sand cushion of 20 cm all round. All sanitary piping shall be of UPVC class 4 suitably buried below the ground with a sand cushion of 20 cm all round. Changes in direction on the ground

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shall be achieved with inspection chambers of 45 cm x 45 cm and heavy-duty CI/Steel reinforced fibreglass chamber covers.

1.8.22.1 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 Employer'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

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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.

1.8.22.2 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

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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.

1.8.22.3 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”).

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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.

1.8.22.4 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.

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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.

1.8.23 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 Employer'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:

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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

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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.

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

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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.

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.

Wall thimbles

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 IS 210 Gr 260
Stem cover	Polycarbonate transparent tube.

Parameters

Type	Rectangular rising spindle
Size	As per requirement
Applicable code	IS 13349

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Class 1

Maximum seating head As per contractors design

Unseating head As per contractors design

Maximum distances between gates As per contractors design.

centre line and operating platform

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.

1.8.24 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 A 240	AISI: 304
Resilient rubber seal	Natural Rubber EPDM Rubber Neoprene Rubber		
Seal retainer bar	Stainless Steel	ASTM A240	AISI: 304
Stem / Spindle	Stainless Steel	ASTM A276	AISI: 304
Operating Nut/ Stem Nut	Leaded Tin Bronze	IS: 318 – 1981	LTB 1, LTB 2
Fasteners	Stainless Steel	ASTM A276	AISI: 304
Anchor Bolts	Stainless Steel	ASTM A276	AISI: 304

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Yoke	Mild Steel	IS: 2062 – 1992	Grade A

1.8.25 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.

1.8.26 Valve Actuators

All actuators shall be motorized type (Non-integral Starter 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.

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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

1.8.27 Laboratory Equipment

Laboratory equipments shall be provided as mentioned below (each location):

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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

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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

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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

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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

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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	Bensene	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

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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	Gelatin 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

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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
1	Potassium dichromate	gm	500gm
62	Potassium chromate	gm	500gm
63	Potassium nitrate	gm	500gm
64	Potassium permangate	gm	500gm
65	Patton & Reeders 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

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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

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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	Brillient 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

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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	Erichrome 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		4 Nos.
6	Steel Almirah		2 Nos.

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4) TECHNICAL SPECIFICATION FOR ELECTRICAL & INSTRUMENTATION WORK (SEWAGE TREATMENT PLANT) (PART C)

General

The scope of work includes design, equipment selection, manufacture, inspection at Contractor's or his Sub-Contractor's works, supply, installation (including storing, unloading and transferring the material / equipment to Contractor‘s storage area, maintaining equipment / material in safe custody and assembling the elements of the equipment and installing at the place of work), testing and commissioning of the plant equipment/ electrical system on _turnkey‘ basis. After successful commissioning and trial run of the plant, it should be handed over to the Employer or their representative. The Contractor shall submit their design calculations/ drawings based on _Design criteria for electrical equipment/ system‘ for Employer or their representative‘s review and approval. These specification covers, 33kV switchboard, LV switchboards, LV energy efficient motors, LV soft starters, LV capacitors, HV, and LV power cables and control cables, DC supply system and other allied equipment, etc. along with th

e specifications for workmanship, laying cables, lighting system, earthing systems, lightning protection etc. for this project. It shall be the responsibility of the Contractor to design the electrical system based on the selection of the mechanical equipment.

The Contractor shall make his own estimate of sizes, ratings and quantities for 33kV system, equipment, all plant items and miscellaneous systems such as earthing, lightning protection, lighting for SPS, STP and Master Control Centre etc. as required. However, facility for upgrade/ expansion of all equipment to cater any future requirements of load shall have to be considered during design-engineering stage.

All equipment offered shall comply with the requirements specified in the latest editions of applicable Indian/ International Standards and shall also comply with the good engineering practices.

Contractor shall design the electrical system on the basis of _Design Criteria‘and to be submitted for Employer or their representative‘s approval. Contractor shall incorporate any changes/ suggestions in the drawings to suit site conditions and design criteria and standard engineering practice and resubmit for approval to Employer or their representative.

Electrical installation work shall be carried out through agency having valid electrical license of appropriate class from the concerned statutory bodies governing the area of work place. The Contractor shall fully comply with the relevant statutory rules and regulations.

All type (as applicable), routine and acceptance tests shall be conducted in the presence of Employer's representative on all the equipment as per latest applicable IS/IEC at no extra cost. Typical type test reports for other equipment shall be submitted by the Contractor for approval by Employer or their representative.

All commissioning tests shall be carried out in the presence of Employer or their representative and approval for the same shall be obtained before commissioning and installation. All test reports shall be properly maintained by the Contractor duly approved by the statutory bodies and shall be handed over to the Employer or their representative after completion of the job. All instrument and accessories required for testing and commissioning of the equipment specified herein shall be provided by the Contractor at no extra cost to the Employer or their representative.

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Liaison with JVVNL/RVPLN and other Government organization/ statutory bodies for obtaining Power supply/ other clearance shall be Contractor ‘s scope. After completion of installation work, the Contractor shall arrange for inspection and obtain approval from the concerned statutory bodies. Any fees that are to be paid to such statutory bodies for testing, inspection or calibration shall be paid by the Contractor. Any modification / revision in the equipment / installation of equipment as required by the statutory bodies shall be carried out by the Contractor. All such costs / fees for revisions / modifications shall be deemed to be included in the prices of supply, installation, testing and commissioning of equipment as quoted by the Contractor.

Power Supply Information

The proposed power supplies are as follows:

33 kV AC System	Voltage variation +10 to -5% Freq. Variation +5 to -3%	Three Phase, 50 Hz, effectively earthed AC System SC. Rating of 750 MVA
415V AC System	Voltage variation +10 to -10% Freq. Variation +5 to -5%	Three Phase and neutral, 50 Hz, effectively earthed system, SC. rating of 20 MVA

240V AC System	Voltage variation+10% to 10% Freq. Variation + 5% to - 5%	Single phase and neutral, 50 Hz, effectively earthed system
110V DC Supply	Voltage variation +/- 15%	Unearthed two wire system

All equipment shall have rated withstand capacity based on above criteria.

Design Criteria for Electrical Equipment/ System

The Design Criteria described below covers the electrical equipment/ system for the proposed STP.

General Power Distribution Scheme

Estimation of Load

The following assumptions have been be made to arrive at the estimated load of the different sites.

a) Load Factor

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i)	Motor :		0.9
ii)	Auxiliary load, valve motors, etc.	:	0.9
iii)	Lighting load :		1.0
b)	b) Diversity Factor		
i)	Motor :		1.0
ii)	Auxiliary load, valve motors, etc.	:	1.5
iii)	Lighting load :		1.2

Power factor of Motors : As per Manufacturer ‘s Catalogue

Efficiency of Motors : IE 3 as per IS 12615

(Energy efficient, high performance motors shall be provided for optimum utilization of energy).

Protections

The following protections are proposed for various switchboards, transformers, motors and other plant feeders.

32 kV Switchboard

IDMT over current and earth fault protection for incomers

IDMT and instantaneous over current and earth fault protection for outgoing transformer feeders

LV switchboard

Over current, short circuit and earth fault protection on ACBs/ MCCBs

Motors

Overload protection by thermal (bimetal) relays in all the three phases to trip with single phase preventer (SPP) and short circuit protection in all the three phases through motor protection circuit breakers/ MCCBs.

Metering

The following metering shall be provided.

33 kV Switchboard

Multifunction meter (for incomer) containing -

Ammeter

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Voltmeter

kW meter

Frequency meter

Power factor meter

Kilowatt-hour meter

kVAr meter

kVA meter for outgoing feeder

Ammeter with selector switch

LV Incomers

Ammeters with selector switch

Voltmeter with selector switch

kW meter

Power factor meter

Kilowatt-hour meter

Frequency meter

Alternately MFM shall be provided. Multifunction meter shall be equipped with interfacing capability for RS-485 port.

LV Outgoing Feeders

Ammeter with ammeter selector switch

Indicating Lamps

The following indication shall be provided:

33kV Incomer, and Outgoing feeders

Circuit breaker ON, OFF and TRIP, spring charged, control supply healthy and trip circuit healthy (Mains ON (R, Y,B) indication for incomer only)

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LV Incomers

Mains ON (red, yellow and blue)

Motor Feeders

Motor ON, OFF and Trip indication (Red, green and Amber)

Motor ON, OFF and Trip indication (Red, green and Amber), control supply healthy and trip circuit healthy for breaker feeder.

Multifunction meter whereever power gurantee is asked

All electrical equipment will be rated for 500 C design ambient temperatures.

All power cables shall be sized based on continuous current capacity, permissible voltage drop and short circuit current rating. The voltage drop shall be limited to

% at rated equipment current rating. For cable sizing.

The illumination levels proposed for various areas are as follows:

Area	Illumination level (Lux)
Pump House	250
Office/Conference Room	400
Switchboard Room/SCADA Room	250
All other indoor areas	150
Outdoor plant area and Road	10 – 20

Component of luminaries shall be _energy efficient low loss‘type. LED type of luminaries shall be used for office/ all indoor areas including pump house area.. Decorative fixtures/ receptacles shall be used for office areas and industrial type fixtures/ receptacles shall be used for remaining areas. Street/ area lighting shall be of LED type and controlled by time switch/ photocell for automatic switching of luminaries. Emergency light shall be provided for safe evacuation of the people in case of fire or panic (blackout, total power failure, etc.) Emergency lighting shall be automatically switched ON when mains power supply fails.

The values of fault level for designing the electrical system shall be based on transformer capacity, its impedance and system fault level. Fault clearing time for sizing of earth conductor will be taken as one second.

The material of earthing conductor shall be hot dip Galvanized Steel. All connections between the earth conductors buried in earth/concrete and between earth conductor and earth leads shall be of welded type.

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While sizing the buried earth conductor, a corrosion allowance of at least 20% shall be taken. Plant earthing system shall be designed such that the overall earthing grid resistance is maximum one ohm.

Main earthing conductors outside and inside the building shall be planned in such a manner that various equipment is connected to earthing system by two connections in a reliable manner.

System Description

Electrical System

Each STP with 33 kV power sub-station shall be constructed and single power source shall be feed to MPS & STP's. The 33kV supply shall be made available by RVPNL/JVVNL but Contractor has to get verified the available system voltage from RVPNL/JVVNL prior to commencement of works.The contractor's scope shall start from outgoing of the meter.

The 33 kV switchboard shall feed two nos. of 33/0.433 kV transformers with on

-load tap changer (OLTC), which in turn to feed the 0.433 kV indoor switchboard. 100% redundant transformer shall be provided to feed the entire load of the STP& SPS. The off circuit tap changer shall be provided in transformer as per requirement. The 33kV indoor switchboard shall consist of two incomer VCBs (with line VTs), a bus coupler VCB and VTs on both the bus sections along with two nos of outgoing VCB feeders. One VCB incomer with 2 outgoing VCB feeders along with one Bus coupler as per requirements.

A 415 V PCC shall receive power from two nos of 33KV/0.433 kV transformers and to feed the individual loads through different switchboards located at different locations and sufficient space for installation of these switchboards should be made available at site.

LV capacitor banks with control panel consisting of automatic power factor correction (APFC) relay are to be proposed across each LV bus section of the LV switchboards.

Necessary metering, protection and indication/ annunciation are to be provided on all the switchboards.

Units of Measurement

Metric units of measurement (System International) shall be used in all Contract documentation. Angular measurement shall be in degrees with 90 degrees comprising one right angle.

Reference Standards

All equipment / systems supplied under this Contract shall conform to the latest editions of the International Electro-technical Commission (IEC) Standards or equivalent Indian Standards or other International Standards, provided they promise to confirm equal or superior performance. If standards other than IEC are referred, then the Contractor shall enclose English Version of the standard with the bid.

Inspection and Testing at Manufacturer's Works and Dispatch

The Contractor shall follow the approved QA/QC Plan for the Inspection and Testing of Equipment at Manufacturer's Works and Dispatch.

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Construction Power Supply

Contractor shall make his own arrangements for construction power supply from JVVNL authorities. However, upon request of the Contractor, if Employer or their representative agrees to provide the construction power supply then it is the responsibility of the Contractor to connect his equipment at the point of supply and pay the requisite charges / fees to the Employer or their representative as per the prevalent rates of JVVNL.

All power and lighting circuits shall be constructed with due regard for personnel safety and shall comply with recognized codes of practice and local regulations. All circuits shall be fitted with earth leakage systems.

Power Transformers

Standards

Transformers and its accessories shall comply with the following International Standards, including those referred to therein.

IEC 60076, 60214, 60296 / IS 2026, IS 335 / BS 148, 171

The technical parameters of transformers shall be as below:

Description	Unit	Particulars
General		
Quantity required		2 nos at each STP or load centre
Installation (Indoor / Outdoor)		Outdoor
Ratings		
Rated power		
(*) Contractor shall submit their design calculation for rating of each equipment for Employer or their representative for approval.	kVA	
No load voltage Primary	kV	33
Secondary	kV	0.433
Number of phases		3
Rated frequency	Hz	50
Impedance voltage	%	As per IEC/BIS

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Description	Unit	Particulars
Vector group		Dyn11
Winding material		Electric Grade Copper
Type of cooling		ONAN
System Voltage		
Nominal system voltage Primary	kV	33
Secondary	kV	0.415
Highest system voltage - Primary	kV	36
Secondary	kV	
Transformer Secondary Neutral Earthing		Effectively earthed
Insulation Withstand		
Rated lightning impulse withstand voltage	kV (peak)	170
- Secondary	kV rms)	3.5
Temperature Rise		
Reference design ambient	0C	50
Temperature rise over design ambient temperature of 50 0C		
- Average winding temperature rise (by resistance measurement)	0C	55
- Top oil temperature rise (by thermometer)	0C	50
Tap Changing Gear		
Type of tap changer		OLTC
Tapping range	%	? 10%
Tapping steps	%	1.5
Bushings		
Rated voltage – Primary	kV	36

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– Secondary	kV	1.1
One minute power frequency withstand voltage (dry and wet) – Primary	kV (rms)	70
- Secondary (Line and Neutral)	kV (rms)	2.5
Rated lightning impulse withstand voltage	kV (peak)	170
Nominal creepage distance	mm/kV	31
Terminal Connections		
Primary line end		Cable box
Secondary line end		Cable box/Bus Duct
Secondary neutral end		One bushing each inside and outside cable box
Type of wheels		Plain – Bi- directional

(*) Values to be ascertained by the Contractor after Submitting design calculations subject to approval.

Design Features

Transformers will be located outdoor and shall also be rated for satisfactory

operation at 500C design ambient temperature.

Accessories and Fittings

Each main power transformer shall have the following fittings and accessories including but not limited to:

A conservator of sufficient volume with

oil level gauge with potential free contacts for initiating alarm for low oil level

weather-proof dehydrating breathers for both compartments with activated alumina or silica gel as the dehydrating breather

shut off valves

filling plug and drain valves

The conservator shall be designed to maintain an oil seal upto a temperature of 1000 C.

Gas and oil actuated Buchholz relay with

necessary shut off valves

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test cock with pipe connections for sampling

potential free contacts for initiation of alarm in case of slow gas formation and trip in case of fast oil and gas surges

Dial type thermometer with

maximum temperature indicator and its resetting device

potential free contacts for initiating alarm on high temperature and trip on very high temperature

Winding temperature indicator with

necessary sensing, compensating and calibrating devices

potential free contacts for initiating alarm on high temperature and trip on very high temperature

WTI transmitter for remote indication on remote tap changing panel

Detachable type of radiators including but not limited to:

Shut-off valves and blanking plates on transformer tank at each point of connection of inlet and outlet header

Top and bottom shut-off valves and blanking plate on each radiator

Lifting lugs

Top oil filling plug, 19 mm size

Air release plug at top

Oil drain plug at bottom, 19 mm size

Earthing terminals

Pressure relief device for transformer tank

Weather - proof marshaling box mounted on transformer tank

Name plate, rating plate and Diagram plate

Valves and plugs as below:

Drain valve

Filter valve

Oil sampling valves at top and bottom

Valves between radiators and tank (in case of detachable radiators)

Air release plug

Twin outlets (with plug) for applying vacuum with attachments.

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Earthing pads of copper or non-corrodible material for transformer tank (2 places) and radiator banks

Inspection manholes as required

Lifting arrangement for

fully assembled transformer

core and coil

tank

Hauling eyes on each face of the transformer

Bi-directional flanged wheels

Anti-earthquake clamping devices

Jacking pads

Adequate number of air vents for relieving trapped air during oil filling and during maintenance.

Accessories for clamping the wheel to the foundation channel in order to withstand earthquake forces.

Windings

The windings shall be of electrical grade copper.

Materials used in insulation and assembly shall be insoluble, non-catalytic and chemically inactive in the hot transformer oil and shall not soften or otherwise be affected under operating conditions. Windings and insulation shall be so arranged that free circulation of oil is possible between coils, between windings, and between winding and core.

Leads from winding to the terminal board and bushings shall be rigidly supported to prevent injury from vibration. Guide tubes shall be used where practicable.

Windings shall be subjected to shrinking and seasoning processes so that no further shrinkage occurs during service. Adjustable devices shall be provided to take up possible shrinkage in service. High voltage end - windings shall be suitably braced to withstand short circuit stresses.

Core

The magnetic circuit shall be constructed from high grade, cold rolled, non- ageing, grain oriented silicon steel laminations. Each sheet shall have an insulating coating resistant to the action of hot oil. Each lamination shall be coated with insulation which is unaffected by the temperature attained by the transformer during service.

The insulation structure for the core to bolts and core to clamp plates shall be such as to withstand appropriate dielectric test. All steel sections used for supporting the core shall be thoroughly shot or sand blasted after cutting, drilling and welding. Core laminations shall be annealed and burrs removed after cutting. Cut edges shall be insulated. The framework and clamping arrangements of core and coil shall be securely earthed inside the tank by a copper strap connected to the tank. The core clamping structure shall be designed to minimize eddy

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current loss. The core shall be provided with lugs suitable for lifting the complete core and coil assembly. The framework and clamping arrangements shall be securely earthed.

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The core and coil assembly shall be dried out and impregnated under vacuum.

Tank

The transformer tank shall be made from high-grade sheet steel, suitably reinforced by stiffeners made of structural steel sections. All seams, flanges, lifting lugs, braces, and other parts attached to the tank shall be welded. The interior of the tank shall be cleaned by shot blasting and painted with two coats of heat resistant, oil insoluble paint. Adequately sized manholes shall be provided for ease of inspection and maintenance. Steel bolts and nuts exposed to atmosphere, shall be galvanized.

Tank together with radiators, conservator, bushings and other fittings shall be designed to withstand without permanent distortion the following conditions:

Full vacuum of 760 mm of Hg for filling with oil under vacuum

Internal gas pressure of 0.35 kg/cm^2 with oil at operating level

Tank shall be provided with a pressure release device, which shall operate at a pressure below the test pressure for the tank and radiators. The device shall be provided with a device visible from ground to indicate operation. An equalizer pipe connecting the pressure relief device to the conservator shall be supplied. The device shall be provided with potential free contacts for alarm and tripping. Alternatively, a separate pressure relay shall be provided for this purpose.

The tank cover shall be bolted type and not welded, sealed type. The tank cover shall be removable and shall be suitably sloped so that it does not retain rainwater.

Radiators

Radiators shall be designed to withstand the vacuum pressure conditions specified for the tank. They shall be so designed as to completely drain oil into the soak pit and to prevent formation of gas pockets when the tank is being filled.

Transformers of rating above 1500 kVA shall be equipped with detachable or separately mounted radiator banks. Radiators for the main transformers shall be with bolted and gasket flange connections. Transformers of rating 1500 kVA and below shall be provided with fixed type radiators. Fins of the radiators shall not have sharp edges and shall be rounded in shape.

When transformers are provided with separately mounted radiators, flexible joints shall be provided on the main oil pipes connecting the transformer tank to the radiator banks, to reduce vibration and facilitate erection and dismantling. The interconnecting pipes shall be provided with drain plug and air release vents.

On Load tape changer

On Load tap changer shall be provided for auxiliary transformers. It shall comprise

Operating handle or wheel accessible from ground level

Tap position indicator

Padlocking arrangement with padlock.

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Marshalling Box

The marshalling box shall be tank mounted, weather proof, vermin proof, dust proof, sheet steel (2 mm thick), enclosed and. Door and gland plate shall be fitted shall be atleast 600 mm from grade level. Top surface shall be sloped. The degree of protection shall be IP65.

Contacts / terminals of electrical devices / relays, etc. mounted on the transformer shall be wired to the marshalling box. Interconnecting wires between the marshalling box and the accessories / devices shall be either PVC insulated wires in GI conduits or PVC insulated, armoured cables together with provision of double compression type, brass cable glands at the marshalling box. The above-mentioned cables as well as terminating the cables shall be the Contractor's responsibility.

All contacts for alarm, trip and indication circuits shall each be electrically free, designed for the auxiliary DC supply of 110 V and brought out to separate terminals in the marshalling box. Terminals shall be rated for 10 A. Disconnecting / shorting type terminal block shall be used for CT circuits.

Provision for remote annunciation shall be provided with two changeover contacts for alarm condition and two changeover contacts for trip condition for each of the following conditions including but not limited to:

Buchholz alarm

Buchholz Trip

Oil Temperature high

Oil Temperature very high

Oil level low

Pressure relief device operated

Winding temperature high

Winding temperature very high

Conservator oil level low

Cable Terminations

Cable boxes shall have sufficient space for segregating the cable cores and for adequate clearance in air between bare conductors at the terminals. Cable boxes shall be complete with necessary glands, lugs and armour grips.

Air filled cable boxes shall be of adequate dimensions and designed in such a manner that they can be opened for inspection without disturbing the gland plate or incoming cable. Disconnecting chamber shall be provided for disconnecting and moving away the main transformer, without removing the cables or the cable box. Provision shall be made for earthing the body of each cable box.

Tests

All tests required by the specification including repeated tests and inspection that may be necessary owing to the failure to meet any tests specified, shall be carried out at the Contractor's expense.

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The following tests shall be carried out on the assembled transformer during inspection at the manufacturer‘s works.

Temperature rise test on one transformer

Measurement of resistance of windings at principal and extreme taps

Ratio at each tap, polarity and phase relationships

Measurement of impedance voltage at principal and extreme taps

Measurement of no load current and no load losses at rated frequency and at both the rated voltage and 110 % rated voltage

Measurement of efficiency and regulation at ½, ¾ and full load

Measurement of insulation resistance

Induced over voltage withstand test

Separate source voltage withstand test

Magnetic balance test

Test on OLTC

Type test certificates shall be provided for verification. Whenever two nos. or more identical transformers are being offered, type tests on one of them shall be carried out, including heat run test. Heat run test shall be carried out as per stipulations laid down in the bid document.

All auxiliaries and accessories such as temperature indicators, Buchholz and pressure relays shall be tested as per the applicable standards and test certificates shall be furnished to the Employer ‘s Representative for approval.

Rejection

The Employer may reject the transformer if anyone of the following conditions arises during testing:

Any of the quantities / parameters of transformers subject to tolerances are outside the tolerances given in the applicable standards or such tolerance as guaranteed in the Contractor's bid.

Winding and / or top oil temperature rise exceeds the specified / guaranteed value; and

Transformer fails to withstand any of the dielectric tests.

Additional tests shall be conducted to locate the failure and after rectification, all tests shall be repeated to prove that the rebuilt transformer meets the specification in all respects, all at the Contractor‘s expense.

Employer reserves the right to have the transformer replaced or repaired by the Contractor within reasonable period to Employer's satisfaction at no extra cost to the Employer. The Contractor shall also bear the costs, including but not limited to, incurred by the Employer in re-inspection / re-testing such as travel and incidental [illegible]

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expense, etc. The Contractor shall note that any delay in completion time due to such repair / replacement shall be subject to liquidated damages as specified in the Conditions of Contract.

HV Indoor Switchboard

HV switchboard shall comply with the following Standards, including those referred to therein.

IEC 60044, 60186, 60255, 60265, 60282, 60298, 60466, 60529, 60694, 60787,

62271 IEC/TR2 61211 and IS 9046, 9920, 9921, 13118, 3427, 4237, 2156, 2705,

3156, 10118, 722, 13118.

The technical parameters of HV switchboards shall be as below:

HV switchboard

Description	Unit	Particulars
General		
Type		Metal enclosed, compartmentalized, draw-out type
Rated voltage, no. of	kV / - /	33 kV, 3 Phase, 50Hz

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Description	Unit	Particulars
phases and rated frequency	Hz	
System neutral earthing		Effectively Earthed
Rated Insulation Levels		
- Rated short duration power frequency withstand voltage	kV (rms)	70
- Rated lightning impulse withstand voltage	kV (peak)	170
Rated normal current of bus bars under design ambient temperature of 500C and material of busbar	A / -	(*), Copper - suitable for 100% load including future loads
Rated short-time withstand current and time	kA (rms) / sec	16 kA for 1 sec
Dynamic rating	kA (peak)	40
Constructional Requirements		
Minimum thickness of sheet steel in mm Cold rolled (Frame/Enclosure/ Covers)	mm	Frame – 2.5 Doors/Covers – 2.0
Degree of protection of enclosure		IP-5X
Color finish shade		
- Interior		Glossy White
- Exterior		Light Grey Semi Glossy
Cable connection		Bottom entry and exit
Circuit Breakers		
Type		Vacuum/ SF6

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Rated current inside the cubicle under design ambient temperature at 50□C	A	(*) – (Breakers shall be rated for final ratings of motors in STP)
Rated operating sequence		O–3 Min–CO-3 Min-CO
Rated short time breaking current	kA (rms)	16
Rated short time making current	kA (peak)	40
Rated short-time withstand current and time	kA (rms) / sec	16 kA for 1 sec
Rated peak withstand current	kA (peak)	40
Min. no. of auxiliary contacts		6 NO + 6 NC after internal use by manufacturer
Type of operating mechanism		
- Normal		Spring charging for closing and tripping
- Emergency		Manual and Spring charged for closing and tripping
Auxiliary control voltage		

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Description	Unit	Particulars
- Closing coil / Tripping coil	V	110V DC
- Spring charging motor	V	110V DC
- Space heater and lighting	V	230V AC
Earthing switch		Required
Current and Voltage Transformers		
Details of ratio, taps, burden, accuracy		As per Single Line Diagram (*)
Protective Relays		
Type		Numerical (Microprocessor based)
Auxiliary supply	V	110V DC
Details of protective relays		As per Single Line Diagram
Switch-Disconnector		
Rated current under design ambient temperature of 50□C	A	(*)
Rated making current	kA (peak)	40
Rated peak withstand capacity	kA (peak)	40
Rated short-time withstand current and time	kA (rms) / sec	16 kA for 1 sec
Insulation levels		
Rated lightning impulse withstand voltage		
- Across the isolating distance	kV (peak)	70
- Phase to phase, between phases and across open	kV (peak)	60

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switching devices		
Rated short duration power frequency withstand voltage		
- Across the isolating distance	kV(rms)	23
- Phase to phase, between phases and across open switching devices	kV(rms)	20
Operating mechanism		
- Closing and opening		Spring charged
- Control voltage	V	110V DC
Earthing switch		Required
HV Fuses		
Application		Indoor
Type		HRC
Rated current	A	(*)
Rated voltage	kV	36
Rated breaking capacity	kA (rms)	16

(*) Value to be ascertained by the Contractor after submitting design calculations subject to approval.

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Circuit Breaker

Circuit breakers shall preferably vacuum type. Circuit breaker along with its operating mechanism shall be mounted on a wheeled carriage moving on guides, designed to align correctly and allow easy movement. Plugs and sockets for power circuits shall be silver faced and shall be insulated with suitable insulating material shrouds. All corresponding components of circuit breaker cubicles of same rating shall be interchangeable with one another.

There shall be _Service', _Test' _Fully withdrawn' positions for the breakers. In the _Test' position the circuit breaker shall be capable of being tested for operation without energizing the power circuits, i.e. the control circuits shall remain undisturbed while the power contacts shall remain disconnected. Separate limit switches, each having a minimum of 2 _NO' + 2 _NC' contacts, shall be provided for both _Service' and _Test' positions of the circuit breakers for future SCADA.

Electrical tripping shall be performed by shunt trip coils. —Local / Remote‖ selector switch lockable in —Local‖ position shall be provided on the cubicle door. `Red' and `Green' indicating lamps shall be provided on cubicle door to indicate breaker close and open positions. Breaker —Service‖ and —Test‖ positions shall be indicated by separate indicating lamps on the cubicle door, in case mechanical indication of —Service‖ and —Test‖ positions are not available on the cubicle door.

Connection of the control / interlocking circuits between the fixed portion of the cubicle and the breaker carriage shall be preferably by means of plug socket arrangement.

Operating Mechanism Control

Circuit breakers shall be operated by a motor spring charging type of mechanism. The mechanism shall be complete with motor, opening spring, closing spring and all accessories to make the mechanism a complete operating unit

Operating mechanism shall normally be operated from the breaker cubicle itself.

The tripping spring shall be charged by the closing action, to enable quick tripping. Closing of the circuit breaker shall automatically initiate recharging of the springs to enable the mechanism to be ready for the next closing stroke. Charging time for the springs shall not exceed 30 seconds. It shall be possible to manually charge the springs in an emergency. Transfer from motor to manual charging shall automatically disconnect the charging motor. All operating mechanisms shall be provided with "ON" - "OFF" mechanical indication. The charging mechanism shall be provided with mechanical indicators to show "charged" and "discharged" conditions of the spring. Failure of any spring, vibration or mechanical shock shall not cause tripping or closing of the circuit breaker.

Only one closing operation of the circuit breaker shall result from each closing impulse (manual or electrical), even if the breaker trips while the control device (manual or electrical) is being held in the "close" position.

The circuit breaker mechanism shall make one complete closing operation, once the push button (PB) or control switch has been operated and the first device in the control scheme has responded, even though the PB or control switch is released before the closing operation is complete, subject to the condition that there is no counter- impulse for tripping.

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Means shall be provided to manually open and close the breakers slowly, when the operating power is not available, for maintenance and adjustments. A local manual trip device shall also be provided on the operating mechanism.

Circuit breaker control shall be on 110 V DC. Closing coils and other auxiliary devices shall operate satisfactorily at all voltages between 85-110

% of the control voltage. Trip coils shall operate satisfactorily between 70 - 110 % the rated control voltage.

Provision for remote control shall be provided for future SCADA.

Safety Interlocks and Features

Withdrawal or engagement of a circuit breaker / switch disconnector shall not be possible unless it is in the open position.

Operation of a circuit breaker / switch disconnector shall not be possible unless it is in service position, withdrawn to test position or fully drawn out. It shall not be possible to close the circuit breaker electrically in the service position, without completing the auxiliary circuit between the fixed and moving portions.

Circuit breaker / switch disconnector cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker / switch disconnector carriage to cover the stationary isolated contacts when the breaker / switch disconnector is withdrawn. Padlocking facilities shall be provided for locking the shutters positively in the closed position. It shall, however, be possible to open the shutters intentionally against spring pressure for testing purposes.

The circuit breaker / switch disconnector carriage shall be earthed before the circuit breaker / switch disconnector reaches the test position from fully withdrawn position. In case of breakers / switch disconnector with automatic disconnecting type of auxiliary disconnects, the carriage shall be earthed before the auxiliary disconnects are made and the carriage earthing shall break only after the auxiliary disconnects break.

Caution nameplate, —Caution Live Terminals‖ shall be provided at all points where the terminals are likely to remain live and isolation is possible only at remote end, i.e. incomer to the switchboard. Suitable interlock shall be wired for the purpose.

Current and Voltage Transformers

CTs and VTs shall have polarity marks indelibly marked on each transformer and at the associated terminal block. Facility shall be provided for short- circuiting and earthing the CT secondary at the terminal blocks.

CT shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit current. Core laminations shall be of high grade silicon steel.

VTs shall be of the single phase type and mounted on a draw out trolley. VTs shall be protected on their primary and secondary sides by current limiting fuses with interrupting ratings corresponding to breaker rating. It shall be possible to replace the secondary fuses safely when the switchboard is energized. Alternatively, MCB having auxiliary contact shall be provided. Primary side fuses shall be replaceable only in the de-energized position.

Secondary winding of voltage transformer (VT) shall be rated for a three phase line to line voltage of 110V.

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Identification labels giving type, ratio, output and serial numbers shall be provided for CTs and VTs.

Relays

Protection relays shall be Numerical (microprocessor based) type. Relays shall have interfacing facilities to communicate data to SCADA system.

All relays shall be enclosed in rectangular shaped, dustproof cases and shall be suitable for flush mounting.

All relays shall be accessible from the front for setting and resetting. Access to setting devices shall be possible only after the front covers of the relays are removed.

All protective relays shall be of the draw-out type and shall be provided with operation indicators visible from the front.

Over Current / Earth Fault Protection

This relay shall be of the multi-characteristics type which has a flexible mode selection facility so that it is possible to select one mode for the over current elements and another for the earth fault element.

Phase current range shall cover at least 50-300% of ‗In' in steps of not more than 10% while the earth current range shall cover at least 5-100% of

‗In' in steps of not more than 5%.

The time setting range of the definite time mode shall not be less than 5 seconds in steps of 0.1 second each.

The time multiplier setting for the inverse time-current characteristic modes shall have a range not less than 0.05- 1.6 in steps of 0.05.

Over current and earth fault relays shall have separate timers and operation indicators.

The high set element shall have a range of 2 - 15 times the nominal current in steps of ‗In' and shall be of low transient overreach, with a tripping time of less than 25 ms and possible to be selected on "blocked" position. Reset time shall be not more than 50 ms for both elements.

The relays that are installed on the transformer neutral side shall be of single phase version, but they shall have the same characteristics as the phase side relays.

Restricted Earth Fault Protection

The restricted earth fault relay shall be operated from a completely separate core of line and neutral current transformers. The dedicated CTs shall be of class PS and have the same magnetization characteristics with a knee ‗emf' value higher than the highest possible setting of the relay. Intermediate CTs for ratio correction are not acceptable. CT sizing shall be matched with the requirements of the relay.

For this protection, 1-phase high impedance relay shall be provided and all the aspects regarding stability of the protection, dimensioning of current transformer, considering the peak short circuit current, etc. and all the auxiliary equipment such as non-linear VDR resistor for voltage limiting, filter for harmonics and DC component, etc.

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suppression and variable shunt resistor for sensitivity adjustment, if required, shall be provided. The total fault clearing time shall not exceed 20 m sec. at 3 x In. the maximum short circuit of the switchboard shall be submitted.

Under Voltage Relays

Suitable voltage operated relays for sensing loss of voltage shall be provided. The relay shall have a drop off to pick up ratio of the order 90%. The relays shall be fast operating type and shall be fitted with operation indication. The indication shall come on drop off or loss of voltage.

Additional potential free contacts for all the relay outputs i.e. trip as well as alarm signals shall be provided for connection to future SCADA.

Auxiliary Relays and Timers

Following auxiliary relays shall be provided on each breaker cubicle:

Trip circuit supervision relay

Anti- pumping relay

Hand reset type lockout (tripping) relays and timers shall be provided as required in addition to the protection relays given in the single line diagram.

Auxiliary relays and timers shall be rated to operate satisfactorily between 70 % and 110 % of the rated voltage.

Voltage operated relays with sufficient contacts to initiate tripping, alarm, annunciation for various trip functions like Buchholz relay operation. Each relay shall have four (4) pairs of self-reset contacts except for Buchholz and "PRD" trip which shall have hand-reset contact. The relays shall have hand-reset operation indicators.

Voltage operated relays with sufficient contacts to initiate alarm and data logging for various alarm functions for transformers, etc. shall be provided. Each relay shall have four (4) normally open self reset contacts. The auxiliary relay for Buchholz alarm shall be slugged to have delay on drop off at 100 ms. The relays shall have hand reset operation indicator.

Switch Disconnectors and Fuses

Switch disconnectors when switched, shall be of the load break, fault make, grouping operated type. For use on 3-phase systems, the switches shall be of the triple pole type with a link for neutral connection.

Switch disconnectors shall be of the heavy duty, quick make and quick break type. It shall be electrically and manually operated. Their contacts shall be silver plated, and contact springs shall be of stainless steel. Their handles shall have provision for locking in both fully open and fully closed positions. Mechanical _ON-OFF‘ indication shall be provided.

For combination units of switch disconnector and fuses, the following interlocks shall be incorporated:

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The fuses should not be accessible unless the switch disconnector is in fully open condition.

It should not be possible to close the switch disconnector when the fuse cover is open, but an authorized person may override the interlock and operate the switch disconnector. After such an operation, the cover shall be prevented from closing if the switch disconnector is left in the "ON" position.

All fuses shall be of the HRC cartridge type in accordance with IEC 60269 mounted on plug-in type of fuse bases. Fuses shall be provided with visible indicators to show that they have operated. Current vs. time characteristics of all types of fuses shall be furnished to the Employer or their representative.

Fuses and links functionally associated with the same circuit shall be mounted side by side.

An adequate number of spare fuse cartridges of each rating shall be supplied and fitted in clips inside the panel.

Constructional Features of Switchboard

Switchboard design shall comprise metal enclosed, fully compartmental and draw out execution having separate sections for each circuit. Compartments with doors for access to operating mechanism shall be so arranged as not to expose high Voltage circuits. Switchboard cubicle shall be provided with hinged door on the front with facility for locking door handle.

Switchboard shall be dust and vermin-proof and shall have a degree of protection of enclosure of IP 4X.

All removable covers shall be gasketed all around with neoprene or superior gaskets.

Instruments, relays and control devices shall be flush-mounted on hinged door of the metering compartment located in the front portion of cubicle. The metering compartment shall be properly shielded to prevent mal-operation of electronic equipment such as numerical / static relays due to electro-magnetic fields. Separate signal earth shall be provided for such devices, if necessary.

Each switchboard cubicle shall be fitted with a label on the front and rear of the cubicle. Each switchboard shall also be fitted with label indicating the switchboard designation, rating and duty. Each relay, instrument, switch, fuse and other devices shall be provided with separate label.

Sheet steel used for fabrication of switchboards, control cabinets, marshalling boxes, etc shall be cold rolled.

All panels, cabinets, kiosks and boards shall comprise rigid welded structural frames made of structural steel sections or of pressed and formed cold rolled sheet steel of thickness not less than 2 mm. The frames shall be enclosed by sheet steel of at least 2 mm thickness. Stiffeners shall be provided wherever necessary.

All doors, removable covers, gland plates, etc. shall be of at least 2 mm thickness and shall be gasketed all round the perimeter.

All doors shall be supported by strong hinges of the disappearing or internal type and braced in such a manner as to ensure freedom from sagging, bending and general distortion of panel or hinged parts.

All floor mounted panels / boards shall be provided with a channel base frame. It shall be possible to extend the switchboard on both sides.

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The fully draw-out modules shall have all the circuit components mounted onwithdrawable type steel chassis. All power and control connections shall be of the draw out type. It shall be possible to withdraw the chassis mounted circuit components without disconnecting any connections. All draw-out contacts shall be of silver plated copper.

In case of circuit breaker compartments, suitable barriers shall be provided between breaker and all control, protective and indication circuit equipment including instrument transformers such that no live parts are accessible. External cable connections shall be through separate cable compartments for power and control cables.

One metal sheet shall be provided between two adjacent vertical sections running to the full height of the switchboard except for the horizontal bus bar compartment. However, each shipping section shall have metal sheets at both ends.

After isolation of the power and control connections of a circuit, it shall be possible to carry out maintenance in a compartment safely, with the bus bars and adjacent circuits alive.

Earthing

A copper earthing bus shall be provided and extended throughout the length of the switchboard. It shall be bolted to the framework of each unit and brazed to each breaker earthing contact bar. It shall be located at the bottom of the board.

The earth bus shall have sufficient cross section to carry the momentary short circuit and short time fault current for at least 1 second or higher as specified, without exceeding maximum allowable temperature rise. The earth bus shall be properly supported to withstand stresses induced by the momentary short circuit current.

Suitable clamp type terminals at each end of the earth bus shall be provided to suit the size of the earthing conductors.

Bolted joints, slices, tap, etc. to the earth bus shall be made with at least two bolts.

Positive earthing of circuit breaker frame shall be maintained when it is in the connected position and in all other positions whilst the auxiliary circuits are not totally disconnected.

Hinged doors shall be earthed through flexible earthing braid of adequate cross section. All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Positive connection of the frames of all the equipment mounted in the switchboard to the earth busbar shall be maintained through insulated conductors of size equal to the earth bus bar or the load current carrying conductor, whichever is smaller.

All instrument and relay cases shall be connected to earth bus bar by means of 1100V grade, green colored, PVC insulated, stranded, tinned copper, 2.5 sq. mm conductor looped through each of the earth terminals.

Circuit / Bus bar Earthing Facility

It shall be possible to connect each circuit or set of 3 phase bus bars of the switchboard to earth through earthing switches.

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Earthing switches / earthing devices shall be mechanically interlocked with the associated breakers / switch disconnector to prevent accidental earthing of live circuit or bus bars.

In case the earthing facility comprises earthing trucks to be inserted in place ofcircuit breakers, separate earthing trucks shall be supplied for each type / size of breaker.

The earthing facilities proposed to be provided by the Contractor shall be clearly detailed in the Bid and shall be subject to Employer or their representative‘s approval.

Auxiliary contacts (min. 2 NO + 2 NC) shall be provided on each earth switch / earthing device and shall be wired to the terminal block for interlocking purpose.

Annunciators

Annunciators shall be of facia type with translucent plastic window for each alarm point. Annunciator facia plates shall be engraved in block lettering with respective alarm inscriptions. The inscriptions shall be clearly readable and visible when the respective facia light is lighted.

Each annunciation window shall be provided with two lamps to provide redundancy against lamp failure. Lamps shall be replaceable from the front. Lamps shall be of clustered LED type.

All facia annunciator points shall be suitable to accept external contacts of either ‗NO‘ or ‗NC‘ self or hand reset type for initiating the annunciation sequence. Annunciators shall be suitable for accepting fleeting faults of duration as less as 15 millisecond.

For static annunciator schemes, special precaution shall be taken by the Contractor to ensure that spurious alarm conditions do not appear due to influence of external magnetic fields on the annunciator wiring and switching disturbances from the neighboring circuits within the panels / desks.

A ―Lamp Test‖ push button shall be provided for each individual panel‘s group of annunciators to limit the sudden drain on the battery.

Provision of testing facilities for flasher and audible alarm circuits of annunciators is desirable. The Contractor shall give the details of the offered scheme.

Annunciators shall have following features:

Suitable for annunciating subsequent faults immediately after the sound cancel of the previous fault.

During lamp test, if a fault occurs, the corresponding lamp circuit shall be automatically disconnected from the ―lamp test‖ circuit and shall start flashing.

Designed to prevent mal-operation of the scheme or sequence when the push buttons are pressed incorrectly or in the wrong order.

"Alarm Supply Failure‖ Alarm scheme similar to the normal annunciation sequence, but shall operate on a different DC supply or on AC auxiliary supply.

Instruments

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All electrical instruments and meters shall comply with IEC 60051, 61010 and IS 722, 1248.

All indicating and recording instruments shall be flush mounted in dust proof cases complying with IEC 60068 and dimensions to IEC 61554. All digital instruments shall have interface facilities to communicate data to SCADA system.

Indicating Instruments

Electrical indicating instruments shall be 96 or 110 mm square with 2400 scale. Taut band type of instruments is preferred. Taut band moving coil instruments for use on AC systems shall incorporate built-in transducers.

Instrument dials shall be white with black numbers and lettering. A red line shall be drawn on each scale to represent rated conditions.

Normal maximum meter reading shall be of the order of 60 % normal full scale deflection. Ammeters for motor feeders shall have suppressed scale to show current from full load up to six times the full load current.

Instruments shall have accuracy class of 1.0 or better. The design of the scales shall be such that it can read to a resolution corresponding to 50% of the accuracy class index.

Ammeters and current coils of Watt meters and Voltmeters shall continuously withstand 120% of rated current and 10 times the rated current for 0.5 sec., without loss of accuracy. Voltmeters and potential coils of Watt meters and Varmeters shall withstand 120% of rated voltage continuously and twice the rated voltage for 0.5 sec. without loss of accuracy.

Alternatively, instruments can be electronic / digital type with LCD display. These instruments should have high performance ratio and can be equipped with digital output (for alarms) or with interfacing facilities for communication and remote reading of parameters in SCADA.

Metering instruments

A multi function meter with suitable communication port to interface with SCADA. These instruments should have high performance ratio and can be equipped with output for alarms.

Control and Selector Switches

Control and instrument switches shall be rotary type, provided with escutcheon plates clearly marked to show operating position and suitable for semi-flush mounting with only the switch front plate and operating handle projecting out. The connections shall be from the back. The contact assembly at the back of the switch shall be enclosed in dust tight removable covers.

The control switches shall be 3 position, spring return to neutral type. They shall be provided with contacts to close in ‗normal after close' and ‗normal after trip' position. Each switch shall have external red and green indicating lamps, (except when discrepancy type switches are called for). In addition, a semaphore indicator shall be provided for earthing switch.

Contacts of the switches shall be spring assisted and contact faces shall be of silver / silver alloy. Springs shall not be used as current carrying parts. Contact rating and configurations of the switches shall be adequate for the functions desired.

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Instrument selector switches shall be of the maintained (stay-put) type. Ammeter selector switches shall have make-before-break type contacts so as to prevent open circuiting of CT secondary when changing the position of the switch.

Lockable type switches, which can be locked in a particular position, shall be provided, if required.

Emergency stop buttons, if any, shall incorporate _stay-put' features with independent reset facilities.

Indicating Lamps / Pilot Lights

Indicating lamp shall be of the double contact, bayonet cap type rated for operation at either 230 V AC or at the specified DC system voltage as applicable. Lamps shall be provided with translucent lamp covers.

Clustered LED type lamps shall be provided Lenses shall be glass or plastic in standard colors, red, green, blue, white and amber, in accordance with IEC 60073.

Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panel. Tools, if any, which are required for replacing the bulbs and lenses, shall also be included in the scope of supply.

Miniature pilot lamps may be provided with plastic marking plate contained inside square (or rectangular) front lens to provide indication of legend or symbols engraved on the marking plate.

The basis of colors shall be as follows:

Red : Flow of energy. Green : No flow of energy.

White : Supervision of power available, relay coil healthy, etc.

Amber : Disagreement with original condition, _abnormal' condition or _Sequence–on' condition.

Push Buttons

Push buttons shall be of momentary contact type with rear terminal connections. The color of the push button actuator shall be red for _OPEN / STOP' and green for _CLOSE / START' and for other applications shall be as per specified requirements. The push button knob shall be suitably shrouded to prevent inadvertent operation. The push buttons shall be provided with integral inscription plates engraved with their designation.

All push buttons shall have independent, potential free, 2NO + 2NC contacts. The contact faces shall be of silver / silver alloy. The contacts shall be rated 10A and capable of breaking inductive load of 1A at 110V DC and 5A at 110V AC.

Space Heaters

Adequately rated anti-condensation space heaters shall be provided for each switchboard / cubicle.

Space heater shall be of the industrial strip continuous duty type, rated for operation on a 230 V, 1 phase, 50 Hz, AC system.

Space heater shall be provided with a single pole MCB with overload and short circuit release, a neutral link and a thermostat to cut off the heaters at 350 C.

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Cubicle Lighting / Receptacle

Each cubicle shall be provided with interior lighting by means of 18 W fluorescent tube lighting fixture. An MCB shall be provided for the lighting circuit. The lighting fixture shall be suitable for operation from a 230 V, 1 ph, 50 Hz, AC supply.

A 230 V, 1 phase, AC receptacle (socket) plug point shall be provided in the interior of each panel with an MCB.

Power and Control Cable Terminations

Terminals for power connections shall be complete with adequate phase

segregating insulating barriers, shrouds and suitable crimping type of lugs for terminating the cables.

Double compression type glands with armour and bonding clamps for the termination of all solid dielectric multicore cables shall be provided. They shall be designed to secure the armour wires to provide electrical continuity between the armour and the threaded fixing component of the gland and to provide watertight seals between the cable outer sheath and gland and between the inner sheath and threaded fixing component. The gland shall preferably project above the gland plate to avoid entry of moisture.

Earthing connectors between cable armour and earth shall be routed outside the cable gland in an approved manner. Gland insulation shall be capable of withstanding test for appropriate higM Voltage for one minute.

Cable terminations for HV / MV cables shall be heat / cold shrinkable type. Adequately sized shrouds/bolts shall be provided at connections to completely cover the terminations.

Where core-balance type current transformers are provided on the feeder cables for earth fault protection, glands for cables shall be insulated from earth in an approved manner.

Wiring for Control and Protective Circuits

All low voltage wiring for control, protection and indication circuits shall be carried out with 1100 V grade, PVC insulated cable with stranded, tinned copper conductor of minimum 1.5 sq. mm size. The size of conductor for CT circuits shall be minimum 2.5 sq. mm.

All wiring shall be run on the sides of panels and shall be neatly bunched and cleated without affecting access to equipment mounted in the panel.

The wiring shall be bound and supported by clamping, roughing or lacing. Spiral wrapping will not be accepted. Wire ways shall not be more than 50% full. Adequate slack wire shall be provided to allow for one restriping and reconnection at the end of each wire. When screened cables or wires are necessary, an insulating sheath shall be included.

Wiring and supports shall be of fire resistant material.

Wiring shall only be jointed or teed at terminals. Terminals of the clamp type shall not have more than two wires connected.

Terminations and Ferrules

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Engraved core identification ferrules, marked to correspond with the wiring diagram, shall be fitted to each wire and each core of multicore cables terminated on the panels.

Moisture and oil resisting insulating material shall be used. The ferrules shall be of the interlocking type and shall grip the insulation firmly without falling off when the wire is removed.

All wires forming part of a tripping circuit shall be distinctively marked.

Spare auxiliary contacts of electrical equipment shall be wired to terminal blocks.

Control Wiring Terminal Blocks

Terminal blocks shall be of 1000 V grade and stud type. Brass stud of at least

6 mm dia. with fine threads shall be used and securely locked within the mounting base to prevent turning. Each terminal shall comprise two threaded studs, with a link between them, washers, and matching nuts and locknuts foreach stud. Connections to the terminals shall be at the front.

Terminals shall be numbered for identification, grouped according to function. Engraved _black on-white‘ labels shall be provided on the terminal blocks describing the function of the circuit.

Terminals for circuits with Voltage exceeding 110 V shall be shrouded. Terminal blocks at different voltages shall be segregated into groups and distinctively labeled.

Terminals used for connecting current transformer secondary leads shall be

_disconnecting and shorting‘ type with a facility for earthing the secondary.

Terminal blocks shall be arranged with 100 mm clearance, between any two sets.

Separate terminal stems shall be provided for internal and external wiring respectively.

All wiring shall be terminated on terminal blocks, using crimping type lugs or claw type of terminations.

Electronic Equipment

Electronic equipment shall be capable of withstanding randomly phased transient over voltages of either polarity on the power supply or interruptions of the power supply without damage or impairment to the equipment's subsequent performance. In the case of controls, no mal-operation shall occur.

Where manufacturers require that electronic equipment supplied under this Contract should not be subjected to insulation resistance tests ('Meggering'), suitable warning notices shall be provided and installed in appropriate locations. When specified by manufacturers, separate shield / signal earthing shall be provided.

It shall be possible to remove / replace cards from / to electronic equipment without damage and without interfering with the operation of the rest of the equipment or system. If necessary, consideration should be given to switching off the supplies locally to a card to prevent inadvertent interference to the equipment or system during removing / replacing a card.

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Electronic equipment shall not use local internal batteries unless the approval of the Employer or their representative's Representative has been obtained. Where approval is given, batteries used inside equipment shall be of the totally sealed, leak proof type.

Interference

Self-Generated Interference

Equipment shall not generate any type of interference at a level, which could be detrimental to the performance of any other equipment / component or which could cause annoyance or discomfort to personnel.

The earthing and cabling arrangements shall be such that detrimental interference is not generated.

External Interference

In the presence of interference expected in substation environments, the design of the equipment shall be such that no damage occurs and performance is maintained to the requirements of the individual specifications.

Spark Quenching

Spark quenching devices shall be fitted wherever necessary to ensurecontinued satisfactory operation of contacts and prevent mal-operation of electronic devices.

Noise and Vibration

The acoustical noise levels and / or vibration produced by the equipment in operation shall be as low as is reasonably practicable for the type of equipment concerned and shall be agreed with the Employer or their Representative.

Setting-Up and Maintenance Facilities

All equipment shall be provided with sufficient easily accessible test points to facilitate setting-up and fault location together with maintenance aids such as extension boards, jumper leads and special maintenance tools.

Pin or terminal numbering of all cards in all crates shall be consistently uniform throughout. Power supplies shall use the same pin positions on all cards in an equipment or system.

Loose Equipment

Special connecting leads, extension boards and any special item required for calibration or maintenance purposes, together with the mating half of all necessary connectors shall be supplied.

Printed Circuit Boards

Printed circuit boards shall be epoxy glass fabric boards to comply with IEC - 60321 suitable for use in hot humid climates. Printed circuit boards may be single-sided, double-sided or multi-layer.

Printed boards shall, in general, comply with IEC 60326. They shall not bow perceptibly when they are mounted in their shelves or racks. Means shall be provided to prevent boards being plugged into the wrong sockets and the plugging in / out action shall be arranged in a positive manner.

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An approved protective coat shall be applied to the printed circuit side of the board to protect against tracking, tarnishing and general deterioration due to moisture and deposition of dust. The coating shall not have any adverse reaction with any other material or components used and shall be suitable for use under tropical conditions. When boards are repaired in the field it shall be possible to apply (or 'touch up') such a finish by simple convenient means.

Component Identification

A component reference number shall be marked adjacent to each component. Where this is impossible, components shall be identifiable from the layout drawings provided.

The following shall be marked in all instances:

Fuses

The rating and the circuit identification of each fuse shall be marked adjacent to the fuse base.

Control, Protection and Indication Devices

The function of each control, protection and indication device shall be marked. The caption and its arrangement shall be subject to the approval of the Employer or their Representative.

Preset Controls

The circuit in a position where it will be clearlyvisible while the adjustment is being made.

Connectors

The diagram reference number shall be marked on or adjacent to each connector.

Test points shall be individually marked with the diagram reference number.

The polarity of any polarized devices (e.g. diodes) shall be marked.

Test Terminal Blocks

Test terminal blocks, if any, shall be provided for secondary injection and testing of relays. A suitable metering block shall be provided where specified for the connection of a portable precision instrument to be operated when required for specific plant testing purposes.

Tests

The following routine tests shall be carried out on the assembled switchboard / panel during inspection at the manufacturer‘s works in addition to other tests as per applicable standards.

Primary injection tests to ensure correct ratios and polarity of current and voltage transformers and of the current operated protection relays and direct acting coils, over their full range of settings.

Balance earth fault stability test by primary current injection. Care must be taken to reproduce accurately the burdens of interconnecting cables. A further test to ensure correct polarity must be made after assembly.

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Tests on auxiliary relays at normal operating voltages by operation of associated remote relays.

Correct operation of sequencing and control circuits at normal operating voltages by operation of local control switches, and simulation of operation from remote control positions.

Carry out functionality tests, check interfacing status contacts and instrumentation.

Checking of Differential protection relay.

One minute power-frequency voltage dry withstand tests on the main circuits

One minute power-frequency voltage dry withstand tests on auxiliary circuits

Insulation resistance tests

All circuit breakers shall be subject to the following tests:

Routine tests including HV pressure test, millivolt drop tests and mechanical tests.

To ensure the operation of the dc closing coil and satisfactory closing of the circuit breaker with the voltage of the coil down to 80% of its rated voltage, and that mal-operation does not occur with a voltage on the coil of 120% of its rated voltage.

Interchangeability of withdraw able identically equipped circuit breakers, and checking of all mechanical and electrical interlocks.

Type test figures for heat test runs performed on identical panel types shall be made available.

Motors

All motors shall comply with IEC 60034, 60072/ IS 325, 4691, 6362,4029,12065, 12075, including standards referred to therein.

The technical parameters of main

The technical parameters of motors shall be as below:

Description	Unit	Particulars
Type		Squirrel cage Induction motor (TEFC)
Rating	kW	(*)
Rated voltage	kV	0.415
Type of mounting		Vertical / Horizontal (As required)
Duty type		Continuous (S1)

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Method of starting		By variable speed drive (For Blower/compressor /Return Sludge Pumps, Compressor, motors) Direct on line- for motors upto 3.7kW Star-Delta (Close transition type) – For motors above 3.7kW and upto 75kW Soft Starter – For motors above 75kW or as per process requirements
Type of system earthing		Effectively earthed
Class of insulation		F
Design ambient temperature	0C	50
Limits of temperature rise of winding	0C	
- Determination by resistance method	0C	70
- Determination by ETD method	0C	80
Location		Indoor
Degree of Protection		IP55
Cooling designation		IC411
External cable details		0.4 / 1 kV, 3C x (*) Aluminum, XLPE, armoured
Space heater for motor		Required for rating 30kW and above
Class of Efficiency		IE 3

(*) Value to be ascertained by the Contractor after submitting design calculations subject to approval.

The LV motors shall be of the totally enclosed fan cooled type, with degree of protection for enclosure of IP 55 and shall be suitable for continuous operation and direct-on-line starting, unless otherwise specified.

They shall be suitable in all respects for service in extreme climatic conditions. Main conductor and slot insulation shall be non-hygroscopic and in accordance with Class F of IEC 60085.

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Motors shall be capable of operating continuously at rated output at any frequency between 49 and 51 Hz and at any voltage within + 10% of the

nominal value. Motors shall be designed to be operated for a period of not less than five minutes at a voltage of 20% below the nominal value and at normal frequency without injurious overheating.

The starting current at rated voltage when started direct-on-line shall not exceed 6 times the rated full load current. When started with soft starter it should be 2.5 to 3 times the rated full load current. The motor characteristics shall be coordinated with soft starter manufacturer.

All bearings shall be fitted with oil or grease lubricators. Vertical shaft motors shall have thrust bearings.

All terminals shall be of the stud type of adequate size for the particular duty, marked in accordance with an approved standard and enclosed in a weatherproof box.

All terminal boxes shall be fitted with an approved sealing chamber, conduit entry or adapter plate, as required, together with the necessary fittings to suit the type of cable specified.

The power rating of the motors shall be larger of the following:

115% of the power input to the pump at duty point at a speed corresponding to a frequency of 50 Hz.

Motors shall be capable of starting and accelerating the load with the applicable method of starting, without exceeding permissible winding temperatures, when the supply voltage is 80% of the rated voltage.

Motors shall be capable of satisfactory operation at a supply voltage of 80% of the rated voltage for 5 minutes, commencing from hot condition.

The locked rotor withstand time under hot conditions at 110% rated voltage shall be more than the starting time at minimum permissible voltage by at least two seconds or 15% of the accelerating time, whichever is greater. The locked rotor current of motors shall not exceed 600% of full load current of motor, which is inclusive of 20% tolerance.

Motors when started with the drive imposing its full starting torque under the specified supply voltage variations shall be capable of withstanding at least two successive starts from cold conditions and one start from hot condition without injurious heating of windings. The motors shall also be suitable for three equally spread starts per hour under the above referred supply conditions.

In case of motors started by soft starters, the three phases shall be segregated by metal barriers within both line and neutral side terminal boxes. The two terminal boxes shall be on opposite sides.

The earthing pad shall be of non-corrodible metal, welded / brazed at two locations on opposite sides. The pad size shall be 75x65x25 mm with two holes drilled at 40mm centers, tapped and provided with suitable bolts and washers for connecting the earthing strip.

Motors shall have space heaters suitable for 230 V, single phase 50 Hz AC supply. These shall be placed in easily accessible positions in the lower part of motor frame. Provision shall be made to measure temperature of bearing by inserting hand held temperature measuring device.

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Motors shall have drain plugs so located that they will drain water, resulting from condensation or other causes from all pockets in the motor casing.

Pockets held instrument per pumping station shall be provided for

measuring motor bearing temperature. The same instrument shall also be used to measure the pump bearing temperature.

Insulation

Any joints in the motor insulation such as at coil connections or between slot and winding sections, shall have strength equivalent to that of slot sections of the coil. The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in extreme climate. The motors shall be provided with class F insulation with temperature rise limited to that of class B insulation.

Constructional Features

The motor construction shall be suitable for easy disassembly and re- assembly. The enclosure shall be sturdy and shall permit easy removal of any part of the motor for inspection and repair.

Motors weighing more than 25 kg shall be provided with eyebolts, lugs or other means to facilitate safe lifting.

The rotor bars shall not be insulated in the slot portion between the inner core laminations for squirrel cage motors.

Terminal Box

Terminal boxes shall be of weather proof construction designed for outdoor service. To eliminate entry of dust and water, gaskets of neoprene or equivalent approved shall be provided at cover joints and between box and motor frame. It shall be suitable for bottom entry of cables. It shall be suitable of being turned through 3600 in steps of 900.

The terminals shall be of stud type with necessary plain washers, spring washers and check nuts. They shall be designed for rated current carrying capacity and shall ensure ample phase to phase and phase to earth clearances. Suitable cable glands and lugs shall be supplied to match specified cables.

Accessories

Two independent earthing points shall be provided on opposite sides of the motor for bolted connections. These earthing points shall be in addition to earthing stud provided in the terminal box.

Tests

Motors shall be subject to routine tests which shall also include the following:

Insulation resistance

Measurement of winding resistance

High voltage test

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no load / full load tests to determine efficiency, power-factor and slip

momentary overload test

test for noise levels of motor

test for vibration severity of motor

over speed test

locked rotor reading of voltage, current and power input at a reduced voltage.

Type test certificates for test runs performed on identical motors (below 11 kW

rating) shall be made available. Whenever two nos. or more identical motors (above 11 kW rating) are being offered, type tests on one of them shall be carried out, including heat run test.

Soft Starters for LV Motors

The soft starters shall comply with the requirements of IEC 60034, 60947 and IS 325 including those standards referred to therein.

Constructional and Performance Features

Motor soft starters shall be switched or electronic type.

Soft starter panel shall be indoor, metal clad with separate metal enclosed compartments for

control, metering and current transformers for differential protection, if specified

shorting (bypass) arrangement

bus bars

power cable terminations

push buttons with indicating lamps.

Soft starter shall achieve smooth starting by torque control for gradual acceleration of the drive thus preventing jerks and extending the life of equipment.

Starting current shall be limited to 2.5 to 3 times the rated current of the motor. The soft starter manufacturer shall co-ordinate with motor manufacturer for this purpose.

Separate removable gland plates shall be provided for power and control cables.

Each cubicle shall be fitted with a label in the front and rear of the cubicle, indicating the panel designation, rating and duty. Each relay, instrument, switch, fuse and other devices shall be provided with separate labels.

Necessary wiring diagram shall be provided considering starting interlock, trip circuit, starting and running mode signal.

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It shall be possible to manually start the motor locally from the starter panel or in Auto mode through PLC.

Main Bus Bars

Bus bars shall be fully insulated by encapsulation in epoxy resin /shrinkable PVC Sleeve, with moulded caps protecting all joints. Bus bars shall be supported on insulators capable of withstanding dynamic stresses due to short circuit. Bus bars shall be of Aluminum conductor(Copper is not recommended in sewage corrosive atmosphere as it us oxidized.)

Earthing

A copper earthing bus shall be provided at the bottom and extended throughout the length of the panel. It shall be bolted / welded to the framework. All non-current carrying metal work of the panel shall be effectively bonded to the earth bus. Hinged doors shall be earthed through flexible earthing braid.

Panel Accessories and Wiring

Panel shall be supplied completely wired internally upto equipment and terminal blocks and ready for the external cable connections at the terminal blocks. Inter panel wiring between compartment of the same panel shall be provided.

All auxiliary wiring shall be carried out with 1100 volts grade, single core, stranded copper conductor with PVC insulation. The sizes of wire shall be not less than 1.5 sq. mm.

Terminal blocks shall be of stud type, 10 A rated, complete with insulated barriers. Terminal blocks for CTs shall be provided with test links and isolating facilities.

All spare contacts and terminals of cubicle mounted equipment and devices shall be wired to terminal blocks.

Accuracy class for indicating instruments shall be 1.0 or better. Instruments shall be 110 mm square, 2400 scale for flush mounting with only flanges projecting.

Push buttons shall be provided with inscription plates engraved with their functions. Indicating lamps shall be of clustered LED type.

Space heaters of adequate capacity shall be provided inside each panel. They shall be suitable for 230 V, 1 ph, 50 Hz supply. They shall be complete with MCB and thermostat.

Each panel shall be provided with 230 Volts, 1 phase, 50 Hz, 5 A, 3 pin receptacle with MCB located in a convenient position. An interior illuminating lamp together with the operating door switch and protective MCBs shall be provided.

The DC and AC auxiliary supply shall be distributed inside the panel with necessary isolating arrangements at the point of entry and with sub-circuit MCBs as required.

Capacitors and APFC Panel

Capacitors shall comply with IEC 60871 and IS 5553, 13925 including those standards referred to therein.

The technical parameters of capacitors shall be as given below:

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LV Capacitors and Control Panel

Description	Unit	Particulars
Capacitor Bank		
Application		Power factor improvement
Arrangement		Automatic Power Factor Correction (APFC)
Type of insulation		Polypropylene (APP) / Mixed Dielectric (MD)
Rated output	kVAR	(*)
Rated voltage	V	415
Rated frequency and no. of phases	Hz / -	50, 3 Phase
Capacitor bank connection		Delta
Type of mounting and location		Floor mounted and Indoor
Design ambient temperature	C	50
Type of switching		Automatic
Control supply		110V DC
No. of steps for control	Nos.	Minimum 8
Description	Unit	Particulars
Degree of protection of enclosure		IP4X
Color finish shade		Light Grey Semi Glossy
Type of APFC relay		Microprocessor based automatic power-factor correction relay (maximum setting 0.99 lag)

(*) Value to be ascertained by the Contractor after submitting design calculations subject to approval.

APFC relay and a panel shall be provided for connection to LV switchboard bus, where specified.

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Design Criteria

LV capacitors – Rated for improvement of power factor on LV side to 0.98

General

The capacitor bank shall be complete with all parts that are necessary or essential for efficient operation. Such parts shall be deemed to be within the scope of supply whether specifically mentioned or not. It shall be complete with the required capacitors along with the supporting post insulators, steel rack assembly, aluminum bus bars, copper connecting strips, foundation channels, fuses, fuse clips, etc. The steel rack assembly shall be hot dip galvanized.

The capacitor bank shall comprise of suitable number of single phase units in series parallel combination. However, the number of parallel units in each of the series racks shall be such that failure of one unit shall not create an over voltage on the units in parallel with it, which will result in the failure of the parallel units. The assembly of the banks shall be such that it provides sufficient ventilation for each unit.

Each capacitor case and the cubicle shall be earthed to a separate earth bus. Capacitors shall be of polypropylene type. Each unit shall satisfactorily operate at 135% of rated kVAR including factors of over voltage, harmonic currents and manufacturing tolerance. The units shall be capable of continuously withstanding satisfactorily any over voltage up to a maximum of 10 % above the rated voltage, excluding transients.

Each capacitor unit / bank shall be fitted with a directly connected, continuously rated, low loss discharge device, if required, to discharge the capacitors to reduce the voltage to 50 volts within one minute upon disconnection.

Unit Protection

Each capacitor unit shall be individually protected by a HRC fuse suitably rated for load current and interrupting capacity, so that only the faulty capacitor unit will be disconnected without causing the bank to be disconnected. An operated fuse shall give visual indication so that it may be detected during periodic inspection. The fuse breaking time shall co-ordinate with the pressure built up within the unit to avoid explosion. Mounting of the individual fuse should be internal to the capacitor case.

Capacitor (APFC) Control Panel for LV Application

APFC microprocessor based relay shall automatically switch ON / OFF the capacitor banks to attain the value of ‗pf' close to the set value. Switching shall follow first in first out (FIFO) method to ensure uniform use of all capacitor banks. At least eight steps shall be provided for switching. Harmonic filter (inbuilt with APFC panel) shall be provided to restrict Total Harmonic Distortion (THD) to 3% or less.

Capacitor and capacitor control shall be housed in a metal enclosed cubicle. Capacitor shall be housed in the lower compartment and capacitor control unit at the top compartment, the two compartments being segregated.

The cubicle shall be fabricated out of 2 mm thick cold rolled sheet steel and shall of a degree of protection of IP 4X (for Capacitor Panel IP 4X is applicable as cut out for fan for heat dissipation.). The panel shall be of indoor type and shall consist of:

Isolating MCCB

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Contactors with overload element

Relays responsive to current / voltage / kVAR / pf for automatic switching

Sequencing devices, timers and auxiliary relays for automatic sequential switching of capacitor units in and out of circuit

Auto-manual selector switch

Microprocessor based Automatic Power Factor Correction (APFC) Relay

Push button for opening and closing the power circuit

Red and Green lamps for capacitors ON / OFF indication

Protective relays to protect the healthy capacitor units when one unit fails in a series connection

Space heater and cubicle lighting

Tests and Test Reports

Capacitors shall be subjected to routine tests as per IS: 13925. Test for capacitor losses shall also be carried out on one capacitor bank of each type ordered.

In addition to the above, the capacitor units shall be subjected to the following tests:

Load test at 110% rated voltage at an ambient of 45 to 50 o C for a period of 8 hours or more.

Leak proofness test-initially after impregnation and total sealing, each capacitor shall be heated up to 80o C to 110 o C for a few minutes. After the load test each capacitor unit shall be carefully inspected for leakage.

Type tests shall be carried out as per IS: 13925 on capacitors above 1000V rating of identical design. Certificates of type tests carried out in the last three years for similar capacitor units shall be furnished.

HV and LV Cables

HV / LV Cables shall comply with the following International Standards, including those referred to therein.

IEC 60183, 60227, 60502, 60885 and IS 7098, 5831, 8130, 1554, 10810.

The technical parameters of cables shall be as given below:

Description	Unit	Particulars
HV XLPE Power Cables		
Rated voltage U / Uo (Um)	kV	18 / 30 (36)
Material of conductor		Aluminum (stranded)

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Cross-sectional area		(*)
Type of insulation		XLPE
Inner sheath		Extruded
Outer sheath		Extruded
Conductor and insulation screening		Required
Material of armour		Galvanized Steel (Aluminum for single core cable)
LV Power, Control and Lighting Cables		
Rated voltage U / Uo (Um)	kV	0.6 / 1 (1.2)
Material of conductor		Aluminum for Power and Tinned Copper for Control cable (stranded)
Cross-sectional area		(*)
Type of insulation		XLPE for power and PVC for control cables
Inner sheath		Extruded
Outer sheath		Extruded
Material of armour		Galvanized Steel (Aluminum for single core cable)
Cable Protection		Compound of outer sheath of all HV/MV/LV cables shall contain suitable chemicals for preventing attack by rodents.

(*) Value to be ascertained by the Contractor after submitting design calculations subject to approval.

Installation

In air or buried in ground

Depth of laying in ground 1000 mm for directly buried HV cables and 750 mm for LV cables

In conduit: space factor not more than 40 % (ratio of total cable area to internal conduit area)

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In trays: single layer with spacing of one diameter for HV and main LV cables and touching for small LV cables

Control cables shall be 2C, 4C, 7C, 12C and 19C type. Minimum size of conductor for control cables shall be 2.5 sq.mm. copper.

All power cables shall be sized based on continuous current capacity, maximum permissible voltage drop of 2.5% and rated short circuit current withstand. In addition, rating factors for variation in ground/air temperature, grouping of cables, depth of laying, number of racks, etc. shall be considered for cable sizing.

Tests

All HV, and LV cables shall be subject to routine tests in accordance with the relevant Indian Standard Specifications.

Test certificates shall be provided against each drum and/or cable length.

The tests carried out on every cable length and / or drum at manufacturer's premises shall include following tests as applicable but not limited to:

High Voltage dc insulation pressure test, between cores, each core to earth, metallic sheath or armour as applicable;

insulation resistance test;

core continuity and identification;

conductor resistance test

Elongation test

Smoke density test

HCl gas generation test

Anti rodent test (Presence of lead)

LV Indoor Switchboard

LV indoor switchboard and its components shall comply with the following International Standards, including those referred to therein.

IEC 60269, 60947, 61459, 60529 and IS 4237, 8623, 1248, 722, 2705, 3156,

10118, 11353, 13947

The technical parameters of LV switchboard shall be as given below:

Description	Unit	Particulars

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General		
Rated voltage, no. of phases and rated frequency	V / - / Hz	415V, 3, 50Hz
System neutral earthing		Effectively Earthed
Rated short duration power frequency withstand voltage		
- Power circuit	kV (rms)	3.5
- Control circuit	kV (rms)	1.5
Rated normal current of bus bars under design ambient temperature of 50□C and material of busbar	A / -	(*), Copper
Rated short-time withstand current and time	kA (rms) / sec	25 kA for 1 sec
Constructional Requirements		
Thickness of sheet steel in mm Cold rolled (Frame/Enclosure/Covers)	mm	Frame – 2.5 Doors/Covers – 2.0
Degree of protection of enclosure		IP-5X, Form-4 enclosure
Color finish shade		
- Interior		Glossy White
- Exterior		Light Grey
Cable connection		Bottom entry and exit
Circuit Breakers		
Type		Air

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Description	Unit	Particulars
Rated current inside the cubicle under design ambient temperature at 50□C	A	(*)
Rated operating sequence		O–3 Min–CO-3 Min-CO
Rated short-time withstand current and time	kA (rms)/ sec	25(*)
Min. no. of auxiliary contacts		6 NO + 6 NC after internal use by manufacturer
Type of operating mechanism		
- Normal		Spring charging for closing and tripping
- Emergency		Manual and Spring charged for closing and tripping
Auxiliary control voltage		
- Closing coil / Tripping coil	V	110V DC
- Spring charging motor	V	110V DC
- Space heater and lighting	V	230V AC
Earthing switch		Required
Current and Voltage Transformers		
Details of ratio, taps, burden, accuracy		As per Single Line Diagram (*)
Protective Relays		
Type		Numerical (Microprocessor based)
Auxiliary supply	V	110V DC
Details of protective relays		As per Single Line Diagram

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Moulded Case Circuit Breakers		
Type		Moulded Case (microprocessor based)
Rated current when installed within cubicle under design ambient temperature of 500C	A	As required (*)
Rated short-time withstand current	kA (rms)	25 kA
Miniature Circuit Breakers		
Type		Miniature
Rated current when installed within cubicle under design ambient temperature of 500C	A	(*)
Rated short-time withstand current	kA (rms)	10
Motor Starters and Contactors		
Type		Variable Frequency Drive/ Star-Delta / Direct- on line
Rated current	A	(*)
Rated voltage of coil	V	230V AC / 110V DC

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Description	Unit	Particulars
Utilization category		AC-3

(*) Value to be ascertained by the Contractor after submitting design calculations subject to approval.

These cover the main switchboard and distribution boards. The distribution board shall be of floor / wall mounting and Draw out execution type. Entry for incoming and outgoing cables shall be from bottom. Bus bars shall be of Copper Degree of protection of the panel shall be IP 5X.

The board shall be provided with circuits as required, ammeter with ammeter selector switch and voltmeter with Voltmeter selector switch. Contractor shall furnish proposed single line diagram of the board along with the Bid.

Incoming and outgoing circuit shall be protected by suitably rated ACBs/MCCBs. The switchboard and its components shall be subjected to tests as per the applicable standards.

Bus Bars

The phase and neutral bus bars shall be of rating indicated in the corresponding single line diagram. Bus bars shall be of aluminum and shall be provided with minimum clearances as per standards.

All bus bars and bus taps shall be insulated with close fitting sleeve of hard, smooth, dust and dirt free, heat shrunk PVC insulation of high dielectric strength, to provide a permanent non-ageing and non-tracking protection, impervious to water, tropical conditions and fungi. The insulation shall be non- inflammable and self-extinguishing type and in fast colors to indicate phases. The dielectric strength and properties shall hold good for the temperature range of 0 to 95 degree centigrade. If the insulating sleeve is not colored, bus bars shall be color coded with colored PVC tape at suitable intervals.

Busbar joints, if any, shall be of the bolted type with minimum 4 bolts. Spring washers shall be provided to ensure good contact at the joints. Bus bars shall be thoroughly cleaned at the joints and suitable contact grease shall be applied just before making a joint.

Direct access to, or accidental contact with bus bars and primary connections shall not be possible. All apertures and slots shall be protected by baffles to prevent accidental shorting of bus bars due to insertion of maintenance tools.

Sequence of red, yellow and blue phases and neutral for four-pole equipment shall be left to right and top to bottom, for horizontal and vertical layouts respectively.

Moulded Case Circuit Breaker (MCCB)

MCCBs shall be of the air break, quick make, quick break and trip free type and shall be totally enclosed in a heat resistant, moulded, insulating material housing.

MCCBs shall have an ultimate short circuit capacity not less than the prospective short circuit current at the point of installation.

MCCBs shall have a service short circuit breaking capacity equal to the ultimate short circuit capacity.

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Each pole of MCCB shall be fitted with microprocessor based protection for over current, earth fault and short circuit (L-S-I-G). Such a protection system shall be fully self-contained, needing no separate power supply. The elements shall be adjustable. Adjustments shall be made simultaneously on all poles from a common facility. MCCB shall be suitable for remote On-Off-Tripoperation. Necessary spare auxiliary contacts (minimum 2NO+2NC) shall be provided for future use.

Motor protection circuit breaker (MPCB) shall be used for motor feeder instead of MCCBs.

Miniature Circuit Breaker (MCB)

Miniature circuit breakers shall be of the thermal and magnetic tripping type, and comply with IEC 60898 and IEC 60947-2.

MCB shall be hand operated, air break, quick make, quick break type.

Operating mechanisms shall be mechanically trip-free from the operating knob to prevent the contacts being held closed under overload or short-circuit conditions.

Each pole shall be fitted with a bi-metallic element for overload protection and a magnetic element for short-circuit protection. Multiple pole MCBs shall be mechanically linked such that tripping of one pole simultaneously trips all the other poles. For motor feeders, MCB shall have type C characteristics.

The short circuit rating shall be not less than that of the system to which they are connected with a minimum of 10 kA.

Contactors and Starters

The power contactors used in the switchboard shall be of air break, single throw, triple pole, and electromagnetic type. Contactors shall be suitable for uninterrupted duty and rated for Class AC3 duty in accordance with IEC 60947-4.

Operating coils of all contactors shall be suitable for operation on 230 V, single phase, 50 Hz supply.

Contactors shall be provided with at least two pairs of NO and NC auxiliary contacts.

Contactors shall not drop out at voltages down to 70 % of coil rated voltage. All motor contactors and their associated apparatus must be designed to operate for a period of not less than 5 minutes at a voltage of 20% below the nominal value and at normal frequency without injurious overheating.

Contactors shall be provided with a three element, positive acting, ambient temperature compensated, time lagged, hand reset type thermal overload relay with adjustable settings. The hand reset button shall be flush with the front door of the control module, and shall be suitable for resetting the overload relay with the module door closed. Relays shall be either direct connected or CT operated. Overload relay and reset button shall be independent of the "Start" and "Stop" push buttons. All contactors shall all be provided with single phasing preventer (SPP).

Motor starters shall be complete with auxiliary relays, timers and necessary indications.

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Starters shall be of the electrically held-in type with integral —start‖ and —stop‖ push buttons mounted externally on the door, with integral interlocked isolators. Where required, auxiliary switches shall be included for the operation of —red‖ and —green‖ indicating lights in remote instrument panels.

For details of other equipment/ accessories of LV switchboard (e.g. circuit breaker, current and voltage transformer, relay, constructional features of switchboard, earthing, annunciator, indicating and measuring instrument, control and selector switch, indicating lamp, push button, space heater, cubicle lighting/ receptacles, power and control cable termination, wiring, terminalblocks, etc), refer specification of HV switchboard.Bus Duct shall be provided for current ratings 1000 Amps of Incomer

Tests

The following routine tests shall be carried out on the assembled switchboard / panel during inspection at the manufacturer ‘s works in addition to other tests as per applicable standards.

Primary injection tests to ensure correct ratios and polarity of current and voltage transformers and of the current operated protection relays and direct acting coils, over their full range of settings.

Balance earth fault stability test by primary current injection. Care must be taken to reproduce accurately the burdens of interconnecting cables. A further test to ensure correct polarity must be made after assembly.

Tests on auxiliary relays at normal operating voltages by operation of associated remote relays.

Correct operation of sequencing and control circuits at normal operating voltages by operation of local control switches, and simulation of operation from remote control positions.

Carry out functionality tests, check interfacing status contacts and instrumentation.

Checking of Differential protection relay.

One minute power-frequency voltage dry withstand tests on the main circuits

One minute power-frequency voltage dry withstand tests on auxiliary circuits

Insulation resistance tests

All circuit breakers shall be subject to the following tests:

Routine tests including HV pressure test, millivolt drop tests and mechanical tests.

To ensure the operation of the dc closing coil and satisfactory closing of the circuit breaker with the voltage of the coil down to 80% of its rated voltage, and that mal-operation does not occur with a voltage on the coil of 120% of its rated voltage.

Interchangeability of withdrawable identically equipped circuit breakers, and checking of all mechanical and electrical interlocks.

Type test figures for heat test runs performed on identical panel types shall be made available.

DC Equipment

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DC equipment shall comply with IEC 60896 including those standards referred to therein.

Requirements

Following items shall be covered in the Contract:

One no. 110 V Nickel Cadmium type Battery (Minimum capacity of Battery

– 200AH)

Two nos. Float-cum-boost chargers for 110 V battery

DC distribution board.

All connections between battery, battery chargers and DC distribution board shall be designed for effective segregation between positive and negative leads.

110 V Battery

Battery offered shall be Nickel Cadmium (Ni-Cd) type. Nickel hydroxide and Cadmium hydroxide shall be used for positive and negative electrode respectively. Aqueous solution of Potassium hydroxide with small quantities of lithium hydroxide shall be used as electrolyte. It shall be used only for ion transfer and shall not chemically changed during charging/ discharging.

The containers shall be transparent and preferably be made of toughened glass or plastic and provided with acid level indicator.

The battery shall be rated on 5-hour basis and for the specified ambient temperature. The battery shall have maximum recharge time of 8 hours. The batteries shall be sized for a backup of 24 hours, in case of power failure. The ampere-hour capacity shall be selected to cater to all the emergency loads, operation of control gear, indication lamps, annunciation panels, emergency lighting, incoming breaker(s) spring charging currents, short time loads etc. A margin of about 25% shall be taken to cater to the contingencies.

Terminal posts shall be designed to accommodate external bolted connection conveniently and positively. Each terminal post shall have two bolt holes of the same diameter, preferably at right angles to each other. The bottom hole shall be used to terminate the inter-cell connection. The top hole shall be left for external terminal connections. Bolts, heads and nuts, except seal nuts, shall be hexagonal and shall be lead covered. The junction between terminal posts and cover, and between cover and container shall be so sealed as to prevent any seepage of electrolyte.

Required quantity of electrolyte for first filling with 10% extra shall be supplied in non-returnable containers.

Each battery shall be complete with following accessories, as applicable, that include, but are not limited to:

Battery racks

Porcelain insulators, rubber pads, etc.

Set of inter-cell, inter-tier and inter-bank connectors as required for the complete installation.

Electrolyte for first filling + 10% extra. Accessories for testing and maintenance

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i.	One	-3, 0, +3 volts DC voltmeter with built-in discharging resistor and suitable leads for measuring cell voltage.
ii.	One	Filler hole thermometer fitted with plug and cap and having specific gravity correction scale.
iii.	Three	Pocket thermometers
iv	Two	Cell lifting straps
v	One set Each of	Terminals and cable boxes with glands for connecting cable as required. Spare connectors Spare vent plugs Spare nuts and bolts Suitable set of spanners

Each battery shall be mounted in a manner that permits easy accessibility to any cell. The racks shall be suitable for fixing on flat concrete floor. The complete racks shall be suitable for bolting end to end.

It shall be the responsibility of the Contractor to provide batteries of adequate capacities to meet specified requirements pertaining to control, indication, annunciation, etc. and emergency lighting. For computing battery capacity, it shall be assumed that the battery is fully charged at the beginning of loading cycle and is discharged to a voltage of 1.2 volts per cell at the end of the loading cycle.

The battery shall have minimal difference (approx. 0.3 V per cell) between float and boost charging voltages.

Battery Charger (110 V)

The float-cum-boost type battery charger shall comprise silicon controlled rectifiers (SCRs) connected in a full wave bridge circuit.

Each battery charger shall be suitable for float charging the battery under normal conditions and boost charging the battery when it has discharged during service conditions. The changeover from float to boost mode and vice versa shall be automatic.

The rectifier transformer shall be dry type and double wound with required number of taps.

The DC output voltage during float charging shall be stabilized within + 1% of the set DC bus voltage for AC input voltage variation of +10%, frequency variation of + 5% and DC load variation from 0 - 100%. The voltage regulation shall be achieved by a constant voltage regulator having fast response SCR control. The ripple content shall be within 1% of DC output nominal voltage with battery disconnected and shall be designed to have voltage regulation of 1%. Also in any mode of operation, the maximum harmonics in the charger output shall not exceed 5%.The setting of the output DC bus voltage shall be adjustable between + 10% of nominal rated voltage. There shall be provision for manual control if auto mode fails. Line surge suppressers shall be provided.

For boost charging the discharged battery after a mains failure, the rectifier shall charge the battery at high rate limited to the maximum boost charging voltage. The boost charging shall come on only when selected for boost c

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mode manually. In auto control, the DC output current shall be stabilized within +2% for AC input voltage and frequency variation of + 10% and + 5% respectively. There shall be provision for manual control if auto-mode fails. Boost charging time for charging the battery to full capacity from fully discharged condition shall not exceed 8 hours.

In the float charging mode, the charger shall be designed for supplying:

The DC loads of control, indication and annunciation circuits that remain energized during normal operation and the momentary closing and trip coil loads of circuit breakers, vacuum contactors; and

The float charging current of the battery.

25% margin over the above load

Battery charging equipment complete with all accessories shall be housed in a free standing sheet steel cubicle having degree of protection of IP 4X. Sheet steel used for construction shall be 1.6 or 2 mm thick. The units shall be wired using 1100 V grade, PVC insulated, stranded copper conductor cables.

Each battery charger shall be provided with accessories that include, but not limited to the following:

Silicon controlled rectifiers connected in full wave bridge circuit with ripple control devices and transient suppression network.

Double wound dry type transformer with taps

Automatic voltage regulator unit with manual / auto control switch

Coarse and fine control potentiometers for manual control

Selector switch for mode of charging i.e. float charging / boost charging

Off-load tap changing switch for changing the taps of the transformer

DC voltmeter with fuses and a three position selector switch

DC ammeter with shunt

AC ammeter with selector switch for incoming AC power

AC voltmeter with selector switch for incoming AC power

MCB for incoming AC supply along with surge suppressers

Switch-fuse / MCB on DC output side with kick fuses and alarm contacts

Voltage dropping diodes in load circuit during boost charging mode

DC under voltage relay and earth fault relay

AC / DC switching relays for alarm and indication circuits including buzzer

Cubicle space heater suitable for 230 V AC, 1 ph, 50 Hz supply, with MCB and thermostat

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230 V AC compact fluorescent lamp fixture for internal lighting with MCB Each battery charger shall be provided with the following alarms / indications:

AC and DC supply 'ON'

AC and DC supply fail

Modes of charging

Over voltage

Under voltage on DC side

Earth fault on DC side

AC / DC MCB trip

The Contractor shall include in the bid, detailed AC and DC scheme for battery charger offered.

110 V DC Distribution Board (DB)

The distribution board shall be of floor mounting design. Entry for incoming and outgoing cables shall be from the bottom. Bus bars shall be of aluminum or copper.

Incomers, bus coupler and outgoing circuits shall be controlled by suitably rated double pole MCBs type suitable for DC application. Contractor shall furnish proposed single line diagram of the board along with the Bid.

Constructional features, pre-treatment, painting and other aspects shall comply with the specifications for LV switchboard.

Aluminum earth busbar of suitable size shall be provided along the length of the DB at the bottom. Two nos. earthing terminals shall be provided on the external face of the board for connection to the earthing grid.

Tests

The batteries, chargers and distribution boards and their components shall be subjected to routine/ acceptance tests as per the applicable standards. For battery, following tests are also to be carried out:

Capacity test

Test for voltage charging and discharging

Ampere-hour and watt-hour efficiency test

Certificates of type tests carried out on similar equipment shall be furnished.

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Variable Frequency Drives (VFD)

General

AC induction motor shall be coupled with a frequency drive of rating commensurate with the rated motor for different process driven equipment like blower etc. VFD should be chosen in such a way the power consumption can be optimized. The Frequency drives shall be of Current Source Inverter Pulse Width Modulated (CSIPWM) with GTO/IGBT/IGCT/SGCT/DTC technologies or later version, which performs precise speed and torque control of standard squirrel cage motors with optimum efficiency. Each drive must have a soft starting feature and a bypass arrangement for DOL starting of motors. All frequency dives shall be suitable for data connectivity with PLC/SCADA system and shall have suitable communication port and protocol. The drives must be easily programmable. The drives shall be provided with surge protection, programmable lockable code. The Frequency drive shall have following characteristics:

Accurate open loop torque control

Torque step rise time typically less than 5 ms

Speed control inaccuracy typically 0.1% to 0.5% of nominal speed

150% overload capacity for 60 second

Total Harmonic distortion shall comply with the provisions of IEEE 519. Necessary metering, self-diagnostic arrangement (including display and alarm facilities) shall be provided for local/ remote monitoring.

Technical Parameters

Main connection		
Voltage	:	3 phase, 415 +/- 10 % permitted tolerance
Frequency	:	45 to 65 Hz, maximum rate of change 17%/s
Imbalance	:	Max. +/- 3% of nominal phase to phase input voltage
Fundamental Power factor	:	0.97 (at nominal load)
Motor connection		
Voltage	:	3 phase, from 0 to applied incoming supply voltage, 3-phase symmetrical
Output Frequency	:	0 to 250 Hz
Frequency Resolution	:	0.01 Hz

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Continuous Current	:	1.0 * I2N(normal use)
Short Term Overload Capacity (1min./10min)	:	I2max = 1.1 * I2N
Field Weakening point	:	8 to 300 Hz
Acceleration Time	:	0 to 1800 sec
Deceleration Time	:	0 to 1800 sec
Efficiency	:	Min. 97% at nominal power level
Environment limits		
Ambient temperature	:	0 to 45 deg. Cent.
General Standard Control Connections or as per Process Requirement		
3 programmable differential analogue inputs (1 voltage signal, 2 current signals)		
7 programmable digital inputs		
2 programmables analogues outputs (current signal)		
3 programmable digital outputs (from C relays)		
Analogue and digital extension modules can be added as well as a wide range of field bus adapters.		
Protection		
Over current		
Short circuit at start-up		
Input phase loss		
Output phase loss		
Motor overload		
Earth fault		
Overvoltage		
Under voltage		
Over temperature		

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Motor stall
Application macros
The features a selection of built-in, pre-programmed application macros for configuration of inputs, outputs, signal processing and other parameters. It shall have interfacing facilities to communicate data to SCADA system. These include:
Factory setting for basic industrial applications
Hand/auto control for local and remote operation
Pid control for closed loop processes
Torque control for process where torque control is required.
Sequential control for processes where torque control is required.
User macro 1 and 2 for user‘s own parameter setting
Comprehensive testing and diagnostic function

Tests

Each unit of Variable frequency drive shall be tested at the manufacturer‘s work. Test result must satisfy the efficiencies on various loads and at different frequency levels against their quoted values during bidding.

Lighting System Equipment

Lighting system shall comply with the following International Standards, including those referred to therein.

IEC 60083, 60598, 60669, 60884, 60906 and 60947

General Requirements

Lighting system equipment shall cover lighting panels, lighting fixtures, switches, receptacles with switches, for outdoor lighting - lighting masts, street lighting poles, etc.

Normal and emergency lighting for indoor and outdoor areas shall be provided. Supply for emergency lighting shall be derived from 110 V DC distribution board to be provided under this Contract. The Contractor shall provide emergency lighting in the vital installation including pump house, switchboard room, office building, administration areas, etc. 10% of the total normal lighting shall be emergency type.

Galvanized conduits shall be used for all exposed wiring and black enameled MS conduit shall be Employer's representative for all concealed wiring. Minimum size of conduit shall be 20 mm / 25mm for exposed / concealed conduits respectively. Wiring inside the pump house, switchboard room and other areas shall be concealed type.

Wires used for conduit wiring of lighting fixtures / ceiling fans and receptacles shall be 250/440V grade, PVC insulated, single core, stranded copper conductor wires of sizes not less than 2.5 sq. mm and 4 sq. mm

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respectively. Wires shall conform to IS standards. Three individual wires with proper color coding (P-N-E) shall be used for wiring and no joint in wires between conduit is allowed. 3 core x 2.5 sq. mm. copper cable shall be used for circuiting of peripheral lighting.

Lighting Panels

Lighting panels shall be of wall mounting type and fabricated out of 1.6 mm. thick cold rolled sheet steel. Incomer circuit shall be controlled by a switch disconnector with a link in the neutral circuit. Outgoing circuits shall be controlled by single pole MCBs of minimum 10A rating and a link in the neutral circuit. TPN MCB shall be provided for street lighting/ area lighting purposes. Breaking capacity of MCBs shall not be less than 10 kA. Residual circuit breakers (RCCBs) shall be used on all lighting and receptacle circuits.

It shall be possible to terminate incoming and outgoing circuits from top and bottom. Knock-out for cable / conduit entries for all the circuits shall be provided. Separate circuits shall be provided for control of lighting fixtures and receptacles. Each phase shall have at least one spare circuit.

The panel shall be provided with 3 phase and neutral copper busbar adequately rated to cater to the requirement of all the outgoing circuits. Two earthing terminals shall be provided external to the panels for terminating the external earthing conductor.

The panel shall be internally wired using color coded, stranded copper conductor, PVC insulated wires of 1100 V grade.

The panels shall have hinged door, gasketed all round and provided with handle lock. Operation of incomer switch or MCBs shall be possible without opening the door.

Detailed specification of lighting panel and its accessories (e.g. busbar, MCB, indicating instrument, indicating lamp, etc.) are described at MV and LV switchboard.

Lighting Fixtures and its Accessories

Lighting fixtures for illumination of outdoor and indoor areas shall be supplied. Fixtures for outdoor installation shall be of weatherproof design with degree of protection of IP65. The fixtures shall be suitable for operation on a nominal supply of 240 V, single phase, 50 Hz, AC with a voltage variation of + 10 %.

Fixtures shall be complete with internal wiring, lamp, capacitor, starter, holder, ballast, reflector, louvres / perspex, etc. as required for their satisfactory operation. Fixtures shall be energy efficient and ballast shall be electronic low loss type. All indoor lighting fixture for office and control room shall be decorative type and for remaining areas it shall be industrial type.

Starter of the LED light fixture shall be replaceable without disturbing the reflector or lamps and without the use of any tool. The capacitor of the lighting fixture shall have adequate value of capacitance to correct the power factor of its fixture to 0.98 lag.

All the lighting fixtures shall be of approved make and Lighting Fixtures of manufacturer standards shall be acceptable.The fixtures shall be suitable for the SPS and STP environment.Lighting fixture reflectors shall generally be manufactured from steel or aluminum sheet of not less than 20 SWG thickness. Each fixture shall be complete with a four way terminal block for connection and looping of incoming and outgoing cables. Each terminal shall be able to accept two 2.5 msqm copper stranded conductors. Each lighting fixture shall be

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provided with an earthing terminal suitable for connecting 16 SWG copper stranded conductor. All metal or metal enclosed parts of the housing shall be bonded and connected to the earth terminal to ensure satisfactory earthing continuity throughout the fixture. All reflectors and louvers shall be finished to the same standard as the fixture housing.

The enamel finish shall have a minimum thickness of 2 mils for outside surface and 1.5 mils for inside surfaces. The finish shall be non-porous and free from blemishes, blisters, and fading.

Size of wire chosen shall be such as to limit the voltage drop to within 3 %. Minimum area of conductor shall be 1.5 sq mm stranded copper for lighting and 2.5 sq mm / 4 sq mm for 5A / 15A receptacle circuits respectively, and current density shall not exceed 2.5 A/sq mm. Generally, not more than 8 to 10 lighting points shall be wired in one circuit. For calculating connected loads of various circuits, a multiplying factor of 1.25 shall be assumed on the rated lamp wattage for sodium vapour and fluorescent lamp fixtures to take into account the losses in the ballast. A loading of 100 watts and 500 watts shall be assumed for each, single-phase 5 amps and 15 amps receptacles respectively. Wires belonging to different phases shall not be run in the same conduit. However, more than one circuit on the same phase can be run in the same conduit. For every phase wire, a separate neutral wire shall be run. Neutral wire for different phases shall not be looped.

The type of fixtures shall be considered for various areas subject to approval from the employer.. The construction features are indicative. Equivalent or superior feature is acceptable.

Street lighting fixtures for Plant for the approach road shall be weather-proof, suitable for 150W LED lamp and shall be cut-off type. The degree of protection shall be IP67. Street lighting control (switching ON and OFF automatically) shall be done by photo-electric sensor or by timer.30% of total lighting shall be on Panels.

1200mm sweep ceiling fans shall be provided in areas such as offices, etc. as per design requirement. Adequate ventilation arrangements shall be made for enclosed areas where ceiling fans are not proposed to be installed or cannot be provided. Power supply for the ceiling fans shall be derived from lighting circuits. Ceiling fans shall be complete with all accessories. Regulators shall be electronic (triac) type.

The work shall comprise wiring in heavy gauge (minimum 16 SWG) GI conduits, fixed and supported at intervals of 300 mm on walls, ceiling etc.; installation of light control switches and receptacles housed in GS boxes; earthing with 16 SWG copper wire run along the conduit and clamped to it at every 300 mm; and termination of cables/wires at lighting panels, light control switches, receptacles, lighting fixtures etc., as required. The minimum size of conduit shall be 20 mm. Space factor (ratio of total wire area to internal conduit area) shall be 40 %. Concealed conducting shall be provided to all building / office areas. For pump house area, the Contractor shall adopt surface conducting also.

Receptacles and Switches – It shall be weather-proof for outdoor application. For Pump-house area and Switchgear room, industrial type receptacles with switch shall be provided. For Office areas, it shall be decorative type. 3 phase welding receptacles shall also be provided as per requirement.

Types of fixtures proposed by the Contractor for various areas shall be subject to Employer or their Representative approval.

The lighting poles for streetlights shall be of tubular / swaged type steel poles, circular in construction. The steel poles shall be coated with bituminous preservative paint on the inside as well as embedded outside surface. Exposed outside surface of the steel poles shall be painted with one coat of red lead oxide primer. After

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completion of installation, two coats of aluminum paint shall be applied. The supply of poles shall be complete with fixing bracket, necessary pipe reducer for fixing the fitting and also include the necessary associated pole mounted junction boxes. 2 nos. studs shall be provided on the pole for earthing. The lighting poles shall have an end cap with brackets for mounting LED street lightslamps (of suitable wattage) in weatherproof fittings, cut-off type or semi- cut off type luminaries. The brackets shall be welded to the pole and shall ensure an suitable overhang depending on height of the pole.

Junction boxes with terminals shall be supplied for branching and terminating the lighting cables, weatherproof and suitable for usage in outdoor areas. The junction boxes shall be dust and vermin proof and shall be fabricated from 2 mm CRCA sheet steel and shall be complete with removable cover plate with gaskets, two earthing terminals each with nut, bolt and washer. The Contractor shall provide support arrangement (through 25 x 4 mm GI flat U clamp) for proper fixing of the junction box to the pole.

The boxes shall be hot dipped galvanized / painted with on shop coat of red oxide zinc chromate primer followed by a finishing coat of paint. Suitable rubber gaskets shall be provided on the doors of the junction boxes. The junction boxes shall have a locking facility, suitable to be opened by a common panel key for all the junction boxes. The boxes shall have provision for mounting on the poles. Suitable knockouts for the entry for cable / conduit entry shall be provided with terminal blocks, HRC fuses etc.

The terminal blocks shall be mounted securely on brackets welded to the back sheet of the box. The terminals shall be 1.1kV grade, one piece construction complete with barriers, galvanized nuts, bolts, washers and provided with identification strips of PVC. The terminals shall be made of copper alloy and shall be of box clamp type. Double compression brass glands shall be provided for entry / exit of the cables into the junction box.

Receptacles with Switches

Adequate number of receptacles of 6A, 16A and 32A rating with MCBs suitable for operation on 230 V AC, 1 phase, 50 Hz supply shall be provided as detailed below:

Decorative and industrial type shall be proposed in relevant areas.

Receptacles proposed for outdoor installation shall be of weatherproof design of degree of protection IP65.

Single phase receptacle shall be provided with a switch / MCB of the same current rating, housed in the same enclosure. Three phase receptacles shall be associated with a MCB of the same rating, housed in the same enclosure. The number, type, rating and location of receptacle shall be subject to approval of the Employer or their representative‘s Representative.

Switches

Decorative / industrial type switches of 6A / 16A rating shall be provided for all indoor areas. Switches shall be provided to control a group of lighting fixtures in various areas. Switches shall be housed in galvanized steel boxes.

Tests

Lighting panels, fixtures, receptacles and other accessories shall be subjected to routine and acceptance tests as per the applicable standards.

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Cabling System Installation

General

The scope shall cover, in addition to supply, complete installation of plant items and accessories as indicated in various parts of the specification. Requirements / guidelines / information / parameters / instructions, etc. specified in this section shall apply to all the sections.

Installation work pertaining to plant items and systems such as cabling, lighting, earthing and lightning protection systems, etc. shall comply with the applicable standards, safety codes, etc.

Installation shall be carried out strictly in accordance with the approved drawings. Changes, modifications, if any, required to suit site conditions, shall be carried out only with the prior approval of the Employer or their representative‘s Representative. All such changes shall be incorporated in the "As built" drawings to be furnished by the Contractor.

All tools, brazing equipment, crane, scaffolding, rigging materials, ladders, consumables, hardware, etc. required for installation shall be provided by the Contractor.

It shall be the responsibility of the Contractor to engage Specialist Engineers from his Sub-Contractors / Manufacturers to supervise installation work for plant items such as switchboard, motors, etc. where felt essential. Such services shall be arranged by the Contractor at no extra cost to the Employer or their representative.

It shall be the responsibility of the Contractor to obtain approval / clearance, if any, from local statutory authorities, for conducting any work for completed installation.

The Contractor shall ensure that all plant under erection as well as the work area and the project site are kept clean to the satisfaction of the Employer or their representative. In case the Employer or their representative is not satisfied about the cleanliness, he will have the right to carry out the cleaning operations. Expenditure incurred by him in this regard will be to the Contractor's account. Packing cases and packing material, except for spares shall be cleared from sites.

In order to avoid hazards to personnel moving around the equipment, which is kept charged after installation before commissioning, such equipment shall be cordoned off by suitable barriers to prevent accidental injury.

Switchboard shall be installed on finished surfaces. Proper aligning, joining of various vertical shipping sections, busbar connections, inter panel wiring, etc. will be the responsibility of the Contractor.

The Contractor shall take utmost care in handling instruments, relays and other delicate mechanisms. Wherever the instruments and relays are supplied separately, they shall be installed only after the erection of switchboards is complete.

Cabling System

All apparatus, connections and cable work shall be designed and arranged to minimize risk of fire and any damage, which might be caused in the event of a fire.

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Cables shall be laid directly buried in earth, on cable trays in built-up trenches, in conduits / pipes along walls / structures / foundations / ceilings, etc. The Contractor's scope of work includes unloading, excavation, laying, backfilling, fixing, bending and terminating the cables. The Contractor shall supply the necessary material and accessories required for installation and termination of the cables which shall include but not be limited to items such as glands, lugs, terminating accessories, hardware, consumables, saddles / spacers, GI conduits / pipes, cable identification tags, protective bricks, civil materials, etc.

Buried Cables

Cable installation in outdoor areas shall be carried out in directly burried cable trenches. Stabilized thermal backfilling shall be used for directly buried cables. Cabling from trenches up to junction box / equipment, etc. shall be carried out in GI conduit / pipes of class B. Provision of GI pipe sleeves in trench wall shall be the Contractor's responsibility. Where cables cross roads or water / sewage pipes, the Contractor shall provide rows of 150 mm diameter GI pipes in a concrete block for passage of cables. Contractor shall also lay spare pipes for future use. Alternatively, Contractor shall provide concrete cable duct for road crossing. LV cables shall be buried at a depth of minimum 750 mm while HV and MV cables shall be buried at a depth of minimum 1000 mm. For road crossings, the pipe for the cables shall be buried at not less than one meter depth.

Directly buried cables shall be laid on a 75 mm thick riddled and compacted earth bed. The cables shall then be covered on top and at their side with riddled earth to a depth of about 150mm. This shall then be gently pulled down to a depth of about 100 mm above the top of uppermost cable to provide bedding for the protective concrete cable covers, which shall be placed centrally over the cables. The protective cable covers shall be of reinforced concrete. The RCC covers shall have one hole at each end to tie them to each other with GI wires to prevent displacement. The trench should be then backfilled with the excavated soil and well rammed in successive layers of not more than 300 mm thick, with the trenches being watered to improve consolidation, wherever necessary. To allow for subsidence, a crown of earth not less than 50 mm in the center and tapering towards the sides of the trench should be provided.

All cables to be routed along any particular route shall be laid at one time to avoid repeated excavation, etc. Each cable shall be tagged with numbers. The tag shall be of aluminum with the number punched on it and securely attached to the cable / conduits by not less than two turns of 20 SWG GI wire. Cable tags shall be of rectangular shape for power cables and of circular shape for control cables. Cables tags shall be provided on all cables at each end, on both sides of wall / floor crossings, on each duct / conduit entry, at each bend/ corner and at every thirty (30) meters in cables trench / tray racks on straight run.

Where groups of HV, LV and control cables are to be laid along the same route, suitable metallic barriers to segregate them physically shall be Employer or their representative. When power cables are laid in the proximity of communication cables, minimum horizontal and vertical separation of 300 mm shall be maintained. Power and communication cables shall, as far as possible, cross at right angles to each other.

Cables in Trays

Cables in trays shall be cleated individually or in a group using GI saddles. Interval for cleating shall not exceed 1500 mm.

In case of laying on cable trays / racks, power and control cables shall be laid in separate cable trays, the order of laying of various cables being as given below:

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HV cables on top tiers

LV cables on subsequent tiers

Control, instrumentation and other service cables in bottom-most cable tier.

Ladder type GI cable trays and painted rack support shall be installed in cable trenches for power cables. Perforated trays shall be used for control and instrumentation cables. Embedded flats for fixing cable tray supports shall be provided in cable trenches to support the cable trays during civil works. Where such flats cannot be used, the fixing of cable trays shall be done using anchor fasteners. All cable trays shall be earthed at a regular interval.

The cable trays shall be complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories and hardware. Cable trays and accessories such as tees, elbows, reducer, etc. shall be fabricated out of minimum 2 mm thick sheet of hot dip galvanized sheet except for trays of width 300 mm and lower for which 16 G GS sheet is acceptable. Bends, tees, etc. shall be suppliedor fabricated at site, as required. Cable tray supports such as angles, channels, etc. shall be of galvanized steel. Galvanizing thickness shall be not less than 85 micron.

Cable Pulling

The cables shall be laid in built-up trenches, directly buried in ground, or on cable trays, vertical raceways, clamped on structures / walls / ceiling, pulled through pipes and conduits, etc. The scope of cable installation shall include excavation and backfilling (in case of buried cable trench), laying, pulling of cables, proper dressing of cables on cable trays, racks, vertical raceways and supply and installation of cable tags, saddles, spacers and nylon chord for tying as required. The cost of supplying covers for cable route / joint markers, supply of sand and cover plates are included in the scope of the Contractor.

Standard cable grips and reels shall be utilized for cable pulling. If unduly difficult pulling occurs, the Contractor shall check the pull required and suspend pulling until further procedure has been approved by the Employer or their representative‘s Representative. The maximum pull tension shall not exceed the recommended value for the cable measured by the tension dynamometer. In general, any lubricant that does not injure the overall covering and does not set up undesirable conditions of electrostatic stress or electrostatic charge may be used to assist in the pulling of insulated cables in conduit / pipes and ducts.

After pulling the cable, the Contractor shall record cable identification with date pulled neatly with waterproof ink in linen tags / aluminum tag and shall securely attach such identification tags. Identification tags shall be attached to each end of each cable with non-corrosive wire. The wire must be non-ferrous material on single conductor power cable. Tags would further be required at intervals on long runs of cables on cable trays and in pull boxes. Cable and joint markers and RCC warning covers shall be provided wherever required.

Each cable shall be pulled into the particular conduit / pipe and shall be taken from the particular reel designated for the run. In hand holes, pull boxes or junction boxes having any dimension over 1000 mm, all conductors shall be cabled and / or racked in an approved manner. Care shall be taken to avoid sharp bending or kinking cables, damaging insulation or stressing cable beyond manufacturer's recommendations in pulling. Cable shall be protected at all times from mechanical injury and from absorption of moisture at unprotected ends. The bending radii for various types of cables shall not be less than 12/15 times the overall diameter of the cable for armoured cables and 15/20 times the overall diameter of the cable for unarmored cables.

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Cables on cable racks and in conduits / pipes shall be formed to avoid bearing against edges of trays, racks, conduit / pipes or their supports upon entering or leaving racks or conduit / pipes.

Cables splices shall not be used except where permitted by the Employer or their representative's Representative. Splices shall be made by Contractor for each type of wire or cable in accordance with the instructions issued by cable manufacturers and the Employer or their representative's Representative. Before splicing, insulated cables shall have conductor insulation stepped and bound or penciled for recommended distance back from splices to provide a long leakage path. After splicing, insulation equal to that on the spliced conductors shall be applied at each splice.

At cable terminal points, where the conductor and cable insulation will be terminated, terminations shall be made in a neat, skillful and approved manner by specially trained staff. Terminations shall be made by the Contractor for each type of wire or cable in accordance with instructions issued by cable manufacturers and / or the Employer or their representative's Representative.

Control cable termination shall be made in accordance with wiring diagrams, using proper color codes for the various control circuit.

When control cables are to be fanned out and corded together with a cord, the Contractor shall make connections to terminal blocks, and test the equipment for proper operation before cables are corded together. If there is any doubt about correctness of connection, the Contractor shall make a temporary connection with sufficient length of cable so that the cable can be switched to another terminal without splicing. After correct connections are established, cables shall be cut to their correct lengths, connected to terminals in the specified manner, and corded together where necessary to hold them in place in a skillful manner. Jointing of cables shall be in accordance with relevant Standards and manufacturer's instructions. Materials and tools required for cable jointing work shall be supplied by the Contractor. Cables shall be firmly clamped on either side of a ‗straight through joint' at a distance of not more than 300 mm away from the joints. Identification tags shall be provided at each joint at all cable terminations.

Where cables pass through floor or wall openings or other partitions, suitable bushes / pipe sleeves of GI shall be provided by the Contractor. The Contractor shall seal the cables at the bushes / pipe sleeves using fire resistant material.

Cable seals shall be examined to ascertain if they are intact and that cable ends are not damaged. If the seals are found to be broken, the cable ends shall not be jointed until after due examination and testing under supervision of the Employer or their representative's Representative. Before joining is commenced, insulation resistance of both sections of cables to be jointed shall be checked by megger.

In case of motor cables, after installation and alignment of motors, the Contractor shall complete the conduit / pipe installation, including a section of flexible conduit / pipe between motor terminal box and trench / tray, if necessary. The Contractor shall install and connect the power, control and heater supply cables as per equipment manufacturer's drawings / instructions. The Contractor shall be responsible for correct phasing of the motor power connection and shall interchange connections at the motor terminal box, if necessary, after each motor is test run.

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Connections to recording instruments float switches, level electrodes, limit switches, pressure switches, thermocouples, thermostats and other miscellaneous equipment shall be done as per manufacturer's drawings and instructions.

In each cable run, some extra length shall be kept at a suitable point to enable one or two straight-through joints to be made, should the cable develop fault at a later date.

Conduits / Pipes

Where cable trench is not available, cables shall be laid in GI conduits / pipes routed along walls / columns / beams / steel structures or buried in concrete slabs, etc. to suit site conditions. GI conduits shall be Class C type. Supply and installation of GI conduits / pipes, their accessories such as bends, tees, couplers, etc., saddles, spacers, junction / marshalling boxes and GI hardware required for installation shall be included in the Contractor's scope. Interval between supports shall not exceed 500mm. For multiple cables, maximum utilization factor (ratio of total wire area to internal conduit area) shall be 50% of the conduit area.

Non-metallic conduits / pipes shall be used for single core cables of a 3 phase circuits.

Junction Boxes / Marshalling Boxes

Junction boxes / marshalling boxes shall be hot-dip galvanized, weather proof with IP 55 degree of protection and shall be provided with cable glands for incoming and outgoing cables. The boxes shall be fabricated from 1.6 mm thick sheet steel and galvanized. The boxes shall be suitable for mounting on walls / columns / steel structures, etc. and shall be supplied with mounting accessories. The front covers of the boxes shall be removable and provided with gaskets. All the terminals shall be complete with insulated barriers, terminal studs, washers, nuts, etc. The boxes shall be effectively earthed.

Fire Proof Sealing (FPS) System

Fire proof sealing system shall be provided and shall consist of

Fire-stops / fire-seals for sealing of cable / cable tray and conduit / pipe penetrations, both horizontal and vertical, through brick or RCC walls / floors, to prevent the spread of fire from one area to other areas by fire-resistant barriers.

The FPS system shall also include all the necessary accessories and equipment required for supporting, holding in position, fixing and installation of the fire-stop.

The FPS system shall comply in all respects with the requirements of the codes and standards mentioned herein IEC-111 and IEC-112.

Fire Stop / Seal

The FPS system adopted for cables or cable trays penetrating through walls and floor openings, or cables passing through embedded conduits / pipes / pipe-sleeves, constitutes a `fire stop / seal', which is meant to prevent spreading of fire between areas separated by fire-resistant barriers.

Performance Requirements

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The material, design and construction of the fire stops shall be such as to provide a fire-rating of 120 minutes for a fire on any side and meet all requirements listed in this specification and the relevant codes and standards.

The materials used in the fire stops shall be non-hygroscopic, compatible with the type of cables.

The fire stops shall be suitable for retrofitting of cables through the penetration seal without disturbing the sealing of the cables already existing.

Application of Fire Proof Sealing System

Fire stops shall be provided for cable penetration openings listed below

The passage of cables / cable trays pipe sleeves / embedded conduits through walls / floors.

Vertical raceways, if any, which carry cables between successive floors, through openings provided in the RCC floor slab, shall be sealed by fire stops at each floor level.

Cable entry through openings in floor slabs.

Contractor shall furnish the test certificates for the fire stops after award of Contract for Employer or their Representative review. If the certificates are not satisfactory, all the tests shall be conducted free of cost. The offered system

i.e. fire stops and fire breaks shall be identical (or better) with the system which is successfully type tested for the specified rating i.e. the composition density of the material, thickness of coating in case of fire breaks and any other properties of the material / system offered shall be identical or better than the tested system and shall be subject to Employer or their representative approval.

Performance Tests

The fire stops shall be subjected to the following type tests:

Fire Rating Test

Hose Stream Test

Type tests shall be conducted on different fire stop test specimens described above as per IEEE-634. The sizes of the fire stop test specimens shall be similar to the largest of the sizes being used in the plant.

Preconditioning of fire stop test specimens

Before conducting the Fire Rating and Hose Stream tests, each test specimen shall be preconditioned for thermal ageing, water immersion and vibration.

Test on Fire Stops

During the Fire Rating test, the transmission of heat through the cable penetration fire stop shall not raise the temperature on its unexposed surface above the self ignition temperature of the outer cable covering, the cable penetration fire stop material, or material in contact with the cable penetration fire stop, with a maximum temperature limit on the unexposed surface of 2000C.

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Earthing and Lightning Protection System

Earthing and lightning protection system shall comply with the following International Standards, including those referred to therein.

ANSI / IEEE Std. 80 and 142, IEC 61024 and IS 2309, 3043.

The scope includes measurement of electrical soil resistivity (during dry season) at site, supply of earthing conductors, earth electrode pits, lightning protection system and their installation including associated civil work as per the specifications and approved drawings, to the satisfaction of the Employer or their representative 's Representative. The scope of works shall also comprise designing the earthing and lightning protection systems as per the applicable standards and specific design basis listed below:

Average value of soil resistivity as measured for different electrode spacing, at site. (from 2 to 100 Meter or more in steps of 5, 10 Meter. At least 20 nos. readings shall be taken over the plant area, each in two different directions)

Permissible values of step and touch potentials based on weight of human being as 70 kg and Earth fault current of 40 kA for 1 seconds

Gravel with surface resistivity of 3000 ohm-m

Depth of burial of earth conductors of 600 mm below ground level

Ground resistance with only electrodes of maximum 1 ohm.

Ground resistance of earthing grid of maximum 1 ohm

Corrosion allowance of at least 20 %

Earthing conductor material shall be minimum 20 mm diameter and 3 m long GI Pipe.

Earthing system design and calculations shall be subject to Employer or their representative's approval.

Earthing and lightning protection system shall be provided to ensure equipment safety, personnel safety and to facilitate designed operation of protective devices during earth fault conditions in the associated system.

The Contractor shall install bare earth conductors as required for the system and individual equipment earthing. All the work such as cutting, bending, supporting, drilling, brazing / soldering/welding, clamping, bolting and connections to structures, equipment frames, terminals or other devices shall be in the Contractor's scope. All hardware and consumables such as fixing cleats / clamps, anchor fasteners, lugs, bolts, nuts, washers, brazing electrodes, flux, bituminous compound, anti-corrosive paint, etc. as required for the complete work shall be included by the Contractor.

Tap connections (earthing leads) of more than 500 mm long, from main earthing grid to equipment shall be embedded in the floor by the Contractor together with associated civil work such as chipping / chasing, concreting and surfacing, etc. The concrete cover over the conductor shall not be less than 50 mm.

The scope of installation of earth conductors in outdoor areas, buried in ground shall include excavation in earth up to 600 mm depth and 400mm width, laying of conductor at 600 mm depth, brazing as required of main grid, e

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conductor joints as well as riser's up to 500 mm above ground at required locations and backfilling. Backfilling material to be placed over buried conductor shall be free from stones and other mixtures. Backfill shall be placed in layers of 150 mm, uniformly spread along the trench and compacted. If the excavated soil is found unsuitable for backfilling, the Contractor shall arrange for suitable material from outside. Earthing conductors in outdoor areas shall be laid 1500mm away from buildings. The scope of installation of earth conductors in outdoor areas buried in ground, shall include excavation of earth up to 600 mm depth, brazing / welding of main grid conductor, joints as well as risers of length 500 mm above ground at required locations and then backfilling.

Wherever earthing conductor crosses underground service duct and pipes, it shall be laid 300 mm below them. If the distance is less than 300 mm, the earthing conductor shall be bonded to such service ducts / pipes.

The scope of installation of electrodes shall include installation of electrodes in constructed earth pits, and connecting to main buried earth grids. The scope of work shall include excavation, construction of the earth pits including all materials required for treatment (salt, charcoal, chemicals, etc.), placing the electrode and connecting to main earth grid conductors.

The preferably before the floors / columns / walls are cast. The embedded conductors shall be connected to reinforcing rods wherever necessary.

The scope of installation of earthing leads to the equipment and risers on steel structures / walls shall include laying the conductors, brazing / cleating at specified intervals, brazing to the main earth grids, risers, bolting at equipment terminals and coating brazed joints by bituminous paint.

Earthing and lightning protection system conductors along their run on walls / columns, etc. shall be cleated at an interval of 750 mm.

Main earthing conductor shall be buried below the trench at crossing points.

Metallic frames of all electrical equipment shall be earthed by two separate and distinct leads and then connected with earthing system.

Neutral of a transformer shall be earthed to two separate earth electrode pit by two separate earth leads.

Crane rails shall be connected to the earthing system.

An earthing mat shall be provided under the operating handle of the disconnector. Operating handle of the disconnector and the supporting structure shall be bonded together by a flexible connection and connected to earth grid.

Metal pipes and cable conduits shall be effectively bonded and earthed by earthing clamps efficiently fastened to the conduit at both ends.

Neutral connection shall never be used for equipment earthing.

A separate earth electrode shall be provided for each lightning arrester and for each lightning conductor down comer.

Cable sheaths and screen shall be bonded to the earthing system.

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Armour of multicore cables shall be bonded to earthing system at both ends, while that of single core cables shall be earthed at source end only. The size of conductor for bonding shall be appropriate with the system fault current.

Conduits, fixtures, junction boxes, etc. shall be bonded to the earthing system by 16 SWG diameter copper wire looped from lighting panel earth bus onwards. Outdoor lighting poles, junction boxes, etc. shall be earthed by 12 SWG copper wires.

Street light pole and junction box shall be earthed with 12 SWG tapped off from the 25x3 mm GI earthing conductor to be laid along the street lighting cable.

All metallic parts such as transformer, fence, gate, etc. shall be properly earthed.

Wherever earthing conductor passes through walls, galvanized steel pipe sleeves shall be provided for the passage of earthing conductor. The pipe ends shall be sealed by the Contractor, by suitable water-proof compound. Water stops shall be provided wherever earthing conductor enters the building from outside below ground level.

All connections in the main earth conductors buried in earth / concrete shall be brazed type. Connections between main earthing conductor and earth leads shall also be of brazed type. Connection between earth leads and equipment shall be by two bolts.

Installation of lightning conductors on the roof of buildings shall include laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods wherever necessary, laying, fastening / cleating / brazing of the down comers on the walls / columns of the building and connection to the test links to be provided above ground level.

Lightning protection system down-conductors shall not be connected to the conductors of safety earthing system above ground level. The lightning protection system for the structures shall be installed by forming a grid of exposed continuous earth conductors and taking down-comers along the walls/supports of the structure and terminating the same at earth pits. A separate earth electrode shall be provided for each lightning arrester and for each lightning conductor down comer. The lightning protection system earth pits shall be inter-connected to form the safety earthing grid provided for the building / structure. The safety earthing grid shall be connected to the mains grid of the switch yard.

The lightning protection air termination rods and / or horizontal air termination conductors shall be fixed in a firm manner. The necessary accessories such as cleats, clamps, brazing materials, bolts, nuts, shall be supplied by Contractor.

Air termination systems shall be connected to earthing system by down conductors. There shall not be any sharp bends, turns and kinks in the down conductors.

All joints in the down conductors shall be of brazed type. All metallic structure within 1 meter of down conductors shall be bonded to lightning protection system.

Every down conductor shall be provided with a ‗test link' mounted on wall / column at about 1000 mm above ground level housed in a 16 SWG GS enclosure. The test joint shall be directly connected to the earth electrode.

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The lightning protection system shall not be in direct contact with underground metallic service ducts, cables, cable conduits and metal enclosures of electrical equipment. However, all metal projections, railings, vents, tanks, etc. above the roof shall be bonded together to form a part of roof grid.

Lightning protection system down conductors shall not be connected to other earthing conductors above ground level. In addition, no intermediate earthing connection shall be made to lightning arresters and transformer, whose earthing leads shall be directly connected to electrode pit.

Earth Electrodes and Pit

Treated earth pits shall comprise of treatment material such as salt and charcoal or any other conductivity enhancing compound. Treatment material placed around the electrode shall be finely graded, free from stones and other harmful mixtures. Backfill shall be placed in 150 mm thick uniformly spread and compacted layers. If excavated soil is found unsuitable for backfilling, the Contractor shall arrange for a suitable soil from outside.

Earth electrodes shall be fabricated from minimum 20 mm diameter, 3m long, copper rod or 40 mm diameter, 3m long GI pipe. The minimum spacing between adjacent electrodes shall be 6 m. Design and constructional details of electrode pit shall be subject to the Employer or their representative‘s Representative approval.

Electrodes shall, as far as practicable, be embedded below permanent moisture level.

Test pits with concrete covers shall be provided for periodic testing of earth resistance. Installation of electrodes in test pits shall be suitable for watering. The necessary materials required for installation of test pits shall be supplied and installed by Contractor. The installation work shall also include civil works such as excavation / drilling and connection to main earth grid. Earth electrode pit marker shall be provided.

Treated earth pits shall be treated with suitable treatment material mentioned above, if average electrical resistivity of soil is more than 20 ohm meter.

Conductor size for connections to various equipments shall be as per the table as follows:

Equipment		Conductor Size
Motors	Up to 11 kW 11 kW up to 22 kW 22 kW up to 37.5 kW 37.5 kW to 90 kW 90 kW to 200 kW Above 200 kW	8 SWG GI wire 4 SWG GI wire 25 x 3 mm GI flat 25 x 6 mm GI flat 40 x 6 mm GI flat 50 x 10 mm GI flat
PCC		50 x 6 mm GI flat
PDB		50 x 6 mm GI flat

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DG and other panel		50 x 6 mm GI flat
Local control station, street light pole and its junction box		8 SWG GI wire
All switchyard equipment		50 x 6 mm GI flat
Main earth grid		50 x 6 mm GI flat
Lighting Panel		25 x 3 mm GI flat
Indoor fixtures		14 SWG GI wire

All paint, scale etc. shall be removed before earthing connections are made. Anchor bolts or fixing bolts shall not be used for earthing connections.

DG Set

Each load center shall be provided with a silent DG Set as a standby power backup for 100% load. DG sets up to 1000 KVA capacity are required to be supplied with acoustic enclosure as per CPCB norms.Cost of diesel will be borne by agency it self.

DG Set with acoustic enclosure shall preferably be installed outside the building. However, DG set shall be as near to the substation as possible i.e. as near to Essential LT Panel as possible.

Associated AMF panel/ Electrical panel of the DG Set can be located inside the acoustic enclosure or outside the acoustic enclosure as per manufacturer standard. All other specifications shall be in line with CPWD specifications.

Instrumentation Specifications

General

Employer wants to have latest technology with compatible automation system having fully automatic process control, ON LINE to monitor and control the plant from a single location. Typical control system architecture is enclosed with bid which is to be strictly followed by Contractor/ Contractor while designing the control system and instrumentation. The plant data collected through online monitoring of sewage quality and desired plant monitoring parameters shall be made available via suitable means of data communications to third party integration.

The Contractor shall provide, install, test and commission all instruments (online and laboratory) and local panels required for proper operation of the works. Details of instruments associated with the actual waste water treatment processes are in some instance given in the relevant sections of the specification. The Contractors are advised to diligently go through the complete tender document and quote instruments accordingly. The

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Contractor shall include in their bid a list of instruments / devices showing compliance to agencies such as ISO, BIS, EPA, etc. as applicable.

The instrument proposed for each application shall be of reputed make with latest technology and that which in the opinion of the Contractor and the manufacturer is most appropriate subject to EMPLOYER approval. In addition to the above criteria, the instruments offered shall be of approved make of EMPLOYER and the selection of instruments shall minimize the quantity and multiplicity of spares required to facilitate ease of maintenance and servicing.

Aim

Using the latest technology for ON LINE monitoring and control of various parameters EMPLOYER hopes to achieve following aim:

Improvement in effluent quality

Proper monitoring and correction

Low manpower

Generation of all faults and trends

Correct display of input raw material and output treated effluent

Long term historical storage of process data

Analysis and graphical plots of historical data

Prevention maintenance management

Inventory control

Maintain plant operation summaries

Improve plant efficiency and increase the plant life

Maintain records of pumping through flow meters

Scope

This part covers the general requirements for the design, supply, installation, inspection and testing of the instrumentation and automation solution proposed for flow measurement, monitoring of waste water quality and control of plant and flow in the river.

Reference Standards

Unless otherwise approved, instrumentation shall comply with relevant quality standards test procedures and codes of practice collectively referred to as Reference Standards in accordance with the requirements detailed elsewhere in this specification. IEC 60381-1:1982 Analogue signals for process control systems.

Statement of Compliance

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The Contractor shall provide a list of the reference standards used and shall provide a compliance/non-compliance statement for all the online and lab instruments proposed.

All standards which the Contractor intends to use but which are not referenced herein shall be submitted to the Employer's Representative for consent before any design against that standard proceeds. Installation works shall comply with all relevant local Indian Regulations including the National Electrical Code

Submissions by Contractor General

The Contractor shall make submissions to the Employer's Representative of all design drawings and schedules relating to instrumentation and control equipment and systems provided under this Contract. These submissions shall include, where relevant, the following:

Functional Design Specification

The Contractor shall submit a complete functional design specification (FDS) for approval by the Employer's Representative. This document shall serve as the primary mechanism by which the Employer's Representative may confirm that the Contractor possesses an accurate understanding of the system and its control requirements. The Contractor is encouraged to obtain clarifications and to suggest refinements to the control descriptions contained in this Specification. The FDS shall comprise an overall description of the plant, its functioning and control, and a detailed description of each section of the control system covering modes of operation, manual overrides, set-point and parameter selection and adjustment. The detailed description shall include a step-by-step control description which defines the function of each piece of equipment and each control action and interlock, including details of the program in each programmable item. The format of the program details may be chosen by the Contractor, however it is suggested that this format be chosen to satisfy the requirements of the software design documentation, if applicable, as described elsewhere.

The FDS shall describe the ‗fail-safe' features incorporated into the design for the event of failure of a plant item or system, or loss of an input signal affecting a control loop or process sequence.

The FDS shall describe control actions taken and monitoring functions which remain available during a power failure, and any automatic controls or sequencing which take place during system start-up and shut-down.

The FDS shall be presented in a clear and precise manner and shall include figures or drawings where appropriate. The Contractor shall submit and obtain approval of the FDS from the Employer's Representative before beginning the detailed control system design. The Contractor should take note of the importance of this obligation.

Drawings and Schedules

Process and instrumentation diagram which shall comply with BS 1646 (all parts) and BS 1553-1:1977.

Generalarrangement drawings of field-mounted instruments showing installation details.

General arrangement drawings of instrument and control panels, fully- dimensioned in plan and elevation views, showing foundation and fixing details, access doors, clearances, cable-entry positions, weight and lifting arrangement.

Layout drawings of panel fascias showing instruments, controls and details of all labels.

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Layout drawings of panel interior showing equipment, terminal blocks and cable ways.

Annunciator arrangement and engraving details.

Internal circuit and wiring diagrams for instrument and control panels.

Schematic control diagrams.

Instrument loop diagrams.

Instrument wiring and piping diagrams.

Interconnection wiring diagrams.

Cable block diagrams, drawings and schedules.

Instrument system and panel power distribution diagrams.

Programmable-device functional design specifications which shall include hardware details, logic flow charts, ladder diagrams and program listings.

Schedules of inputs to and outputs from programmable controllers and telemetry outstations.

Labelling schedules.

Comprehensive testing schedules for all off-site, on-site, pre-commissioning and commissioning tests and take-over tests.

All other drawings necessary for the provision of ducts, openings, trenches, fixing holes for panels and the like and for the complete understanding of the operation, maintenance and extension of the system including any required for the Purchaser to dismantle, repair, maintain, modify or extend the Plant during the O&M period.

Data and Calculations

Manufacturer‘s catalogues and data sheets

Calculations to support control system design

Specification for protective coatings and painting

Certificates

Manufacturer‘s works tests

Pre-installation checks

Pressure-testing schedules

Instrument loop test check sheets

Installed instrument performance tests

System tests

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Statutory certificates of compliance (such as hazardous area equipment)

Operation and Maintenance Instructions

Composite manual describing the functional and operation of each piece of equipment.

Composite manual for testing and servicing every system and individual item.

Basic Features

Each instrumentation system shall be designed, manufactured and installed to

achieve the following basic requirements:

Basic Requirements

To maintain the highest standards of availability, reliability and accuracy and to give clear warnings of any deterioration in performance

To suit the abilities of the staff who will:

Use the systems

Service the systems

To measure, indicate, process, store and control the relevant parameters, as specified

To give clear warnings of dangerous and other abnormal conditions and to initiate plant safety procedures, shutdowns and corrective measures as specified to assure the safety of _operations and maintenance‘ personnel and that of the plant and to store and collate the data, as required

To derive, present and utilize, as required, such additional data to facilitate:

The most efficient operation of the plant

The routine maintenance of the plant

Design Requirements for Instrumentation and Control Systems (I&C)

The instrumentation, control and automation installations shall fully comply with design standards, regulations and the material and workmanship requirements of the Specification. The instrumentation control and automation systems shall comply with the relevant Indian Standards being practiced as per the industry norms. All consumable items and spare parts shall be readily available within India.

All equipment and materials incorporated in the system shall be selected, designed and rated to operate under the defined performance duties and specified site conditions and to maintain a high level of operational reliability. The instrumentation control and monitoring system equipment and materials shall have an operational life of not less than 15 years, unless otherwise consented to by the Employer's Representative.

Unless otherwise specified, all functions shall be transmitted electrically and all analogue signal-transmission systems shall be in accordance with IEC 60381- 1:1982 or equivalent and shall use a signal of 4-20mA dc.Where

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possible, measuring systems shall be designed so that any necessary power supply is taken from the appropriate instrument panel. Transmitting devices shall have integral indicators to monitor the output signal or connections suitable for use with a portable test meter, and shall be capable of meeting the performance requirements specified in the appropriate part of IEC 60770-1:1999 or equivalent. Equipment mounted in enclosures shall be suitable for continuous operation at the maximum internal temperature possible in service, due account being taken of internally-generated heat and heat dissipated by other plant. All components shall be rated adequately and circuits shall be designed so that change of component characteristics within the manufacturers' tolerances shall not affect the performance of plant. All equipment shall be designed to operate without forced (or fan) cooling.

All measuring instruments shall have zero and span adjustment. Instruments not mounted in panels shall be supplied complete with all brackets, stands, supporting steelwork and weatherproof enclosures (separate from the instrument cases) necessary for securing them in their working positions and affording complete protection at all times including periods of servicing, adjustment, calibration and maintenance. The installation arrangements for meters measuring conductivity, pH, dissolved oxygen, chlorine residual and ionic concentration shall include a sample bench and other facilities for operating portable test meters. Each installation shall incorporate a valve and pipe work for obtaining a sample representative of the fluid at the position of the permanent meter, tundish and drain. If the measuring and sampling points are remote from each other, the test and sample facilities shall be provided at both points. Sample transport times shall be minimized by provision of a bypass and drain with control and isolating valves and a local flow meter to enable the correct sample flow to be adjusted. An automatic portable sampler shall be provided for collecting and transporting the samples from the sampling locations to the laboratory.

Instrument Design Criteria

The design criteria to be applied to instrumentation system shall be as follows:

Instrumentation & Control (I&C) systems shall be selected, designed, manufactured, installed, tested and rated to operate under the defined performance duties and specified site conditions and to maintain a high level of operational reliability. Instruments mounted in field and on panels shall be suitable for continuous real time operation. All electronic components shall be adequately rated and circuits shall be designed so that change of component characteristics shall not affect the plant operation.

All I&C equipment shall be new, of proven design, reputed make and have data logging facility. Unless otherwise specified, all instruments shall be tropicalized. The outdoor equipment shall be designed to withstand tropical rain and shall be suitable for the worst environmental operating conditions. Wherever necessary space heaters, heat dissipaters, dust and weather proof cabinets shall be provided. Instruments offered shall be complete with all the necessary mounting accessories & safety features.

No custom made hybrid type IC's [Integrated Circuits] shall be used in any circuit in instrumentation and control equipment. Any hybrid circuits or sealed modules or devices which do not have alternative manufacturer shall be disclosed in the Bid by Contractor, so that such devices can be included as component spares in sufficient quantity in advance and shall be deemed to be included in the bid price.

Instruments and loggers provided shall be able to carry out continuous real time monitoring and logging of selected water quality parameters.

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All instrumentation shall be suitable for continuous real time operation and be powered through the UPS.

The output of the transmitting instruments shall be 4-20 mA / 0-10V DC linear having two wire system

After a power failure, when power supply resumes, the instruments and associated equipment shall start working automatically.

Unless otherwise specified, the normal working range of all indicating instruments shall be between 80% and 120% of the rated value.

The field instruments i.e. the instruments mounted outside the control panel shall be mounted at a convenient height i.e.at eye level. above grade platform.

Unless otherwise stated, field mounted electrical and electronic instruments shall be weatherproof to IP-65 or better.

The instruments shall be designed against corrosion. All wetted parts of instrument sensors shall be non – corrosive and suitable for use within sewerage environment.

The performance of all instruments shall be unaffected for the ±10% variation in supply voltage and ±5% variation in frequency simultaneously.

Unless otherwise specified, double compression glands shall be used for glanding the cable in field instruments and instrument control panel.

All digital outputs shall be volt free.

All probe type analyzers should be IP68 rated.

All displays shall be of the digital type with no moving parts and should utilize back lit liquid crystal diode LCD/ LED technology.

Instrumentation shall utilize solid state electronic technology and avoid the use where practical of any moving parts.

Minimum maintenance requirements. The instruments selected shall be rugged and not require any consumables / filling solutions. Systems should be able to work with minimum power requirements.

Lockable enclosure shall be provided for all the field mounted instruments.

All the instruments and cabinets shall have tag plates / name plates permanently attached to them.

All instruments to be used or installed within a corrosive sewerage environment shall be Explosion Proof and Intrinsically Safe.

Unless otherwise specified, all continuous online monitoring instruments shall be plug and play type.

Instrumentation system shall be provided to monitor the following parameters

Online Continuous Dissolved Oxygen Measuring System

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Ultrasonic Level Measurement

Ultrasonic Differential Level Measurement

Ultrasonic Open Channel Flow Measurement at Parshall Flume

Pressure Transmitter

Continuous Online Total Suspended Solids Analyzer

Online Residual Chlorine Measuring System

Indicative BOD Analyzer

Electro-Magnetic Flow Meter

Auto cleaning arrangement for all Analyzers.

Type of Instrumentation Online Instruments

The online measurement would be done at various locations within the plant. The

location wise instrumentation shall be followed as per the requirement of different process.

Ultrasonic Flowmeter – Open Channel

The open channel flow meter should employ ultrasonic principle to measure level and level to flow conversion should be inbuilt in the unit. Ultrasonic flow measuring system shall consist of flow sensor / transducer, flow computer and flow transmitter. The flow transmitter shall be coupled with an ultrasonic level sensor for emitting and receiving ultrasonic waves and signal conditioning & flow compounding unit. The unit shall be suitable for installation in corrosive environment and shall be unaffected by H2S laden atmosphere.

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.

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. 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 mounting and shall accept an input from the flow sensor. It shall process the input signal and provide isolated 4- 20mA/0-10VDC output proportional to flow rate. The flow range shall be adjustable.

Flow measurement shall not be affected by physical properties of waste water viz., temperature, pressure, viscosity, density etc., within given limits. The system should have inbuilt temperature sensor for automatic compensation for changes in air temperature to ensure measurement accuracy. Contractor shall provide additional compensating electronic circuits if required. The installation shall avoid any degradation of

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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.

Measuring Principal	Ultrasonic
Application	H2S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	Explosion Proof or Intrinsically Safe
Range	2 Meters
Accuracy	± 0.5% of measured value or better Mounting
Sensor	Installation in open channel (above Parshall Flume)
Transmitter / Controller	Wall, Panel, Pole Protection Category
Sensor	IP-65
Transmitter / Controller	IP-66 (NEMA 4X)
Transmitter / Controller Type	Microprocessor Based
Diagnostic	Inbuilt
Display	LCD with LED backlighting
Power Supply	230 V AC ± 10%, 50 Hz
Analog Output	Isolated 4 – 20mA
Relay Contacts	Minimum of 3 SPDT contacts
Zero & Span	Field Adjustable
Operating Temperature	0 to 50°C
Temperature Compensation	Inbuilt temperature sensors for automatic compensation for changes in air temperature
Communication Protocol	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	Integral to sensor
Cable Length	As per site requirement

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Electromagnetic Flowmeter

Flow meters shall operate on the electromagnetic induction principle and shall consist of a measuring sensor and measuring transmitter complying with ISO 6817:1997. Measuring sensors shall have a full bore stainless steel metering tube and non-conductive, abrasion-resistant lining to suit the fluid being metered. The lining of material can be of polyurethane. No rubber lining will be allowed. The flow meter shall have flanged connection. Measuring sensors shall have factory-sealed power and signal cables. Unless otherwise specified, the cable lengths shall be sufficient to permit termination external to the chamber, either at a junction box or at the measuring transmitter. Remote flow indicator cum integrator shall be provided on the control panel.

Measuring sensors installed within a chamber shall be suitable for indefinite submersion under a head of water equal to the chamber depth or 3 meters whichever is the greater. Measuring sensors shall be installed on a steel cradle or concrete plinth with upstream and downstream straight pipe lengths not less than those recommended by the manufacturer. When fitted in lined non-metallic or internally-coated pipe work, measuring sensors shall have an earthing electrode or corrosion-resistant earthing rings. To ensure full electromagnetic compatibility the flow tube flanges and transmitter housing shall be connected earth.

Measuring sensors shall be bonded by tinned copper braid links at each end to the adjacent pipe work to ensure a good connection between the body and the metered liquid. Measuring sensors installed in a catholic protected pipeline shall have isolation and bonding in accordance with the recommendations of the manufacturer. The measuring transmitter shall provide a precise current input to the field winding of the measuring sensor and shall convert the resultant signal from the electrodes to analogue and pulse outputs in accordance with IEC 60381-1:1982. The signal processing facilities of the converter shall ensure that the output signals are unaffected by interfering voltages, stratified flow, changes in fluid electrical conductivity within the limit stated, non-homogeneity of the fluid and the presence of ferrous particles. The zero and output signals shall be unaffected by partly-fouled electrodes.

The following measuring transmitter features shall be provided as a minimum; additional requirements may be stated elsewhere in the Specification.

Measuring Transmitter Features

Pulsed D.C. field excitation

Scaled pulse output for integration counter drive

Capability of bi-directional measurement with differing forward and reverse ranges and with local and remote indication of flow reversal

Contact operation at a programmable measured value

Integral display of flow and integrated quantity

Galvanic isolation between each output circuit and between the electrode circuit and output circuit

Output circuit isolation from earth within the instrument but suitable for earthing at any point in the external circuit

Key entry for basic parameters

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Commissioning and re-scaling to require no special programming knowledge

Adjustable low flow cut-off

Self-diagnosis

Continuously adjustable velocity and flow range settings

Terminals accommodated in a compartment separate from electronic components

Outputs including: analogue - 4-20mA

Pulse - two programmable outputs

Alarms - two outputs programmable for high/low

Flow, polarity, forward/reverse, instrument fault, liquid sensing fault condition including partially empty pipe

Measuring Principal	Electromagnetic
Type	Pulsed DC
Application	H2S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	Explosion Proof or Intrinsically Safe
Metering Tube	SS 304
Sensor Housing	SS 304 fully welded
Connection / Junction Box	SS 304
Lining Material	PTFE/Polyurethane
Range	As per site requirement
Accuracy	± 0.5% of flow rate at maximum mean velocity of1.5 to 3.0 m/sec
Electrode Type	Flush or bullet nose as recommended by the Manufacturer
Earthing Ring/Electrode Material:	Type 316 stainless steel Protection Category
Sensor	IP-68
Transmitter / Controller	IP-65
Transmitter / Controller Type	Microprocessor Based

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Display	Indicating and totalizing
Indicator	Digital 16-character display
Totalizer	Digital 16-character display
Mounting	Pipe, wall, panel
Diagnostic	Inbuilt
Power Supply	230 V AC ± 10%, 50 Hz
Analog Output	Isolated 4 – 20mA / 0-10VDC output based on the flow rate
Zero & Span	Field Adjustable
Turndown Ratio	Minimum of 10 to 1 when flow velocity at minimum flow is at least 0.3 metres per second
Zero Stability Feature	Required to eliminate the need to stop flow to check zero alignment
Pressure Loss	Very Low
Removable Electrodes	Required
Flange Material	Carbon steel, Epoxy Coated
Empty Pipe Detection	Inbuilt
Operating Temperature	0 to 50°C
Temperature Compensation	Inbuilt temperature sensors for automatic

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	compensation for changes in air temperature
Communication Protocol	Open Protocol like MODBUS, PROFIBUS, etc.

Level Measuring System Ultrasonic Level Meters

Ultrasonic level measuring devices applied for liquid level measurement shall

comprise of level sensor / transducer, level transmitter, digital level indicator / remote indicator, control unit and any other items required to complete the level measuring system.

The transducer shall be suitable for flange or bracket mounting as required. To reduce the effect of sewage turbulence in wet wells / tanks, averaging facility should be provided in the transmitter unit for providing steady readings.

The design and application of the ultrasonic level measuring system shall take into account the vessel / sump / wet well / channel construction, the material, size, shape, environment, process fluid or material, the presence of foam, granules, size etc.

In case of ultrasonic level sensor, the installation shall avoid any degradation of instrument performance due to spurious reflections, absorption, sound velocity variations, sensor detection area, temperature fluctuations, specific gravity changes and condensation. For applications where spurious reflections are unavoidable the control unit shall be provided with facilities for spurious reflection rejection. If turbulence exists, shielding, stilling tubes or other measures shall be provided to avoid effects on the measurement.

Measuring Principal	Ultrasonic
Application	H2S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	Explosion Proof or Intrinsically Safe
Range	As required at site
Accuracy	± 0.25% of measured value or better
Resolution	2mm or 0.2 percent of range, whichever is greater

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Blanking Distance	As short as 0.3 meters
Beam Angle	12 degrees or less
Temperature compensation	Integral Mounting
Sensor	Flange or bracket
Transmitter / Controller	Wall, Panel, Pole Protection Category
Sensor	IP-68
Transmitter / Controller	IP-66 (NEMA 4X)
Transmitter / Controller Type	Microprocessor Based
Diagnostic	Inbuilt
Display	LCD with LED backlighting
Power Supply	230 V AC ± 10%, 50 Hz
Analog Output	Isolated 4 – 20mA
Relay Contacts	Minimum of 3 SPDT contacts
Zero & Span	Field Adjustable
Operating Temperature	0 to 50°C
Communication Protocol	Open Protocol like MODBUS, PROFIBUS, etc.

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Sensor Cable	Integral to sensor
Cable Length	As per site requirement

Ultrasonic Differential Level Measurement

The ultrasonic type differential level measuring system shall consist of ultrasonic type level sensors on upstream and downstream of screens, differential level computer / transmitter and indicator. The flow computer / transmitter shall be microprocessor based and shall have facility for programming (i.e. adjustment of set points) while the sensor shall be capable of adjustable datum setting facilities.

The differential level control shall be done by two ultrasonic sensors, one before and one after the screen to sense the differential level through the screen and give a signal to the control to start the screens operation as soon as a preset differential level is reached. After receiving the level signal the control shall start and operate the screen as long as the preset level difference appears.

Measuring Principal	Ultrasonic
Application	H2S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	Explosion Proof or Intrinsically Safe
Range	As required at site
Accuracy	± 0.25% of measured value or better
Resolution	2mm or 0.2 percent of range, whichever is greater
Blanking Distance	As short as 0.3 meters
Beam Angle	12 degrees or less
Temperature compensation	Inbuilt Mounting
Sensor	Flange or bracket
Transmitter / Controller	Wall, Panel, Pole Protection Category
Sensor	IP-68
Transmitter / Controller	IP-66 (NEMA 4X)
Transmitter / Controller Type	Microprocessor Based

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Diagnostic	Inbuilt
Display	LCD with LED backlighting
Power Supply	230 V AC ± 10%, 50 Hz
Analog Output	Isolated 4 – 20mA
Relay Contacts	Minimum of 3 SPDT contacts
Zero & Span	Field Adjustable
Operating Temperature	0 to 50°C
Communication Protocol	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	Integral to sensor
Cable Length	As per site requirement

Pressure Measuring System – Pressure Transmitter

Pressure measuring system shall measure pressure and transmit signal proportional to pressure. The system shall consist of a combined pressure transducer and transmitter, digital panel indicator, connecting pipe work, diaphragm seal and valves. Pressure measuring system shall be rugged in construction and shall be capable for with standing surge pressures likely to occur in the monitored system. Pressure transmitters shall have over range protection up to 1.5 times the maximum line pressure and shall be capable of withstanding full line pressure on any side with the other side vented to atmosphere without damage or effect on the calibration. No plastic material shall be used in their construction. Internal parts shall be of stainless steel, bronze or approved corrosion-resistant material. Where necessary, a special diaphragm shall be used to segregate the corrosive fluid media. In ammonia applications, the diaphragm shall be in stainless steel. In chlorine applications, the diaphragm shall be in silver or tantalum. In Sulphur dioxide applications, the diaphragm shall be in tantalum.

The zero and span of a pressure transmitter shall not change by more than ±0.1% of the span per °C change in ambient temperature. After application for 10 minutes of pressure at 130% of maximum pressure, the change in zero and span shall not exceed ±0.1% of the span. Pressure transmitters shall be protected to BS EN 60529:1992, IP 65 standard or higher. For transmitters installed in locations liable to flooding or underwater applications, they shall be to IP 68 standard and shall operate up to a maximum submergence of 20 meters of water.

Parts	Transmitter and communicator
Type	Electronic variable capacitance; two-wire transmitter
Application	H2S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	Explosion Proof or Intrinsically Safe
Range	As required at site

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Accuracy	± 0.25% of span or better
Humidity	0 to 100% relative humidity
Damping	Fluid or electronic type with adjustment
Indicator	LCD with LED backlighting
Materials	Wetted parts including process flanges and drain / vent valves, Type 316 stainless steel otherwise specified
Wetted O-Rings	Glass filled TFE, graphite filled PTFE, or Viton, unless otherwise specified
Fill Fluid	Silicone
Output	4 – 20mA DC output proportional to the pressure range
Mounting	Pipe or wall as specified. Provide stainless steel brackets with stainless steel bolts
Housing	Modular with separate compartments for electronics and field wiring termination. Epoxy coated aluminum, unless otherwise specified
Power Supply	230 V AC ± 10%, 50 Hz
Operating Temperature	0 to 50°C
Communication Protocol .	Open Protocol like MODBUS, PROFIBUS, etc

Dissolved Oxygen Measuring System - DO Analyzer

DO Analyzers shall be installed to continually record the dissolved oxygen level at every grid within each aeration basin. The primary sensing device used for the dissolved oxygen level measurement, shall be a sensing probe mounted within the aeration basin and connected to a controller for displaying and transmitting the results

Measuring Principal	Optical
Application	H2S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	Explosion Proof or Intrinsically Safe
Range	0 to 20.0 ppm, 0 to 20.0 mg/l

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Accuracy	± 0.5% or better

Repeatability	±0.5% of span
Sensitivity	±0.5% of span
Pressure Limit	4 - 6 bar
Temperature Indication	Inbuilt
Calibration Method	Air Calibration: One point, 100% water saturated air;
Sample Calibration	Comparison to standard instrument, or comparison to Winkler Titration method
Cleaning	Air Blast Unit. Probe should be able to function with cleaning unit attached to itMounting
Sensor	Inside aeration basin at each grid
Transmitter / Controller	Wall, Panel, Pole Protection Category
Sensor	IP-68 for Sensor
Transmitter / Controller	IP-66 (NEMA 4X)
Transmitter / Controller Type	Microprocessor Based
Diagnostic	Inbuilt
Display	LCD with LED backlighting
Power Supply	230 V AC ± 10%, 50 Hz
Analog Output	Isolated 4 – 20mA
Relay Contacts	Minimum of 2 SPDT contacts
Operating Temperature	0 to 50°C
Communication Protocol	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	Integral to sensor
Cable Length	As per site requirement

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Total Suspended Solids Measuring System - TSS Analyzer

Measuring Principal	Optical
Application	H2S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	Explosion Proof or Intrinsically Safe
Range	0 – 50 mg/l, 0 - 1000 mg/l, 0 – 5000 mg/l
Accuracy	<5% of reading or better
Pressure Limit	6 bar
Flow Rate	Maximum 3m per second
Temperature Indication	Inbuilt
Calibration Method	Single point or two point
Cleaning	Inbuilt Mounting
Sensor	Inside pipe / channel / tank
Transmitter / Controller	Wall, Panel, Pole Protection Category
Sensor	IP-68 for Sensor
Transmitter / Controller	IP-66 (NEMA 4X)
Transmitter / Controller Type	Microprocessor Based
Diagnostic	Inbuilt
Display	LCD with LED backlighting
Power Supply	230 V AC ± 10%, 50 Hz
Analog Output	Isolated 4 – 20mA
Relay Contacts	Minimum of 2 SPDT contacts
Operating Temperature	0 to 50°C
Communication Protocol	Open Protocol like MODBUS, PROFIBUS

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	etc.
Sensor Cable	Integral to sensor
Cable Length	As per site requirement

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pH Measuring System – pH Analyzer

Measuring Principal	Combination / Differential Electrode
Application	H2S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	Explosion Proof or Intrinsically Safe
Range	0 - 12 pH
Accuracy	±0.02 pH or better
Repeatability	±0.05 pH
Sensitivity	±0.01 pH
Pressure Limit	4 - 6 bar
Flow Rate	Maximum 3m per second
Temperature Indication	Inbuilt
Temperature Compensation	Inbuilt automatic temperature compensation
Temperature Accuracy	±0.5 °C
Calibration Method	Two point automatic, one point automatic, two point manual, one point manual
Mounting	
Sensor	Inside pipe / channel / tank
Transmitter / Controller	Wall, Panel, Pole
Protection Category	
For Transmitter / Controller	IP-66 (NEMA 4X)
Transmitter / Controller Type	Microprocessor Based
Diagnostic	Inbuilt
Display	LCD with LED backlighting
Power Supply	230 V AC ± 10%, 50 Hz

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Analog Output	Isolated 4 – 20mA
Relay Contacts	Minimum of 2 SPDT contacts
Operating Temperature	0 to 50°C
Communication Protocol	Open Protocol like MODBUS, PROFIBUS, etc
Sensor Cable	Integral to sensor
Cable Length	As per site requirement

Residual Chlorine Measuring System – Residual Chlorine Analyzer

Measuring Principal	Amperometric or DPD Colorimetric
Application	H2S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	Explosion Proof or Intrinsically Safe
Range	0 – 10 ppm
Accuracy	±3% of the reference test or better
Resolution	0.001 ppm
Repeatability	30 ppb or 3%, whichever is greater
pH	Automatic
Temperature Compensation	Inbuilt temperature sensor
Temperature Indication	Inbuilt

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Pressure Limit	0.5 bar
Flow Rate	Maximum 50 L/hour
Calibration Method	1-point or 2-point calibration
Mounting	Wall, Panel Protection Category
Sensor	IP-65
Transmitter / Controller	IP-66 (NEMA 4X)
Transmitter / Controller Type	Microprocessor Based
Diagnostic	Inbuilt
Display	LCD with LED backlighting
Power Supply	230 V AC ± 10%, 50 Hz
Analog Output	Isolated 4 – 20mA
Relay Contacts	Minimum of 2 SPDT contacts
Operating Temperature	0 to 50°C
Communication Protocol	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	Integral to sensor
Cable Length	As per site requirement

BOD Measurement – Indicative BOD Analyzer

Measuring Principle	UV Absorption
Application	H2S laden atmosphere and other poisonous gases, Corrosive Waste Water Environment
Safety	Explosion Proof or Intrinsically Safe
Range	0 – 50 mg/l, 0 - 500 mg/l
Accuracy	± 5% or better
Compensation	550 nm

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Sample pH	4.5 to 9 pH
Pressure Limit	0.5 bar
Cleaning	Automatic
Mounting	
Sensor	Inside pipe / channel / tank
Transmitter / Controller	Wall, Panel, Pole
Protection Category	
Sensor	IP-68
Transmitter / Controller	IP-66 (NEMA 4X)
Transmitter / Controller Type	Microprocessor Based
Diagnostic	Inbuilt
Display	LCD with LED backlighting
Power Supply	230 V AC ± 10%, 50 Hz
Analog Output	Isolated 4 – 20mA
Relay Contacts	Minimum of 2 SPDT contacts
Operating Temperature	0 to 50°C
Communication Protocol	Open Protocol like MODBUS, PROFIBUS, etc.
Sensor Cable	Integral to sensor
Cable Length	As per site requirement

Basic Requirement of OCMD (Online continuous monitoring devices) as per CPCB Guidelines

In case of COD/BOD/TOC Measurement, System should be full spectrum scanning (Working principal-UV-VIS Spectrometry) from 200 – 720 nm wave lengths along with 256 unique pixel diode as detector.

As per CPCB guideline page no. 11 “This spectrophotometer records light attenuation in the wavelength region between 200 and 720 nm. The measurement is performed in-situ, without sampling or sample pre-treatment, thus preventing errors due to sampling, sample transport and storage etc. A measurement cycle takes between 20 and 60 seconds, making possible a high measuring frequency and detection of rapid changes. In order to combine this high measurement frequency with high accuracy and sensitivity, the instrument is equipped with a

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Xenon flash lamp as a light source and a concave holographic grating matched with a 256-pixel diode array as detector. For long-term stability of the signal produced, a split light-beam design is used; one beam passes through the sample while the other travels along a parallel pathway inside the instrument and thus acts as an internal reference beam. This second beam is used to cancel out fluctuations and interferences. These instruments are available for wide range of applications, from ultra-pure water (dissolved organics in the µg/ltrange) up to concentrated wastewaters (organics and non-dissolved materials in tens of grams /ltrange)."

As per CPCB guideline page no. 22 "The other method developed and deployed is based on UV-Visible Spectrophotometry. This UV-Vis spectral absorbance technology has been found to be less labour intensive in comparison. The tradeoffs in the ability to compensate for the various interferences should be taken into consideration. Some Instrument have incorporated features in their system to compensate for the interferences to improve their data quality."

As per CPCB guideline page no. 23 "Some other systems based on UV Visible Spectrometry use the full spectrum involving measurement of organics over the entire spectrum starting from 200 nm to 720 nm with adaptive ranging capabilities. The system takes care of single bond organics also. Any change in matrix needs recalibration of the system to assess the factor for determination of COD & BOD. Preferred tools such as multi-wavelength dual beam scanning in UV-Visible range with library of industrial matrices in analyser with multi-point local adaptive calibrations help to have matrix change adaption seems better for analyser. "

UV-Vis Spectrophotometry (Double beam with entire spectrum scanning) - Fresh water to Waste water analysis Interference check for color and turbidity and compensation

2- System should be Duel beam in nature (Automatically compensated cross sensitivity & Compensation for color and turbidity)

As per CPCB guideline page no. 11 "For long-term stability of the signal produced, a split light-beam design is used; one beam passes through the sample while the other travels along a parallel pathway inside the instrument and thus acts as an internal reference beam. This second beam is used to cancel out fluctuations and interferences. These instruments are available for wide range of applications, from ultra-pure water (dissolved organics in the µg/ltrange) up to concentrated wastewaters (organics and non-dissolved materials in tens of grams /ltrange)."

As per CPCB guideline page no. 12 Turbidity, due to suspended substances, causes light scattering and shading, thus influencing the absorption over the entire fingerprint. This is an important factor that influences in situ measurements and requires compensation in order to obtain reliable and reproducible readings."

As per CPCB guideline page no. 22 "some of the systems based on UV-Vis spectrophotometry use single wavelength (i.e 254nm) or few wavelength bands to estimate COD/BOD values. These systems have measurement limitations. The method is suitable for fairly stable water matrix. Turbidity interferes in the measurements of COD and BOD. The measure is an indirect method as absorbance at specified wavelength is measured and correlated with COD & BOD."

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As per CPCB guideline page no. 23 “UV-Vis Spectrophotometry (Double beam with entire spectrum scanning) - Fresh water to Waste water analysis Interference check for color and turbidity and compensation “

3- The analyser should have inbuilt features for automatic water matrix change adaption. The Sensor should have optimized referencing for excellent zero point and long-term stability

As per CPCB guideline page no. 23 “Some other systems based on UV Visible Spectrometry use the full spectrum involving measurement of organics over the entire spectrum starting from 200 nm to 720 nm with adaptive ranging capabilities. The system takes care of single bond organics also. Any change in matrix needs recalibration of the system to assess the factor for determination of COD & BOD. Preferred tools such as multi-wavelength dual beam scanning in UV-Visible range with library of industrial matrices in analyzer with multi-point local adaptive calibrations help to have matrix change adaption seems better for analyzer.”

4- Sensors should be in-situ in nature.

As per CPCB guideline page no. 23 “For online RTEQMS, the location of the sensors is important and submersible In-situ sensors as preferred option.

The insitu installation are preferred where sensor can be fixed directly in the treated effluent channel.”

5- As per CPCB guidelines page no. 30 & 31. The software should be capable of analyzing the data with statistical tools and shall have the following capabilities:

Statistical data analysis (customizable) for average, min., max., diurnal variation.

Comparison of parameters of different locations in user selectable time formats i.e. in graphical and tabular formats compatible to MS Excel, MS Word, *.txt etc.

Capability of comparison of data with respect to standards/threshold values.

Auto report and, auto mail generation etc.

Providing calibration database for further validation/correction of data.

Data transmission through different media like phone line, Broadband, leased lines (at least any two media supported).

Data Storage for next five years.

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System should be connected to a backup power source with adequate capacity to avoid any power disruption for at least 2-3 hours.

6- As per cpcb guidelines Parameter Accuracy: Allowed Variability is-

COD Accuracy ± 10%

BOD Accuracy ±10%.

pH Accuracy ±0.2 pH

TSS Accuracy +/- 10 %

As this is very critical application because industries/ organization have to share data with cpcb/uppcb so the purpose of industries/ organization should be more accurate and articulate data. This will help us to maintain KPI report.

7- The instrument/analyser should be robust and rugged (In terms of MOC & protection)- Minimum (MOC-Titanium 3.7 or SS316L or better & IP68 protection for sensors)

As per CPCB guideline page no. 7 “The instrument/analyser should be robust and rugged, for optimal operation under extreme environmental conditions, while maintaining its calibrated status.”

The above guidelines are indicative and reference only.The contractor should follow the latest guidelines updated time to time.

Laboratory – Laboratory Instruments and Sampling System

There shall be one laboratory for the entire system. The laboratory shall be housed within the Central Control building and shall be equipped with instruments, equipment, chemicals and other infrastructure that is necessary to perform the routine analysis for the parameters as detailed in table below. The equipment shall be supplied with all the accessories that are necessary to make the equipment functional for analyzing parameters and generating daily reports. In addition to these, Contractor shall also provide necessary chemicals, glassware and reagents required for sample testing in the laboratory along with calibration standards / solutions for calibrating the instruments.

The quality of the sewage entering, passing and leaving the treatment plant shall be monitored via online monitoring equipment as well as manual sampling systems and tested daily while developing appropriate correlation between on-line parameters and that measured in the laboratory.

Parameters

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Sl. No.	Parameter
1.	Biochemical Oxygen Demand - (BOD5 or BOD3)
2.	pH
3.	Suspended Solids
4.	Temperature.
5.	Chemical Oxygen Demand – (COD)
6.	Ammonia
7.	Total Phosphorous
8.	Acidity/Alkalinity
9.	Total Kjeldahl Nitrogen (TKN)
10.	MLSS/MLVSS
11.	Dissolved Oxygen (DO)
12.	Sludge Volume Index (SVI)
13.	Total Hardness, Calcium Hardness
14.	Gas Analysis
15.	Calorific Value Monitoring
16.	Volatile Suspended Solids (VSS)
17.	Total Solids (TS)
18.	Specific Gravity (Sg)
19.	Moisture Content
20.	Total Coliform
21.	Fecal Coliform
22.	Total Dissolved Solids (TDS)
23.	Bacteria, Escherichia Coli

Two nos. portable samplers shall be provided to collect composite samples for monitoring from

Inlet chamber for raw sewage

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At the outlet of treated effluent

The laboratory shall have sufficient space to house equipment, storage space for chemicals and space for all the chemical and bacteriological routine analyses. The laboratory shall have sufficient length of working platforms and adequate no. of sinks. Area of laboratory shall be defined by Contractor as per the requirement but not less than specified in the bid document. At least the following equipment and all required laboratory chemicals / reagents given in below Table are to be provided by the Contractor within the scope of work and have to be replenished by him till the end of the O&M Period.

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Lab Instruments

S N.	Description
1.	Comparator test set for residual chlorine or chloroscope
2.	Single / Multi parameter instrument for pH, Conductivity, DO, Ammonia and Phosphate
3.	Mains operated pH meter completed with one calomel electrode and glass electrode
4.	Turbidity meter - Bench Model
5.	Turbidity meter - Hand held (Portable)
6.	UV / VIS Spectrophotometer
7.	Water bath with 6 to 8 concentric holes and discs, electrically heated
8.	Hot plates – 25cm
9.	Ultrapure Water Plant
10.	Conductivity with TDS meter
11.	Refrigerator (280 litres capacity) double door / cooling cabinet for sample preservation
12.	Muffle furnace
13.	Electronic Burettes and Dispensers
14.	Magnetic stirrer
15.	Analytical balance (Electronic) with weight box – Resolution up to 4 decimal places
16.	Jar-Test apparatus – 6 Stirrers
17.	Centrifuge
18.	Flame photometer with gas cylinder
19.	Fume cupboard
20.	Field Test kit for cations and anions

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21.	Depth Sampler
22.	Total Organic Carbon Analyser
23.	Sieve shaker with standard sieves and two pan balance weighing up to 200gm samples
24.	Hot Air Oven
25.	Autoclave
26.	Binocular microscope
27.	Automatic Portable Sampler
28.	Pipette Box (Stainless Steel)
20.	Wooden Racks/Aluminum Racks
30.	Wire Baskets
31.	Cotton/ Aluminum Foils
32.	Burners (Bunsen) With Pilot Lamp
33.	Suction Flask (1 Litre Cap)
34.	Suction Pump
35.	Sampling Bottles
36.	Measuring Cylinders (1000 Ml, 500 Ml, 200 Ml, 100 Ml, 50 Ml, 25 Ml)
37.	Vacuum pump
38.	Soxhlet extraction unit
39.	Kjeldhal digestion unit
40.	Weighing Balance (max 10kg)
41.	Laminar Air Flow chamber
42.	M. Endo Broth (dehydrated)

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S N.	Description
43.	Lactose or Lauryl Tryptose broth
44.	Mac Conkey broth
45.	Brilliant Green Bile Lactose Broth
46.	Total Plate Count Agar
47.	Peptone / Triyptone Water
48.	BOD Analysis: Incubator, Reagents, etc.
49.	COD Analysis: COD Reactor – 15 Vials, Reagents, etc.
50.	Filtration assembly for suspended solids
51.	Incubator 44°C (Water/Air-Jacketed)

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 semiconductors like Tranzorb, zener diodes, varistors and an automatic disconnect and reset circuit. SPDs shall be passive and shall require negligible power for operation. During the occurrence of a surge it shall clamp on the allowable voltage and pass the excess voltage to the ground. The SPD shall be self-resetting to minimize the down time of the measurement loop.

SPDs shall be provided to protect devices transmitting and receiving analogue and digital signals derived from field devices located outdoors.

The surge protection device shall be rated for surge rating of 10kA.

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 aluminum; field provided not less than IP-65 protection and shall be lockable. The cabinet shall have facilities for earthing. A steel plate shall be provided inside the cabinet for mounting instrument and accessories.

Panel Details

Cabinet / Enclosure for Instruments

Enclosures shall be any form of board, cabinet, panel, desk, box or case used to protect, contain or group instrumentation, telemetry or control equipment. Cabinets shall be fabricated from cold rolled steel with powder coating sheet of minimum 2 mm thick and shall be suitable for wall mounting or pedestal mounting as required. A steel plate/pipe, as per the requirement, shall be provided in the cabinet for mounting the instrument and

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accessories. The cabinet shall be properly painted from inside and outside and shall have built in locking facility. The cabinet shall also be earthed properly. All equipment in or on enclosures shall be arranged logically and, as far as possible, symmetrically, with projections kept to a minimum. Each enclosure shall be designed on ergonomic principles and shall permit in-situ and safe access for any normal adjustment, maintenance and servicing. The tops of plant-mounted enclosures shall be sloped downwards from front to rear.

The minimum degree of protection shall be IP 54 for indoor locations and enclosures for use outside buildings or in places where splashing may occur shall have a minimum rating of protection to BS EN 60529:1992, IP 65 and have tops which project sufficiently to protect the vertical faces of the enclosure and any component mounted thereon from splashing, inclement weather and direct sunlight. Also, when enclosures for use outside buildings are located where exposure to direct sunlight will give rise to high top-panel surface temperatures such that the internal temperature rises above the manufacturer‘s recommendation (normally 40°C), the enclosure shall include a sun shield fitted to the top of the enclosure and should have sufficient air ventilation for heat dissipation.

Fixing arrangements for surface-mounting enclosures shall be external to the enclosure and shall ensure that the rear face of the enclosure is not in contact with the surface to which it is fixed. Enclosures shall have hinged access doors, fitted with recessed lockable handles. Doors shall be of rigid construction and provided with close-fitting flexible seals in recesses to prevent the ingress of liquids, moisture, dust and vermin. Hinges shall be of the lift-off pattern and one hinge shall engage before the other for ease of fitting. Wherever necessary, removable access covers secured by quick-release fasteners shall be provided to ensure ease of maintenance for all installed apparatus. Mounting plates, brackets and racks shall be provided for all other internal equipment which shall be hinged or otherwise arranged with quick-release fasteners or captive screws to give quick and easy access to equipment, securing screws, terminals and wiring.

Enclosures for two or more devices with electrical circuits shall have gland plates and terminal blocks as specified elsewhere. Each enclosure shall be designed for the safe testing and servicing of equipment with the power on. Each part which may be live under any circumstances shall be so covered or shielded as to prevent inadvertent contact.

Panel Design and Construction

Unless otherwise specified, all instrument panels, instrument cubicles, control panels, control consoles and desks, associated equipment and terminal racks, telemetry and electronic equipment racks and the like shall be free-standing, floor- mounted units and shall conform to the requirements of this part and will hereafter be referred to as panels. The design and dimensions of control consoles and desks shall be determined according to their intended function but shall be in accordance with the requirements of the Specification drawings. The height shall not exceed 1400mm above the finished floor level.

Unless otherwise specified or shown in the Specification drawings, the height of panels shall be not greater than 2130mm overall (excluding lifting devices) above finished floor level. Front-of-panel instruments and controls shall be mounted so that the height of their centers above the floor shall be generally between 1800mm and 900mm for indicators, 1400mm and 900mm for recorders and process controllers, 2000mm and 750mm for alarm facias and signal lamps and 1500mm and 750mm for manual controls. Controls, switches and push-buttons shall be positioned below or adjacent to any associated reading instrument. Panels for use in locations such as pumping stations and machinery rooms shall have anti- vibration mountings. The clearance between the

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extremities of apparatus mounted on the internal walls shall allow safe and unobstructed access to all terminals and to parts requiring maintenance. Panel layout drawings shall normally include a list of all instruments, accessories and components contained therein. If the drawings have insufficient space for the list, a separate schedule of instruments, accessories and components shall be provided and the panel drawing shall contain a cross reference to the contents list and an indication of the panel location of each item on the list.

Panels - Major

Panels shall be constructed generally as specified in the preceding clause and as

shown in the Specification drawings. Panel material shall be prime-quality, cold- rolled and annealed mild steel or zinc-coated mild steel sheet, suitably braced and stiffened as necessary with flat bar or angle to form a rigid structure.

Panel fronts shall be flat and free from bow or ripple. Exterior corners and edges shall be rounded or welded and ground to give a smooth overall appearance. Flanged edges shall be straight and smooth. Materials shall be chosen with due regard to the panel size, number of cut-outs, instrument weight and position of centre of gravity and method of fabrication, with the following:

minimum thicknesses except where otherwise shown in the Specification drawings

instrument bearing surfaces, gland plates and pneumatic distribution plates: 3mm

internal mounting plates: 3mm

doors, covers and filler panels: 2mm

No design involving the use of externally-visible assembly or fixing bolts and screws nor any design resulting in dust or water-collecting crevices will be accepted. Stiffeners and supporting frameworks shall be provided where necessary inside panels. Framework shall be hinged or fixed, suitable for the installation of instruments, components and internal equipment for which it is provided and located to give easy access to adjacent equipment.

When a panel is constructed in sections, the sections shall be designed for ease of assembly during installation and, in any case, shall not exceed 2m in length. All necessary nuts, bolts, washers and the like shall be supplied and included in the same shipment as the relevant sections. Sections exceeding 1m in length shall be provided with double doors. Unless otherwise shown in the Specification drawings, each panel shall be mounted on a self-draining base frame fabricated from 150mm deep, steel channel section which shall be drilled or provided with clamps for bolting to the floor. The base frame shall be set back from the panel front face to give a toe space of not less than 25mm. The outside of the base frame shall be covered with an approved kicking strip.

Ceiling and other filler panels shall be fabricated from sheet steel and adequately stiffened. Each section shall have 50mm returned edges along all four sides and shall be braced to the main steelwork of the panel. A chequer-plate floor shall be provided inside and above the level of the base frame, having openings suitable for the bottom entry of cables when applicable. Sufficient removable undrilled gland plates, in sections convenient for handling, shall be fitted close to the appropriate terminal blocks and not less than 230mm above the panel floor or not less than 230mm below the panel top. The gland plates shall have removable side covers giving access to both sides of the gland plate and ensuring vermin-proof and dust-proof construction. Gland plates of 3

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surface-mounted enclosure may form a part of the base or top. Panels containing pneumatic or other instruments using a fluid as the transmission medium shall have distribution plates with bulkhead unions for the termination of internal and external pipe work.

All doors shall open outwards and all doors in one panel assembly shall use the same lock and key combination. Panel design shall ensure adequate ventilation and air circulation without permitting the entry of vermin or dust. Panels installed in control rooms or other clean condition areas shall have louvres to allow air circulation. Temporary closures shall be provided to prevent the entry of dust and vermin during transit and installation. After commissioning has been completed, all entries except air-circulation louvres shall be sealed.

No equipment other than front-of-panel items shall be mounted on panel wall surfaces. If electrical and non-electrical instruments are mounted in the same panel, the panel shall be subdivided internally to separate the electrical and non- electrical sections. All connections shall be arranged to ensure that no accidental damage to cabling or electrical components can occur in the event of failure of any non-electrical component or connection. Provision shall be made for safe and easy handling during transit and installation. If lifting eyes are provided, they shall be reversible and panel tops shall be reinforced where necessary.

Where equipment is specified to be installed at a future date, space shall be allocated, and cutouts with removable masking plates, brackets, supports, wiring, terminals and piping and the like shall be provided. Panels shall be finish-coated at the place of manufacture before commencing the installation of apparatus and other fittings.

Panels - Minor

Panels for installation on the Plant which contain relatively few items of equipment, or where so specified elsewhere, shall be classed as minor panels and shall be constructed generally as specified in the preceding clause and comply with this Clause. Panels shall be fabricated from sheet steel or other approved material less than 2.5mm thick suitably braced to form a robust and rigid structure. Exterior corners and edges shall be rounded to give a smooth overall appearance and assembly bolts, screws or rivets shall not be visible on the front face.

The design shall be such as to ensure adequate ventilation and air circulation where required, without permitting the entry of vermin. Openings for cables shall be made vermin-proof. Doors shall be hinged and shall be provided with close- fitting flexible seals in recesses to prevent the ingress of liquids, moisture, dust and vermin. Unless otherwise specified, panels shall be suitable for floor mounting and shall not exceed 2130mm in height. Where surface mounted panels are provided, the fixing shall prevent the ingress of moisture and the rear of the enclosure shall be not less than 10mm from the wall.

Lifting eyebolts shall be removed, issued to the Purchaser and subsequently replaced with bolts after installation. Panels shall be extensible, and symmetrically arranged as far as possible with projections kept to a minimum. Where two or more panels are fitted together, they shall form a flush-fronted continuous panel of uniform height. Front door and top cover dimensions shall match. Instruments, relays, and control devices shall be mounted at a height not more than 2000mm and not less than 300mm from floor level.

The arrangement of equipment within each enclosure shall be such as to permit easy access for installation and maintenance. No instruments, relays or other components shall be mounted on rear access doors or removable covers.

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Panels - Composite

In situations where space limitations preclude the use of separate instrumentation, control and automation (ICA) and switchgear panels and, at the sole discretion of the Employer's Representative, ICA equipment may be combined within a single enclosure subject to the following conditions:

Enclosure

The observance of all other clauses herein relating to enclosures, mounting boards and minor panels.

The written assurance of each supplier of ICA equipment that the proximity of the switchgear will have no detrimental effect on the life or performance of any ICA component

The total segregation of ICA equipment and switchgear including the glanding and termination facilities.

The absence of any voltage exceeding 250V ac or 50V dc from any compartment containing ICA equipment.

The use of the full height of the panel (excluding the busbar chamber and cable space) for any ICA equipment compartment.

Panels - Glass Reinforced Plastic (GRP)

Any panel required to be installed outside buildings shall, unless otherwise approved by the Employer's Representative, be manufactured from double-skin, resin-bonded fiberglass, with a totally encapsulated infill of rigid weatherproof and

_boil proof' plywood to BS 1203:2001 between the two skins to provide a rigid and vandal-proof enclosure. The environmental rating shall be IP 65 or better.

For any application in a non-temperate climate or where so specified elsewhere, the roof section shall be sloping and have a totally-encapsulated infill of end-grain balsa instead of plywood. Box-section steel shall be encapsulated into door edges and door frames. Door locks, handles and hinges shall be of a high tensile strength, non-corroding alloy with stainless steel pins and through fixing bolts. Large plane surfaces shall have adequate reinforcing to ensure rigidity.

The doors shall be complete with latching handles and locks. All door catches and locks shall latch onto steel-reinforced surfaces. Threaded studs shall be incorporated into the design of the panel for the mounting of sub frames within the panel. Any panel drilled to provide fixings for internal equipment will not be accepted. Each cubicle shall be provided with a floor or deck with a removable gland plate for cable entry.

The laminate material shall have flame-retardant characteristics in compliance with BS 476 Class 2, and shall retain _stability, integrity and insulation' for 30 minutes. Colour-impregnated gel coats backed by coloured resin shall be used to ensure maintenance free and _colour-fast' finishes. The external finish colour shall be advised by the Employer's Representative and the internal finish colour shall be white. The fronts of externally-visible instruments and windows shall be of glass. An air-gap of 100mm shall be provided between the top surface of the panel and its protective canopy. All internal equipment shall be mounted on supports built into the fiberglass structure. Fixing bolts through the skin will not be accepted.

Panel Protection

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Adequate facilities for isolation and protection by miniature circuit breaker or fuse for each instrumentation and control circuit and sub-circuit shall be provided and shall be so arranged that any interruption causes minimum disruption of plant, operates the appropriate alarm and cannot result in any unsafe operating condition. All fuses shall be of the cartridge pattern and main fuses shall be of the high rupturing capacity type. Fuse and solid-link carriers and bases shall be of plastic-moulded insulating material of an approved make. Ceramic materials will not be accepted. Live connections shall be efficiently shrouded and it shall be possible to change fuses with power on without danger of contact with live metal. The fuses shall be rated to give maximum protection to the equipment in circuit and the rating shall be permanently inscribed on the fuse label and on the fuse carrier.

Unless necessary for the protection of particular equipment, miniature circuit breakers used for individual circuits in a panel or control desk shall not trip on over-voltage or under-voltage. Bases for solid links shall not be interchangeable with those for fuses. Fuses and links in the same circuit shall be mounted opposite each other in separate adjacent rows and shall not alternate in the same row. At least 10% and not less than two unallocated miniature circuit breakers or fuses and links shall be provided in each panel distribution board. Miniature circuit breakers and fuses of similar size and rating shall be of the same make and type. At least 10%, and not less than two, spare fuses and links of each rating shall be provided and fitted in clips inside the panel.

Each instrument requiring a power supply shall be individually wired and protected so that, in the event of a failure in one circuit, the remainder is unaffected. Power supply circuits shall be of sufficient rating that any protective device may operate without reducing the voltage at the terminals of any other component to an unacceptable level. Remote alarms shall be operated on failure of the electrical supply to a panel or to any internal sub-circuit. Clearly identifiable, switched socket outlets of 15A minimum rating to comply with IS 4615, supplied at the main cabinet operating voltages shall be fitted within the panel at the rate of one for each operating voltage per meter of panel length; for a panel whose length is less than one meter, one switched socket outlet for each main operating voltage shall be provided. Suitable socket outlets for portable tools and hand lamps shall be provided as specified elsewhere.

Panel Isolation

Clearly-labelled isolating circuit breakers shall be provided for each incoming power supply. Switches shall be of the quick make-and-break type with spring- loaded contacts that close fully without requiring full operation of the handle. The handle and cover shall be interlocked so that the handle cannot be operated when the cover is open and the cover cannot be opened unless the switch is in the ‗off' position. The ‗on' and ‗off' positions of each switch shall be indicated clearly.

Circuit breakers for panel power supplies shall be mounted near an access point and in positions where they may be operated easily from a standing position. Plug-in isolating links or devices of an approved type shall be provided in any circuit that may still be alive when the power supply isolators are in the ‗off' position, as, for example, in circuits controlling equipment whose power supply is independent of the panel. Such links or devices shall be properly screened and, if not incorporated in or adjacent to their associated outgoing terminals, shall be labelled with suitable warning notices. Any item of panel equipment to which panel internal wiring is connected with a plug and socket instead of terminals shall be wired in flexible cable of adequate rating between the ‗free' plug and a socket mounted adjacent to the device. The power supply connector shall be a socket.

Panel Terminal Blocks

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External wiring for panel power supplies shall be terminated on the appropriate isolator. Signal cables from strain gauges, analyzers, resistance thermometers, re-transmitting slide wires and thermocouples may be terminated at their appropriate instruments. A terminal block shall be provided as the interface between the corresponding conductors of each internal and external wire and each internal and external connection except those listed above. The terminal blocks shall be mounted vertically where possible and not nearer than 230mm to the floor or less than 230mm from an incoming cable gland.

Terminal block rows shall be spaced apart by not less than 150mm and arranged to permit convenient access to wires and terminals and to enable ferrule numbers to be read without difficulty. Other circuits shall be grouped on the terminal blocks according to the classification given in the clause for _Panel internal wiring' which shall be clearly marked along the corresponding section of each terminal board. Groups of different voltages on the same board shall be separated by insulated barriers.

All connections shall be made from the front of terminal blocks and no live metal shall be exposed at the back. All terminal blocks shall be of the type which clamps the wire securely and without damage between two plates by means of a captive screw and which permits removal of any terminal without disturbance to adjacent terminals. Pinch-screw type terminal blocks will not be accepted. Terminal mouldings shall be in melamine to ISO 2112:1990, polyamide or equivalent. Terminal rails shall be hot-dip galvanized. Current bars between the two connection points of each terminal block shall be of copper or brass with tin/lead alloy plating. All steel parts shall be zinc-plated and passivated with a yellow chromate layer.

Terminal blocks for input and output analogue signals and for circuits containing volt-free contacts internal or external to the cabinet shall be of the Klippon type SAKC or equivalent which permit the connection of a test millimeter or continuity meter without disconnecting any wiring. Terminal blocks for power supplies for equipment external to the panel shall permit the isolation of the item of external equipment without affecting the operation of any other circuit within or outside the panel.

No more than one core of external cables or one internal wire shall be connected to any terminal. If terminal blocks are used as common points for two or more circuits, individual terminals with the appropriate number of permanent cross- connections shall be provided. The lengths of exposed cable cores shall be sufficient to reach any terminal in the appropriate row or rows. The cores shall be formed into a neat loom and a separate loom shall be provided for each cable. Identification ferrules as specified in the clause for _Panel wiring identification and termination' shall be fitted on each core of all external cables and on each internal wire. The size of the terminals shall be appropriate to the size and rating of the cable cores which will be connected to them but shall not be smaller than Klippon type SAK2.5 or equivalent unless otherwise agreed with the Employer's Representative.

Each row of terminal blocks shall contain at least 25% spare terminals over the number required for terminating all cores of external cables in that row. Unless otherwise specified or shown in the Specification drawings, each external cable shall contain at least 20% spare circuits, with a minimum of one spare circuit. Terminal blocks shall be numbered consecutively in a sequence different from that used for identifying wiring. The terminal numbers, voltage grouping and terminal board layout shall correspond precisely with wiring diagrams so that quick and accurate identification of wiring can be made. All the terminal boards shall be provided with covers of transparent insulating material that does not sustain combustion and shall be sectionalized where possible to give access to groups of terminals without uncovering all boards. Terminals which may be live when the panel is isolated from its main supplies shall be suitably labelled to minimize the risk of accidental contact.

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Panel Internal Wiring

Panel circuits shall be segregated into the following categories:-

Group 1: Power control and very-high-level signal wiring (above 50V)

AC power supplies

DC power supplies

DC current signals above 50mA (such as CT circuits)

AC voltage and control signals above 50V (such as PT circuits)

Group 2: High-level signal wiring (6V to 50V dc)

Signals from conventional electronic transmitters and controllers (such as 4mA to 20mA)

Circuits to alarm enunciators and other solid-state devices (excluding those in categories 2.1, 2.5, 3.1, 3.2 and 3.3)

Digital signals

Emergency shut-down and tripping circuits

On / Off control circuits

Intrinsically safe circuits

Speech-frequency circuits

Group 3: Low-level signal wiring (5V dc and below)

Signals from thermocouples

Signals from resistance thermometers and re-transmitting slide-wires

Signals from analytical equipment and strain gauges

For Group 3 wiring, internal connections to the instruments shall be made by one of the following methods:

The twisted, screened conductors of the external cable shall be led direct to their appropriate instruments via ducting systems installed for this purpose during construction of the panel.

The conductors of the external cables shall be terminated on terminals segregated from all other categories and the connections to the appropriate instruments shall be made using twisted pairs with individual screening installed for this purpose during construction of the panel.

Internal wiring for all circuits in Group 2 except those sharing a common connection shall be multi-stranded, twisted pair, 0.75mm² minimum copper conductors with HPDE or PVC insulated cable of adequate grade and rating in accordance with BS 6004:2000. Wiring for circuits in other Groups or sharing a common connection shall be run in stranded, 1.0mm² minimum copper conductors with 250V grade, PVC-insulated cable of adequate

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grade and rating. Wiring sheath colours shall be black for ac circuits, and grey for dc circuits (excluding thermocouple circuits) and blue for Group 2.6 circuits. Circuits supplied at 240V, between 240V and 110V dc shall also be physically segregated from each other and from other circuits. Access to wiring and components of circuits having voltages exceeding 240V shall not be possible unless and until the circuit has been isolated.

Separate ducts, trunking, cable looms, tray work and the like shall be provided within the panel for each category with at least 150mm between parallel paths of Group 1 and those of any other Group. Intrinsically-safe circuits and their terminals shall be segregated from other circuits and terminals. All wiring shall be neatly and securely fixed by insulated cleats, bunched and secured by approved plastic strapping or run in approved insulated wiring trunking or non-corrodible flexible tubing. Not more than 75% of the capacity of trunking, ducts, looming, or tubing shall be used. Insulated earth wiring shall be so arranged that access to any equipment or connection point or the removal of any item of equipment is unimpeded. Wiring for future equipment shall be secured and terminated on terminal blocks. Lacing for wiring looms shall be of rot-proof cord or plastic strips. Inter-section wiring in multi-section cabinets shall be via a terminal block in each section.

Panel Wiring Identification And Termination

Identification ferrules shall be fitted at both ends of each wire. The numbers or letters used shall correspond with the appropriate wiring diagram. The ferrules shall be of plastic insulating material with permanent black characters on a colour- coded background for numbers and on a white background for letters, unaffected by oil or water. They shall be so arranged that they can be read logically from left to right when viewed normally. The system of wire identification shall be such that wires in the same circuit on opposite sides of a terminal shall have the same reference, and this system shall be continued through all external cabling. Terminal ferrules (spade, tongue, crimped connections) shall be provided on each conductor.

Panel Earthing

A continuous copper earth bar of not less than 25mm % 6mm cross section shall run the full length of each panel and shall be securely fixed and bonded electrically to the main frame. The cable gland-plates and the earth bar shall be provided with suitable brass terminals of not less than 6mm diameter for connecting the metal cladding or armouring of all incoming and outgoing cables to the station earthing system.

A second continuous copper earth bar of not less than 25mm % 6mm cross section, electrically isolated from the steelwork of the panel and metal cladding and armouring of cables, shall be provided for earthing the signal earth connection of each instrumentation and control device and the screen(s) of each instrument cable not earthed elsewhere to the station instrumentation earth plate. The earth bar shall have sufficient brass terminals as specified above for each instrumentation and control device and the screen of every shielded cable plus 25% spare terminals. In multi-section panels, each earth bar shall be electrically bonded to the corresponding bars in the adjacent section(s). Instrumentation and instrument cable screen earthing shall comply with BS 6739: 1986, Section 10, unless otherwise stated in this clause.

Panel Heating

Each panel shall have one or more thermostatically-controlled tubular or ribbed panel heaters to prevent condensation and assist ventilation and which shall be adequate for ambient temperatures down to 5°C. The heater rating shall not exceed 0.2W/mm and the surface temperature of any part which could be contacted accidentally shall not exceed 60°C. Heaters shall be so situated that no deterioration can be caused to any

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equipment or wiring in the panel. The heating circuits shall be switched and fused independently of the instrumentation and control equipment and manually controlled by an enclosed switch mounted in an accessible position within the panel. Thermostats shall be mounted remote from the heaters and other sources of heat and shall be fully adjustable over a range of not less than 0°C to 50°C.

Thermostats shall cut out each heater when the internal temperature of the panel exceeds a preset value; differential thermostats shall be used to maintain the panel internal temperature at a pre-set value above the external ambient temperature. If the permanent power supply is not available at the time of installation of the panel and condensation is detected, a temporary power supply shall be connected to the panel of sufficient rating to operate the heaters.

Panel Lighting

Each panel shall be adequately illuminated internally, as evenly and as free from dazzle as possible, by fixed fluorescent lighting controlled from totally-enclosed light switches and by totally-enclosed door-operated switches positioned so as not to interfere with access. There shall also be one installed inspection lamp per three meters of panel length or part thereof with adequate flexible connection cable to reach any point in the panel. The control switch for an inspection lamp shall form part of the lamp assembly. Lighting circuits shall be fused independently of any instrumentation and control circuit and designed to allow lamps to be replaced safely and shall be fed from a distribution board and circuit breaker connected on the live side of the main panel ac supply circuit breaker.

Panel Ventilation

Each panel shall be provided with ventilation fans as required to ensure that equipment within the panel is maintained within manufacturer‘s recommendations, with due regard to the environment in which the panel will be mounted. Fans shall be controlled by a suitably labeled enclosed switch mounted internally in an accessible position. Fans shall be mounted with their axes horizontal and shall be arranged to draw clean air into the panel. Air entries shall have filters which can be renewed from outside the panel and shall be designed to prevent the entry of rain, spray, injurious fluids, sand or dust.

Panel Piping and Tubing

Panels containing equipment using a supply of compressed air shall have a common air pressure-reducing station with duplicate pressure-reducing valves and filters. The pressure reducing station shall also include isolating valves upstream and downstream of each filter/reducing-valve set, pressure-relief valve, pressure indicator and low-pressure alarm unit for the low-pressure header and a pressure indicator for the high-pressure pipe work. The pressure-reducing station components shall be mounted in a clear space inside the panel, supported on a suitable framework between the lower horizontal row of instruments and the main low-pressure header.

All piping, fittings and valves downstream of the pressure-reducing station shall be of brass, copper or plastic. PTFE tape shall not be used downstream of the main filters. The low-pressure header shall be brass and shall be near the panel floor with drain valves and tundishes piped to a drain. Branch air headers shall be of brass (15mm diameter minimum) and shall run vertically from the header to the instrument. The low pressure header and each branch shall have a 6mm minimum, non-ferrous shut-off valve for each instrument requiring an air supply and a compression coupling for each air-purge connection. At least 10% spare connections for possible future

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instruments shall be provided in each panel section. Any header dismantled before shipment shall have brass unions or flanges at each panel-section junction.

Panel-mounted instruments shall be piped to bulkhead fittings on a gland plate during assembly at the manufacturer‘s works. Piping shall be colour-coded in accordance with Recommended Practice ISA−RP 7.2 issued by the Instrument Society of America and shall be segregated from wiring so that any leakage is harmless. Each panel-mounted pressure gauge shall have a stainless steel flush- mounted shut-off and fine-regulating valve mounted vertically below. A drip tray shall be provided below each row of gauges. Exhaust and de-pressurizing pipe work shall be routed out of the panel.

Panel Labels

Labels shall be provided for every panel to describe the duty or otherwise identify the panel and its sections and every instrument, component and item of equipment mounted internally and externally. Where applicable, front-of-panel labels shall be as shown in the Specification drawings. Wording shall be clear, concise and unambiguous and shall be subject to review by the Employer's Representative before manufacture. Each label shall be permanently secured to the surface near the item to which it refers. Externally-fitted labels shall be of perspex or other approved transparent plastic, with letters and numbers rear- engraved and filled with black. The rear surface of each perspex label shall be finished with a coat of paint of the same colour as the panel external finish. Instrument duty labels fitted externally shall be below the item to which they refer. Embossed tape or similar adhesive labels will not be approved.

Laminated materials or rear-engraved and filled plastic shall be used for internally- fitted labels, which shall be white with engraved black letters. Labels conforming to the requirements of the preceding paragraphs or other approved means shall be provided:

Labels

To describe or identify circuits or circuit components

To identify DC polarity

To warn or remind about dangerous or potentially-dangerous circumstances

Wherever elsewhere specified

Unless otherwise specified, all engraving shall be in plain block letters, 4mm high. The minimum practicable number of different sizes shall be used. Manufacturers‘ nameplates shall not be fitted on panel external surfaces.

Panel Finish

For control and instrument panels, desks and cubicles a hard, smooth, durable finish, free of blemishes, shall be provided. Before painting, all external welds and any rough areas shall be smoothed, and all surfaces shall be thoroughly cleaned and free from scale, contaminates, corrosion or grease. If rust-proof or Zintec steel has not been used in the construction, the panel shall be treated with a passivating agent such as phosphoric acid. All internal surfaces shall have a minimum of three coats of paint of which the first shall be an approved antirusting priming coat and the final coat shall be opaque gloss white enamel. All external surfaces shall have not less than five coats of paint of which the first shall be an approved etchpriming coat, and the second and third suitable undercoats, all of which shall be rubbed smooth when dry before application of the next coat. The undercoats

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shall be easily distinguished in shade or colour from the priming and finishing coats. The two final coats shall be of stove enamel paint, gloss or semi- matt finish, to a colour and finish to be advised by the Employer's Representative. Stoving shall be carried out in accordance with the recommendation of the paint manufacturer. The overall dry film thickness (DFT) shall be between 85 and 120 microns. Nuts, bolts, washers and other fixing devices which may have to be removed for transit or maintenance purposes shall be galvanized or otherwise finished to an approved standard. A 500ml tin of matching touch-up paint shall be provided and packed with each panel. The colour of glass reinforced plastic panels shall be to the approval of the Employer's Representative.

Electrical Indicators and Integrators

Indicators for use with analogue signal-transmission systems shall comply with BS 89:1990 or equivalent and have an accuracy class index of 1.0. Indicator movements shall be critically damped (dead-beat). Indicators for use on more than one circuit shall have rotary switches to select the circuit, with engraved plates to show the circuit selected. Indicators shall have circular scales or shall be of the vertical edgewise type and shall be designed to avoid parallax error. Scales shall be clearly marked in SI units and shall comply with BS 3693:1992 or equivalent. All instruments mounted on one panel or board, or in adjacent groupings, shall have similar styles of figures and letters. Dials shall be white with black scales and lettering not subject to fading.

The material for scales shall be such that no peeling or discolouration will take place with age under any environmental conditions. Major scale marks and numerals shall be of the same size and thickness and shall be separated by not more than twenty-five minor marks. Pointers shall taper to the width of the scale marks. Integrators shall be of the multi-digit cyclometer type. Integrators operating in conjunction with an electromagnetic or ultrasonic flow meter shall use the pulse output from the flow transmitter. Any integrator operating from a device without a pulse output shall have an integral or separate current-to-pulse converter with sufficient adjustment of the pulse rate to avoid the use of any multiplying factor except in integer power of 10. Each integrator shall incorporate an adjustable limiter whereby any input below a pre-set value is inoperative. Unless otherwise specified, integrators shall have a minimum of eight digits with a decimal point where applicable.

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 capable of conversion from open-healthy to open-alarm or vice versa by a simple modification after installation requiring no additional parts or special equipment.

Each alarm shall initiate the operation of both visual and audible devices. The sound intensity of each audible device shall be suitable for the maximum sound level of its environment.

Audible devices in the same room or area shall have distinguishable sounds and adjustable sound levels.

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.

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Each alarm shall initiate a visible and audible indication of the specified condition. Unless otherwise specified, alarm indicators shall be grouped together in annunciator units each having at least 20% spare ways. Alarm indicator lamps (Cluster LED type) shall have transparent screens engraved with legends approved by the Project Implementation Unit of EMPLOYER (PIU). 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 annuciator.

Alarms shall be accepted automatically and the appropriate audible device silenced after an adjustable period of 1 to 5 minutes.

An integral ‗test' pushbutton shall be provided to illuminate each lamp in the appropriate group and to operate the audible device but shall not cause a spurious alarm condition on any other annunciator.

Alarm circuitry shall be arranged so that spurious or transient alarm states persisting for less than 0.5 seconds do not initiate any action.

Alarm annunciator / indicator legends or labels shall be arranged with three lines of text as follows:

Top Line: Location; example: Sludge Blanket Level

Push-Buttons and Indicator Lights

Push-buttons in control circuits shall have shrouds, guards or other suitable means for preventing inadvertent operation. Status-indicator lights shall be of the high-intensity LED type. Indicator lights shall be of a design which allows easy LED replacement from the front. Indicator lights shall be easily visible above the ambient light level when viewed from within an included angle of 120 degrees. LEDs shall be chosen to ensure clear discrimination between the energized and de-energized states and to ensure an average working life of not less than 3000 hours. A ‗lamp-test' push-button shall be provided for each group of indicator lights. The colours of push-buttons and indicator lights on instrument panels shall be as follows:

Indicator Lights on Instrument Panels

Duty Push button	-	Signal lamp
Start or on (energize)	-	Green

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Stop or off (de-energize)	-	Red
Open valve	-	Black*
Close valve	-	Black*
Accept	-	Black
Lamp test	-	Black
Reset	-	Black
Motor running (energized)	-	Red
Motor stopped (de-energized)	-	Green
Valve open	-	Red
Valve closed	-	Green
Urgent alarm	-	Red
Non-urgent alarm	-	Yellow
Plant healthy or ready for use	-	White

*Panel-mounted push-buttons for valve operation shall be coloured black, unless otherwise agreed with the Employer's Representative, with the duty clearly defined by legend on an associated label.

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Analogue Signal Transmission

Unless otherwise specified, analogue signal-transmission systems shall be in accordance with BS EN 60546-1:1993 and shall use a signal of 4mA to 20mA DC. Transmitting devices shall have integral indicators to monitor the output signal or connections suitable for use with a portable test meter. Transmitters shall be capable of meeting the performance requirements laid down in the appropriate part of IEC 60770-1:1999.

Analogue Process Controllers

Analogue controllers shall use solid-state components and shall have outputs containing three terms with negligible interaction. The controller fascia shall have measured value, set value and output indication, manual set-value and output controls, auto/manual switch for control mode and remote-local transfer switch for set-value control. Manual control stations shall have measured-value and set- value indication, local/remote switch and control available lamp indicator. Each controller shall have the means to restrict its output signal to a predetermined, fully adjustable band so that the regulating device is not moved to unsafe positions. The adjustment of these safe operating limits shall be by means of accessible, clearly marked, internal components. A continuously adjustable proportional band of not less than 5 to 500% shall be provided. Integral and derivative action times shall be adjustable over ranges which shall not be narrower than 6 seconds to 25 minutes and 0-to 10 minutes respectively. If the integral or derivative action times' adjustments are in steps, the ratio of successive steps shall not exceed 2. The controls used to set the P, I and D values may be at the front of the instrument or mounted internally in an accessible position.

Each controller shall be designed so that in the event of failure, it shall be possible to plug a portable manual station into the controller case and to control the regulating device manually. Controller design shall ensure automatic procedure- less, bump less transfer whenever the instrument is switched from "auto" to "manual" or vice versa. Controller action shall be adjustable from direct to reverse and vice versa by the operation of an internal switch. Analogue process controllers shall be capable of meeting the performance requirements laid down in the appropriate part of BS EN 60546-1:1993.

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 single PLC and SCADA for entire Sewage Treatment. These shall be located at control room of the STP. The contractor should also submit the plant control & operational philosphy for approval.

The plant shall have provision for operations in following modes –

Automatic – Auto operation through PLC/digital controller.

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Manual – Operator intervention through SCADA/HMI.

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.

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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). 100% Redundancy for UPS shall be provided. 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:

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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.

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).

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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 15% 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.

UPS for PLC with min 1 hr back up.

The battery shall be NiCd as per bid.

Single battery bank shall be provided.

HMI/SCADA system

The HMI system shall be designed as a minimum 6", 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.

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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.

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		
	Processor	Intel i5 or higher
	Processor speed	2 GHz or higher
	Configuration	Tower
	Architecture	32 bit

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	System memory	8 GB
	Hard disk	320 GB or higher
	DVD Drive	Combo (Read/Write)
	Operating system	Microsoft Windows 7 professional
	Communication	USB – 4Nos., Ethernet – 1Nos.
	Graphic	1 GB
	Power supply	240V, 50Hz, 1Phase
	Keyboard	Internet Keyboard (with USB interface)
	Mouse	Optical, 3 buttons (with USB interface)
Monitor		
	Type	Full HD LED color monitor
	Screen size	22" or higher
	Resolution	1920 x 1080
	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:

Quality Assurance Plan

To ensure total conformation of the application to the user requirement and to make sure that S/W package development is of high quality, proper quality control activities shall be performed and documented throughout the development. For this, the Contractor shall give a S/W quality assurance plan to establish system of controls and make the S/W development activity less intangible and more manageable throughout life cycle of S/W development viz. Review and acceptance of Requirement Analysis, Design, Development, Testing, Implementation, User training, Maintenance, etc.

The Vendor shall be ISO 9001:2000 certified and shall ensure that all the activities including documentation comply with the standards.

Preventive Maintenance

Time for regular preventive maintenance with a frequency of not less than once per quarter will be required during the Warranty period. This should include general checkup of various parameters, running diagnostics etc. to avoid any possible failure or deterioration in response time.

Documentation

The following documents shall be required for smooth functioning of the system:

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DOCUMENT NAME
Installation Manual
System Administration and Maintenance Manual
User Manual
Technical Manual
Test Document(FAT &SAT)

Training of Employer's Engineers

The Contractor is required to provide in depth training to Employer's engineers (10 Nos.) for 1 month at his facilities on all aspects of the system being supplied. Training module shall be mutually discussed and finalized to cover Employer‘s personnel to operate, append, modify and troubleshoot the System effectively. All the documentation and write up material for trainees shall be provided by the Contractor.

The vendor should conduct this training at his premises, before testing of the package.

5) TECHNICAL SPECIFICATION FORINSPECTION, TESTING, ERECTION, COMMISSIONING & PERFORMANCE RUN OF MECHANICAL&ELECTRICAL EQUIPMENTS OF PLANT (PART D)

9.1 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.

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.

9.1.2. Test Certificates:

Copies of certificates of all works, routine tests shall be provided as detailed.

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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.

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.

The purchaser (client) or its representative shall have the right to inspect and / or to test the Goods for confirm their conformity to the Contract. The special conditions of the contract and / or the Technical Specifications shall specify what inspections and tests the Purchaser requires and where they are to be conducted. If not specified or not withstanding any mention, the contractor shall submit the inspection plan of all major bought-out items for approval with client specifying the stages of inspection as per manufacturer's quality plan and shall arrange to carry out the inspection along with client or it's representative at manufacturer's works as per the approved plan. The Purchaser shall notify the Contractor in writing of the identifying of any representatives retained for these purposes. Inspection and Testing will be carried out in presence of client's representative or TPI / PMC. All the expenses viz. lodging & boarding, transportation, all facilities as required to carry out inspection at manufacturer's works shall be borne by the contractor. The name of TPI panel shall be provided to JDA by the contractor. JDA will depute the TPL. The fees & expenses for TPI shall be borne by the Contractor.

Materials/ Plant Certificates and Inspections

Where certificates are required by the Specifications 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 and shall include information required by the relevant Reference Standard or Specification clause.

The timing for submittal of certificates shall be as follows:

manufacturer's and supplier's test certificates shall be submitted as soon as the

tests have been completed and in any case not less than 7 calendar days prior to

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the time that the materials represented by such certificates are needed for incorporation into the Permanent Works certificates of tests carried out during the construction or on completion of parts of the Permanent Works shall be submitted within 7 days of the completion of the test.

All material under the contract is divided in 3 categories.

Category A: The Drawing /data sheet will be approved by the Employer before manufacturing and Testing. The material will be inspected by the Employer or by an Inspecting agency approved by the Employer and dispatching. The contractor will borne all the expenses regarding lodging, boarding, to & fro fare of the employee of JDA. The Inspection charges of the TPI agency will be borne by the Contractor. The Contractor shall provide the necessary equipments and facilities for tests and the cost thereof shall be borne by the Contractor.

Category B:- The drawings/data sheet of the Equipment will be submitted and shall be approved by the Employer prior to manufacture. The material has to be tested by Employer/TPI approved by the Employer before dispatching of the Equipment. Notwithstanding the above, the Employer, after examination of the test certificates, reserves the right to instruct the Contractor for retesting, if required, in the presence of JDA representative.

Category C: The material may be manufactured as per standards and delivered to the site. For material / Equipment under category Employer will provide an authorization for packing and shipping after inspection. The testing, approval for dispatching shall not absolve of the Contractor for satisfactory performance of the plant. Employer will tak the decision on category of inspections.

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.

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v). All transformers for routine and type test on.

vi) EOT Crane as per relevant standards.

vii) Blowers

viii) Pipes, valves, fittings,

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,

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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.

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 fulfillment of the works sheet.

The contractor shall submit the SAT (Site Acceptance Test) Proceedure for approval from the employer.

9.1.5. Manufacture's Work Tests

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.

9.1.5.2 Type Tests

i). Impulse voltage withstand both chopped and full wave.

ii). Temperature rise.

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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.The test should be carried out within the last three years.

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.

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.

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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.

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 our in accordance with the requirements of BS 4999.

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.

9.1.6. Tests On Cables During Manufacture:

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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.

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.

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.

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.

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.

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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.

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 fulfillment of these guarantees shall be verified at the test works to be witnessed by Empolyer 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 labor 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.

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.

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9.1.13.1 Circuit Breakers and Control Gear:

Routine tests, including H.V. pressure tests.

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.

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) PLYSWS11,000 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.

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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.

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. The each earthing station shall be separately tested and value of earthing resistance shall be displaced under man hole cover.

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.

9.1.16. Pre-commissioning Trials, Tests Of Electrical Equipments.

9.1.16.1 Start 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.

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 integrated test up

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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.

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 Contractor shall be 24 hours daily, 7 days week.

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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. Water for operating the Plant will be supplied free by the Employer.

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.

9.1.18. Completion

a) The Works will be certified as virtually completed by the Empolyer 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)

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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)

9.2 Start Up and Performance Run

9.2.1 Tests on Completion:

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 Empolyer 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.

5.2.1.2 Dry Test Requirements

5.2.1.2.1 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.

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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.

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

9.2.1.3 Process Plants/Equipments

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All process plant items/equipments shall be tested to ensure that they meet the Employer's Requirements for quality of workmanship, construction and performance.

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.

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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.

9.2.1.5 Process Wet Test

On approval by the Empolyer 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.

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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.

9.2.2 Performance Run After Start Up

9.2.2.1 General

On successful completion of 'Test on Completion' i.e. start up and commissioning, certified by Empolyer, Contractor should start the performance run of the plant for 1 year.

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.

Empolyer 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.

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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 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

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		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.

9.2.3 Performance 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.

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6. Approved MAKES

The contractor has to supply the material/equipments etc. in accordance with the latest list of specified/acceptable makes issued by PHED, Rajasthan/RUIDP. In case the material/equipment etc. does not appear in the list as above the contractor may adopt alternative for the same with prior permission of EIC. The contractor has be submit credentials/Data sheets of the manufacturer/suppliers for the same and got it approved by Engineer-In-Charge prior to order of the materials for equipments etc.

APPROVED LIST OF MATERIALS, SUPPLIERS & VENDORS

Annexure "C" : CIVIL WORKS

SR. NO.	MATERIAL / WORK	SUPPLIER / MANUFACTURER / VENDOR/ AGENCY	MAKE OF MATERIAL PRESENTLY INSTALLED FOR REFERENCE SO THAT NEWLY BROUGHT IS COMPLIANT WITH IT
1.	2.	3.	4.
1	a . Cement (OPC) 43 Grade	L & T, Gujrat Ambuja, Vikram, Corromandel, Indorama, Birla Super	N.A
	53 Grade	ACC, Gujarat Siddhee, Gujarat Ambuja	N.A
	b. Cement (SRC)	ACC	N.A
	c. Cement (White)	Birla , JK	N.A
	d. Cement (PPC)	ACC , Gujrat Sidhee	N.A

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1.	2.	3.	4.
2	Bricks	Ordinary clay Bricks of any brand conforming to IS: 1877 with minimum crushing strength of 40 kg/sq cm and water absorption percentage restricted to 25 % for bricks used in panel walls and 20% for bricks used in load bearing walls	N.A
3 a)	Mid , Tor Steel , CRS Steel	TISCO, SAIL, Vizag, RINL.	N.A
3 b)	Structural Steel	SAIL, TISCO, Viraj	N.A
4	Screws	GKW Nattlefold , Oxidized	N.A
5	Dash bolt fasteners	Fischer, Hitlti	N.A
6	Ceramic tiles	Spartex, Kajaria, Nitco, Johnsons, Somany, Pedder	N.A
7	Glazed tiles (1st Quality)	H & R Johnson, Kajaria, Spartex, Naveen, Rommano, Somani Pilkingtm , ECL	N.A
8	Granito tiles	Bell Granito, Naveen, H & R Johnson, RAK Ceramics Dubai, Restile Ceramic Ltd.	N.A
9	Glass Mosaic tiles	Bisazza India, Pinpo Bisazza	N.A
10	Paver Blocks	Conwood prefeb, Hindustan prefeb or approved equivalent	N.A
11	Adhesives	Pidilite, Fairmate, bal, Adhesive, MC Bauchemie, Cementone India Pvt. Ltd., Fosrock, Sunanda Speciality Coating.	N.A
12	MS Door frames & shutters (with Galvanizing)	Agew, Ferrosteel, Sen Harvic, Weldoors, Yashashri Polyextrusion Ltd.	N.A

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1.	2.	3.	4.
13	Door Shutters (wooden)	Kutty, Anchor, Classic, Goyal Timber techniks, Sejpal doors Wood designs Pvt. Ltd., Yashashri Polyextrusion, Anand Wood Crafts, Northern Doors.	N.A
14	Door Shutters (FRP) & Plastic	Everest fibre glass Industries, Unipals India Ltd. Advance Marketing, Yashashri Polyextrusion Sintex	N.A
15	Hardware (Handles, hinges, mortice locks)	Shalimar, Sobeet Vijayan, Navbharat Brass Works, CIEF, Amarbhoy Dossaji.	N.A
16	Aluminum Windows	Aluminite, Aluplex, Almech, Indtajit Associates, Aldoweit, Crystal Corporation, Indal, Jindal, Ajit India	N.A
17	Night Latch	Godrej, Sobeet, Vijayan, Yale.	N.A
18	Paints :		
	a. Internal	Snowcem, Asian, ICI, British, Hindustan Colours and Chemicals, Supreme, Shalimar, Burger, Jenson & Nicholson, Super Snowcem.	N.A
	b. External	NITCO paints, Killick Nixco, Hindustan Colours and Chemicals, Supreme, Shalimar, Burger, Jenson & Nicholson, Super Snowcem.	N.A
19	Synthetic plaster Finish	NITCO, Accro, Damani Dye, Stuff, Supreme, Renova.	N.A
20	Waterproofing works	India waterproofing Co. Likproof India Ltd, Overseas Waterproofing Co.	N.A
21	Waterproofing Compound	Accoproof, Pediproof CICO, Impermo, Vamiplas 302, vamiproof 101 & 102	N.A

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1.	2.	3.	4.
22	Glazing	Float Glass of Modi / ASAHI/ Saint Gobain	N.A
23	M.S. Rolling Shutters (with galvinisng)	Swastik, Standard, Shudwar	N.A
24 a)	Aluminum Grills	DECO, Alumnigrille	N.A
24 b)	Aluminum Joinery	Crystel Corporation, Alumlite, Aluplex, Aluplex, Alm	N.A
25	Anti-stripping Agent	Yuva, BE 100	N.A
26	Chemical Admixtures and compounds for RCC and Mortar	MC Bauchemie, Krishna Conchem Products Pvt Ltd. Sunanda Chemicals, Pidilite, Fairmate, Foscroc, Sika Qualcrete.	N.A
27	Anti Corrosive paint	Krishna Conchem Products Pvt. Ltd., CICO Chemisol Adhesive Pvt. Ltd., Shalimar Burger.	N.A
28 a)	Sanitary ware	Hindustan, Parry, Cera, John, Gas/ Jotisum	N.A
28 b)	Flushing Cistem	Flush Line	N.A
29	Sanitary Fittings and fixtures	Mark, Jaguar, Gem, Dripless, Kingston, Essco, Metro, Ess Ess.	N.A
30	C.I.pipes and fittings	Neco. BIC, HEP, RIFCO, SRF, Mohit Steel, Centri	N.A
31	G.I.pipes	Tata, Zenith, Indus tubes, Swastic, Jindal.	N.A
32	G.I.fitting	ISI marked R brand, Kirti, Jay.	N.A
33	Gate Valves/NR valves	Mayur, Valve Co., Kirloskar. Fourness IVC, IVA Crane, BDK	Mayur
34	Pressure reducing valves	Leader, Hawa, Dynamic, Group valves India Ltd., Mayur Valve	PAC

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1.	2.	3.	4.
35	RCC NP-2/3 class pipes	India Hume Pipes, Permier Prestressed Concrete Product Pvt. Ltd., Patel Hume Pipes.	N.A
36	Lead for lead jounts	Approvaed ISI Manufactures	N.A
37	Rubber Ring	Approvaed ISI Manufactures	N.A
38	Stainless steel sink	Nirali, Tuff, Diamond, Kingston, Neel Kamal	N.A
39 a)	CI pipes and fittings (LA clas)	Kesoram, ISSCO, RIFKO, SRIF, Electrosteel	N.A
39 b)	DI pipes and fittings	Electrosteel or equivalent	N.A
40	Pumps	KSB, Jyotindra, Bharat Bijlee, Kirloskars, Crompton, Kishor, Flowmore	Kirloskars
41	SW Gully trap and stone ware pipes	Perfect, Sonya, Girco, Elecon, Rejura	N.A
42	CI sluice valves	Kirloskar, IVC, Fouress, Dynamic, IVI	N.A
43	Cast Iron Covers	RIFCO, Mohit, Steel, Ashok Iron works, Jayswal Neco Ltd.	N.A
44	PVC pipes and fittings	Prince, Supreme, Reliance, Premium, Kissan, Garware.	N.A
45	Piling Works	Kavanear, Afcons, Michigan Engineering, Larsen & Toubro, DBM Geotechnics, Meher foundations, Safe foundations, Simplex.	N.A
46	Firefighting Works	Monsher, Mather & Platt Bells Controls, Nitin Fire, Rahul Fire	Naaz Engineering Works
47	Elevators	Otis, Mitsubishi, Kone, Bharat Bijlee.	N.A
48	Sodium Nitrate	Devica Chemicals.	N.A
49	Sodium Silicate	Devica Chemicals.	N.A
50	Marine plywood	Anchor , brand, Kitply	N.A

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1.	2.	3.	4.
51	Neeru	Swastic Instant Neeru	N.A
52	Lime for whitewash	As directed by Engineer-in-charge	N.A
53	Tarfelt	Shalimar / Lloyds	N.A
54	Lightening conductor	Approval IS: manufacturers	N.A
55	Teak wood	C.P.teakwood first quality with following tolerances.Sap wood to the extent of 10 mm in 3 m Knots/meter.	N.A
56	S.W.Pipes	Burn & Co., Perfect Potteries, Navroji Vakil, Kashimira.	N.A
	PLUMBING WORK		
57	C.I.Soli Pipes & Fitting as per IS : 3989/84	NECO, CENTRI	N.A
58	G.I.pipes class "C"	TATA/Zenith	N.A
59	G.I.Fittings	R-brand	N.A
60	Gate Valve/NRV	Sant/Zoloto/Leader	Mayur
61	S.W.Pipes	Rajura or other ISI	N.A
62	Flush Valve	Jaguar / Ess Ess	N.A
63	Water Meter	Capstan	N.A

Annexure "E" : Electrical works

1.	2.	3.	4.
1	S.F.U./breakers	L & T /Siemens / G.E.Power /Siemens / Schneider	Schneider
2	Distribution Boards	MDS / Siemens /Schneider / Hager	N.A
3	Indicating Digital Meters	AE /Meco/ L&T	N.A

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1.	2.	3.	4.
4	Crimping Lugs/ Glands of double compression type	Dowells / Jainson / Lotus	N.A
5	Jelly filled Telephone Cables	Finolex / Universal /RPG	N.A
6	Tag Block with Boxes	Krone	N.A
7	Rossets	ITL / Tele Connectors India	N.A
8	MCB / RCCB	MDS/Siemens /Schneider / Hager	Siemens, Anchor
9	Main L.T Panels / PDB/LDB Panel	Incorporating L&T / Siemens / GEC/Schneider Switchgear Components & Manufactured by those who have CPRI Test certificate	L & T, Siemens
10	Switches and sockets	MDS/Schneider / Anchor, Cona	N.A
11	PVC Copper Wires (FRLS Grade)	Sundeep / Finolex/ RR Kabel / LAPP	N.A
12	Motors	Siemens, ABB, Bharat Bijlee, Crompton, Kirloskar, Texmo, NGEF	N.A
13	Cable glands and Lugs	Dowell, Lotus, A.G.Electricals, Siemens	N.A
14	Cat-6 Lan wire	Lucent / LAPP/ AMP	N.A
15	PVC Pipe	Diamond / Precision (PPI) / Asian	N.A
16	Lighting Fixtures	Wipro / Phillips / Clipsal / Crompton / bajaj / K-lite / Keselec shredder	N.A
17	Fans & Air-Ciculators	Cromton / Bajaj / Almonard / Usha/ CINNI/ Rallies / Orient / Khaitan	N.A
18	Distribution Transformer 11 KV/433 V	Crompton, Kirloskar, Emco, BHEL, Bharat, Bijalee, Voltas, Andrew Xule, Pactil, NGEF	Emco

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1.	2.	3.	4.
19	11 KV VCB breaker & panel	ABB, Schneider, Siemens, Alstom, Jyoti, Kirloskar, Crompton	Schneider
20	Relays	ABB, Siemens, Alstom, Schneider, L &T	N.A
21	11 KV SF6 insulated 3 panel / 4 panel extensible type RMU	Crompton, ABB, Siemens, Alstom, Schneider, L& T	Schneider,
22	ACB 8 way / feeder pillar 6 way / 4 way & minipillars	Popular brass metal works, ABAK, Manish, fitwell, Super Panel, Control & switchgear	N.A
23	Fuse base	Siemens, L & T, Popular brass metal	N.A
24	Control Cables	LAOO, Finolex	N.A
25	Batteries	Amar Raha, HBL Knife, Exide, Emco.	Emco.
26	11 KV End termination & Straight through joint	Raychem, Xicon	N.A
27	Measuring Instruments	MECO, IMP,KEW, Rishiline (L &T)	N.A
28	Cables		
a)	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	N.A
b)	XLPE -LT Cables as per IS: 7098 Part - I: 1988	CCI, Asian, Finolex, Torrent, Macro, Fixolite, KEI, Polycab with Nitrogen Corring, Gloster.	N.A
c)	XLPE -HT Cables as per IS: 7098 Part II - 1985	CCI, Asian, Finolex, Torrent, Macro, Fixolite, Polycab, Vardhaman.	N.A

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1.	2.	3.	4.
d)	PVC Insulated (HD) Cable up to 1.1 KV as per IS: 1554 Part I-1988	Torrent, Macro, Vardhaman, Finolex, CCI, Asian, Polycab	N.A
29	Air Conditioners	Samsung, LG, Voltas, Carrier	N.A
30	Lamps HPMV /HPSV Metal Hallide Lamps & Accessories	Vallient, Fixolite, Bajaj, Philips	Bajaj
31	MCB/ELCB/RVVB/HRC/	Indo Asian, MDS, Datar	N.A
32	T.W.Boards & Blocks	Double folding polished board from plant shall be one piece . Block upto 8" X 10" shall be in two pieces	N.A
33	T.Switch S.P.or 2 way S.A.to IS:A	Porcelain base with bakelite cover Khasla, Keycee, GNE, Modern, Kalki	N.A
34	Three pin socket 5A TO 15A	Porcelain base with bakelite cover Khasla, Keycee, Standard, Ellora	N.A
35	Ceiling rose	Khosla, Keycee, Ellora, Oshan, Modern	N.A
36	Submersible Pump Motor Set	Aqua, Kirloskar, Mather and Platt, Modi, KSB, Kishor, Flowmore, ABS, Grundfos, Flygt	Kishor
37	Ring Main Unit /HT , switch and fuse unit	MEI, South Andrew Yule or MSEB approved	N.A
38	C.T./P.T	MSEB approved	N.A
39	Auto Transormer Starter	MEI, Kilburn JMP, Siemens, Andrew Yule, GEC, KEC	Emco
40	Trivector Meter	MSEB approved	N.A
41	Measuring Instruments	IMP, AE, UE, MECO, FE, Rishilinr (L&T)	N.A

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1.	2.	3.	4.
42	Current Transformer	AE, Gilbert & Maxwell, IMP, Siemens, SEGC (C.S.) or MSEB approved	N.A
43	PVC Conduits , PVC Pipes, HDPE Pipes	Garware, Finolex, Shakti, Circlearc, Popular, Prince	N.A
44	G.O.D. Switches and Dropout fuse outfit	Kiran, Pactil, Atas or MSEB approved	N.A
45	Chain Pully Block	Elephats, Herculas, WMI	N.A
46	Lugs	Dowels, Lotus, AG Electricals	N.A
47	Chlorinator	Panwalt, Shree Mitra Purification	N.A
48	Motor Protection Relays	Universal, Thresold, E.E., L&T, Minilac, Siemens, C.S. Telemechanique, Indo-Asian	N.A
49	Feder Pillar/mini pillar	Popular brass metal works, Anil Elect. Ind. or any other manufacture approved by Dept. or MSEB	N.A
50	MCB & MCB, D.B.	MDS, Siemens, EE, Telemechanique, Haveils, Indo-Asian, Standard, Versa, Trip, Helcon, Safeline, Datar	Siemens
51	ELCB	Datar, MDS, Standard, GE, Telemechanique, Havells, Safex, HH-ELCON, Naptune, Gutts, Indo-Asian, Siemens, EE	Siemens
52	PVC Wires , Copper Aluminium , Conductor, Flexible Cables	Philco, Phyroflux, Parargon, Polyplast, V-Plast, Apex, Silvex, Delta, Pagoda, Spacecab, HMT, Ralicab, Finolex.	Philco
53	HRC Fuses	L&T, Indo Asian, Siemens, Havells, ARCON, Standard, Samrat	N.A

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1.	2.	3.	4.
54	Fuse Switches/ SW Fuse	L&T, Siemens, Crompton, Telemechanique, Indo- Asian, Havells, HH-ELCON, Standard, KEW, Kalki, Sentinel, Stenly, Samrat	N.A
55	Switches / sockets	Kalki, CPL, Anchor, Precision, MK, HME, EEW	N.A
56	Cable glands	HME, EEW, MSEB Approved	N.A
57	HC Fuse Distribution Board	CPL, EE, Ess-ess, Stenly, KEW, Kalki, EE, Standard	N.A
58	Air/Oil Circuit Breakers (HT/LT)	Kilburn, Easun, MEI, Jyoti, Andrew Yule, Siemens, L&T, GEC, Soutern, BHEL, Telemechanique, Crompton & MSEB approved	N.A
59	Energy Meters	Jaipur or MSEB approved	N.A
60	Capacitors	GEC, Khatau, Junkar, Crompton, L&T, Momaya, Madhav, Atlanta, Prabhodhan, Maladay, Asian (S+M) or MSEB approved	Crompton,
61	Steel Tubular Poles	Indian Electric Poles, Bombay Tubes, Nityanand Rajan Tubes	N.A
62	GI Pipes/Poles	Zenith, Tata, Bharat, Jindal, Suryaprakash	N.A
63	Terminal Box, bracket , Junction Box , Control pillar	ELM, United, DVK, Locally fabricated as per CIDCO's approved drg./specifications	N.A
64	Street Lighting luminaries	Bajaj, Crompton, Philips, Genelec, Keselac, ELM, Mysore, Wipro, GE-Apar, Canara, Glolite, Indo-Asian	Bajaj ,
65	Chokes/ignitors	Bajaj, Crompton, Philips, Genelec, Keselac, GE-Apar,Glolite, ECE,Indo-Asian	N.A

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1.	2.	3.	4.
66	Power contactors	L&T, Siemens, Bharat Cutter & Hammer, Telemechanique, HH-ELCON, Kirloskar, Crompton	N.A
67	Lamps	Bajaj, Crompton, Philips, Cema, HMT, Electron, Surya, Mysore, Sylvania-Laxman, Solarson, ECE, Indo-Asian	Bajaj ,
68	Rotary/select or switches	L&T Siemens ,kaycee, EE, BISONS(ELM)	L&T Siemens
69	Post top lantern	Philps, Crompton, Glolite, Bajaj, Parimal, Tulip, Keselec, ECE, Genlec, ELM, Wipro, Indo-Asian	N.A
70	Street ligh controller/Timer	L&T, (TSQ 100) 24 Hrs. dial, ELM	(TSQ 100) 24 Hrs. dial
71	ASCR Conductors	MSEB approved	N.A
72	Alternators	Kirloskar, Jyoti, NGEF, AVK-SEGC, KEL, Caterpiller, Stamford, CG Newage Elect.Ltd,	N.A
73	Diesel Engines	Kirloskar, Greaves, Cotton, Cummins, Ashok Leyland, Cater Piller	N.A
74	Cable jointing kit	Raychem, Xicon, Benson, Mahindra (Push on)M Seal	N.A
75	Pole Paint	Jenson & Nicholson, Asian (S+M), Nerolac	N.A
76	Fluorescent Fixtures	Bajaj, Crompton, Philips, GEC, Genelec, Mysore, Wipro, Glolite, Litwell, Prestolite, Indo-Asian	N.A

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Annexure "M" : Eletromechanical & Instrumentation Work

1.	2.	3.	4.
1	Non clog pumps	Kirlokar, Kishor, Johnson, KSB, Grundfos, Worthington, Mather & Platt, Jyoti, ABS, Aqua	Kishor
2	Submersible pumps	Su Motors, Kishore, Kirloskar, KSB, Grundfos, Aqua, ABS	Kirloskar
3	Mechanical Screen	Dorr. Oliver, Geo, Miller, Voltas, Henabh, Emco, KCP, Batliboi, Jash, Huber, Shivpad	Jash
4	Detritus mechanism	Dorr. Oliver, Geo, Miller, Voltas, Henabh, Emco, KCP, Batliboi, Shivpad	Shivpad
5	Screw conveyor	Dorr. Oliver, Geo, Miller, Voltas, Henabh, Emco, KCP, Batliboi, Shivpad	Shivpad
6	Gate	Dorr. Oliver, Geo, Miller, Voltas, Henabh, Emco, KCP, Batliboi, Shivpad, Yashwant	Auma
7	Clarifiers	Dorr. Oliver, Geo, Miller, Voltas, Henabh, Emco, KCP, Batliboi, Shivpad,	Shivpad
8	Mixers	Dorr. Oliver, Geo, Miller, Voltas, Henabh, Emco, KCP, Batliboi, Shivpad, Fibre, Remi	Congreves
9	Fine Bubble diffusers	EDI, OTT	N.A
10	Centrifuge	Alfa Laval, Pennwalt, Humboldt	Humboldt
11	Chlorinators	Metito, Chloro Control, Industrial Deviops, Pennal Perfect Chloro System	Metito
12	Blowers	Key International, Swam, Everest	Everest

1.	2.	3.	4.
13	Valves	Kirloskar, IVI, Audco, Crane Process, Fouress, IVC, BDK, Auma	Auma
14	Dosing pumps	Asian LMI, VK Pumps, Swellore	Asian LMI
15	PLC	Allen Bradley	Allen Bradley
16	Pressure gauges	H.Guru, Gluck	H.Guru
17	Analysers	Forbes, Endress & Hauser, Yokogawa	Endress & Hauser
18	Level Switch/Level Indicator	Levcon, Revathi, Fitzer, S.B. Electro-mechanical	Endress & Hauser
19	Flow meter - magnetic/ ultrasonic	Endress & Hauser, Fisher Rosemount, Forbes Marshall	Endress & Hauser
20	Compressor	Ingersoll Rand Elgi.	Everest
21	MCC	Interiec, Positronocs, Jay Switchgear, Chavare Engineering, L&T, Siemens, ABB, Schneider, Crompton, Spark Electro	Schneider
22	SS piping	Jindal, Lloyds, Zenith	Jindal
23	HDPE pipes	Hallmark, Vijay, Sangir, Sriram Polymers	N.A
24	UPVC Pipes	Geroge Fisher or Equivalent.	Equivalent

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Schedule- IV

Sr. No	Item	Make
1.	Non – clog submersible	Kishor / ABS / Grundfos / Ebara/ Kirloskar
	pumps	/ M & P – wilo/ KSB/ AQUA
2.	Centrifuge Pumps	Mather & Platt /Grundfos/ ABS/ Jyoti/KSB/Kirloskar
3.	HT/L.T. Motors	Kirloskar Electric Co. Ltd./ Bharat Bijlee/ Siemens India Ltd./
		Crompton Greeves Ltd./ Jyoti / General Electric Co. Ltd./
		Asian Brow Baveri/Areva/L&T.
4.	Screw Pumps	ROTO / Netzsch / Alpha Helical / Ramo
5.	Knife Gate Valves	Forbes / IVC / JASH
6.	Zero Velocity Valves	Kirloskar Brothers Ltd./ Indian Valve Company (Nasik)./ VAG
7.	Pressure Release Valves	Kirloskar Brothers Ltd./ Indian Valve Company (Nasik)./ VAG
8.	Air Valves	Kirloskar Brothers Ltd./ Indian Valve Company (Nasik)/ VAG
9.	Sluices Valves	Kirloskar Brothers Ltd./ Indian Valve Company(Nasik)/ VAG
10.	Sluices Gates	JASH / Kirloskar Brothers Ltd./ Indian
		Valve Company (Nasik)./Oriental/Upadhay
11.	Non – Return Valves	Kirloskar Brothers Ltd. / Indian Valve Company(Nasik) / VAG
12.	Gas Valves	AUDCO / BDK/
13.	Exhaust Fans	Bajaj Electronics Ltd./ Crompton Greaves Ltd./ General Electric
		Co. / ALSTOM
14.	Pressure Gauge	Bells Controls / Forbes Marshal / H. Guru / Manometer India
		Ltd./Baumer
15.	a) Crane	Hercules Hoist Ltd./ INDEF / W.H. Brady & Co. Ltd.
	b) Chain Pulley Block	Hercules Hoist Ltd./ INDEF / W.H. Brady & Co. Ltd.
16.	HT/ L.T. Switchgear	GEC/ L&T/ Siemens/ Kirloskar / Schneider/ABB
17.	415V Switchgear	ABB/ L&T/ Siemens / Voltas /
	Control Gear	Electric Control Gear Ltd., /Schneider
	Components / Bus Duct	
18.	11 KV Switchgear	Siemens /ABB / Areva/ L&T / Crompton/ Schneider.
19.	HT / LT Cables	Indian Cables Ltd./ Finolex / Gloster / Universal / Fort
		Gloster Industries Ltd./ Indian Cable Co. / Asian Cables
		Corporation Ltd./
20.	Optical Fiber Cables	Delkin / CORDS/ RR Cables / ICON / AKSH
21.	Sanitary Wares.	Hindustan / Perry Ware / KOHLER / CERA
22.	Gaseous Chlorinators	PENWALT / Jasco/MFTITO/ SUN
23.	Actuators	AUMA / ROTORK / MARSH / L&T/ABB
24.	Switches	Siemens / L&T / Culter – Hammer / GE / Schneider
25.	HRC Fuses	Schneider India / C&S / GE / L&T/ Schneider/ABB
26.	Contactors	Siemens/ L&T / GE / Schneider/BHEL/ABB/Havels/BCH
27.	Bimetal O/L Relay	Siemens / L&T / GE / Schneider/ABB
28.	Thermostat Relay	L&T / Siemens / GE / Schneider/ABB/ C & S/ ALSTOM
29.	Control Fuses	L&T / GE Power / Siemens / Schneider/ABB
30.	Push Buttons	Siemens / L&T / C&S / Vashinov / Bhartiya Culter Hammer /
		Legrand/ABB
31.	For Non – Flame Proof	Siemens
32.	Flame proof / Weather	FCC / BALIGA
	Proof	
33.	Indicating Lamp	Siemens / L&T / Concord /
		Bharatiya Cutler Hammer / Schneider/ABB
34.	Timers	Siemens / L&T / Schneider/ABB
35.	C.T.S & P.T.S.	Siemens / AEP /Kappa/Mysore Electrical Industries
36.	Outdoor Transformer / HT Panel	GE / Crompton / Kirloskar / ITE / VOLTAMP / EMCO (Nasik) /
		ETC (Thana)/ Voltas / CG/ Areva/ Coronet/ALSTOM/BHEL/ Schneider Electric
37.	Indicating Instrument	AEP / Meco / MECIBUS / PYROTECH
38.	Protective Relays	ABB / Easun / Rerolley / GE/ SEG/L&T/Schneider.
39.	Terminals	Elmex / C & PHONIX
40.	MCB	GE / L & T / Schneider/ Legrand/ABB
41.	ACB /MCCB	Siemens / L&T / Schneider/ABB
42.	IDMT Relay	GE / C&S / ABB
43.	Wires / Cables	Finolex / Fort Closter / KEI/ L &T

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44.	Lightning Arrestor	Elpro / Oblum / CGL / Birla NGK Insulators
45.	Fire Extinguishers	Safex / Newage / Firexe / Minimax / Vijay/ Amco / Ahluwalia
46.	Battery	Exide /Standard batteries Ltd. / Chloride India Ltd./ Amco
		Batteries Ltd.
47.	*Battery Charger*	*UPTRON / AEL/APCO/ CHABI / STATCOM*
48.	Butterfly Valve	Kirloskar /IVC / VAG
49.	Air Blowers	Kay / Everest / Swam / BETA
		Ingersoil Rand/
50.	PH, BOD, COD, TSS,	Lvibond / Systeronics / HATCH / ELICO / TATA HONEYWELL /
	NO3, CL, TOC, DO,	Forbes Marshall / SCAN/ Polymetron / Chemtrols / Dr. Lange /
	TDS, Temp. Meters	Royce / Endress/Enerson/ABB/Yokogawa/E+H/VASTHI
	(online)	
51.	Jar Testing Apparatus	Philips & bird company / Geo miller / Metrex
52.	Vacuum Pump	Kirloskar / Inger Sole Rand / Promivac.
53.	Turbidity Meter (Online)	Tata Honey Well / Lectro Tex / Aplav / Plico / Systeronics /
		Forbes Marshall/ Polymetron / SWAN / SCAN/ Analytical
		Instruments / Chemtrols / Dr. Lange / Royce / Endress /
		Hauser / Hach/ Enerson/ABB/Yokogawa/E+H
54.	Levels Sensing Probe	EPIC / Level Tech / Nova / GE
55.	Transmitter & Level	Level Tech / Nova / Lectro Tex / Tata Honey Well / GE.
	Controllers	
56.	Instrument control	ICA / Siemens /GE / Pyrotech / Rittal / SAI Technologies /
	panel along with logic	Newtch
	control system.	
57.	Instrument & Meters	Universal Electrics Ltd./ Automatic Electric Ltd. / Meco
		Instruments (P) Ltd. / Gollica /Industrial Motors Ltd.
58.	Instrument Transformer	Mysore Electrical Industries / Automatic Electric Pvt. Ltd.
60.	Flow integrators	Blue Star / Level Tech / Nova / Fobres / GE
61.	Flow Meters	Forbes Marshall / ABB / Schumburger / Endress Hauser / YBL
		Yokogawa / Magnetrol/ SCAN
62.	Ultrasonic Insertion	Danfoss, Endress + Hauser, ABB, Ultaflux, France, GE
	Type Flow Meter	
63.	Electromagnetic Flow	Endress + Hauser, Rosemount (Emerson), ABB
	meter	
64.	Level switches	Nova / EPLC / Levcon
65.	Digital LED Indicators	Nishko / Switzer / Lectro Tex / System devices / MEASIBUS /
		MECO./Autonics
66.	Multimeter	Excrope / Motwane
67.	Timer	GEC / L&T / Siemens / BCH / Concorde/ABB
68.	Chlorine Toner	ISGEF / ANUP
69.	Chlorinator	Toshcon Jesco / Pennwatt / Aldos / Metito/SUN
70.	D.I. Pipes & fittings	Electro Steel / Kaithalal / Electrotherrm
71.	Lighting Fixtures	BAJAJ / Crompton Greaves / Philips / Wipro Ltd.
72.	415 V Air Circuit Breaker	ABB/ L&T / Siemens/ Schneider
73.	Power Capacitors	Crompton Greaves./ L&T/ Voltas / Siemens (Apcos)/BHEL/ABB/ Schneider
74.	Voltage & Frequency	Kaithalal / Surya / Sercocon / Logicstat / Globe / Allied Electronic
	Stabilizer	Ltd.
75.	Lightening Protection	NELCO / LPT
	unit	
76.	Relays(for 1.1KV 11 KV	Areva/ Asian
	Switchgears)	Brown Boveri / Siemens / L&T
77.	Nuts & Bolts	TATA /B&W
78.	Ceiling Fans	BAJAJ/ORIENT/USHA/CROMPTON/KHAITAN/HAV ELLS
79.	CEMENT	JK / ULTRATECH/ AMBUJA / BIRLA / VIKRAM / GRASIM / SHRI
80.	STEEL (TMT)	TISCO / SAIL / RINL
81.	PCC/MCC	Tricolite / L & T / SIEMENS / Bhartiya Cutler Hammer /Coronet/C&SG.
	IS- 61947-II	
82.	Flow indicating Totalizer	Lectro Tex, Masibus, Nishko, GE, ABB, ULTRE FLUX, Masibus
83.	Open Channel Ultrasonic	Endress + Hauser, Honeywell, Hycontorls, UK,ABB

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	Flow Meter	
84.	Ultrasonic Type Level	Endress + Hauser, Honeywell, Hycontorls, UK,ABB
	Measurement Device	
85.	Float & Board Type	Nivo (Toshniwal), Endress + Hauser, Pune Techtrol
	Level Measuring System	
86.	Conductivity Type Level	Pune Techtrol / Endress Hauser / Nivo (Toshniwal)/ SBEM /
	Switch	HATCH/ Orbit / EIP / ABB / Level Cone / Magnetrol / Fobres
		Marshall
87.	Pressure Transmitter	Fisher Rosemount, Foxbro System, Endress + Hauser, ABB,
		Warne, YOKOGAWA / Hach
88.	Differential Pressure	Fisher Rosemount, Foxbro System, Endress + Hauser, ABB,
	Transmitter	Warne, YOKOGAWA / Hach
89.	Pressure Switch	Danfoss, Switzer, Varma / Varna Trifag / High Tech (Orion)
90.	Gear Reducer	Essen Pro / Radicon / Elecon / Garves / Graves Cotton / Allen
		Beri.
91.	Electronic Ballast	Philips / OPAL / WASH / BAJAJ/ Crompton Greaves.
92.	Micro Processor Based	GE Power / Rockwell/ L&T / Siemens / Areva/Schneider
	relays for Motor	
	Protection	
93.	Scrubber	Pilani / Eurotech / Innovative Environmental Technology /
		Green Power
94.	Bar Screen	JASH Eng. / Johnson Screen Ind. Ltd./ Hans Huber / Geo Miller/EUROTEC
95.	Wash Compactor	Geo Miller / Jash – Eng. Ltd
96.	Sump Pump	SU Motor P. Ltd./ Mody Ind./ FC Pvt. Ltd./ Grundfos – Pumps / Darling / Harison / Aqua/ Kishore Pumps / KSB.
97.	VFD	ABB / Siemens/ / Rockwell/ NORD/ Schneider
98.	Agitator	REMI / Shivpal / Micro Transmission / Triveni
99.	Submersible Mixer	Grundfos/ ABB/ Siemens
100.	Temperature Scanners	Pyrotech/ Masibus/ Nishko/ Lectrotex
101.	Instrumentation and	Thermpad/ Hyderabad/ Suyog Chords/ Thermo Control Systen
	Control Cable	
102.	PLC/SCADA Software	Siemens (Win CC)/ Rockwell Software/ GE/ FANUC/ L&T/ABB/ Schneider/ A Bradley
103.	Alarm Annunciation	Instaalarm Controls/ Industrial Control & Appliances/ Aplab/Proton/EIPL/
		Minilec
104.	Multi Function power	Schneider/ Enercon/ L&T/ Masibus
	Monitor	
105.	Receiver / Indicator	Masibus/ Sai Tech/ Nishko/ Lectrotex/ PYROTEC/Autonics
	(Micro processor Based)	
106.	Analog Signal Multiplier	Secure/ Sai Tech/ MTL/ INSTS/ NISHKO/L&T/Rishab
107.	Printer/scanner/ copier A-3	Canon/Epson/ Wipro/ HP/ Samsung
108.	Monitor LED	LG/ Samsung/ Dell/HCL/HP
109.	Lightening Protection	MTL Instruments/ Rittmeyer/ P&F
	Unit	
110.	UPS	Tata Emerson/ Merlin Gerin / Mitsubishi / APC
111.	Panel Enclosures &PC	Rittal/ President/ Manshu/ Cuttler Hammer/ Schneider/
	consoles	Pyrotec/L&T
112.	Computer (Servers &	HP/ IBM/DELL
	Workstation)	
113.	Communication System	Sheetal Wireless Tech. Pvt. Ltd. Pune/ Saravani Telecom,
	Integrator	Hyderabad / MIDAS, Ahemdabad / Sai Technologies, Baroda /
		VIOLA - FINNLAND
114.	On Line Turbidity, TOC,	Endress + Hauser / Fobres / Khrone Marshal / Fisher
	MLSS, Residual	Rosemount (Emerson), HACH, Honeywell, Pennwalt,ABB
	Chlorine, - Do meter	
	measuring system	

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7. 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.

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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

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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

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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, Chemical Consumption etc.

_____ _____

Signature of Bidder Company

Seal

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POWER GUARANTEE 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

Power requirement of Raw Sewage Pumping Station & STP of 40 MLD Capacity	Equal to or less then 14000 KWH/per day for upto 600 BOD for 40 MLD flow

_____ _____

Signature of Bidder Company Seal

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POWER GUARANTEE SCHEDULE –VI
FORMAT FOR ELECTRICAL LOAD LIST & GUARANTEED POWER CONSUMPTION

Sr. No.	Description of Equipment	Motor Rating KW	W	S	T	Actual BKW = (Shaft Power/motor eff.)	Operating Hrs. Hrs./day	Power Consumption (Kw.Hrs./day)
A)	Process Units							
1								
2								
3								
4								
5								
6								
7								
8								
9	**Total of Process Units**							
	ADD LINE LOSSES @ 5% On "A"							

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	Net Total of "A"							
B)	Non- Process Units							
	TOTAL of Non Process Unit							
	ADD LINE LOSSES @ 5% On "B"							
	Net Total of "B"							
	C =GRAND TOTAL of "A" + "B"							**14000 KWH per day for 40 MLD Flow up to the 600 BOD (fixed by the department)**

I. Bidders are requested to fill the above power guarantee schedule. Power guarantee formats in schedules- VI must be filled carefully. No alternate source like DG Set, Solar etc. for power supplies other than JVVNL shall be entertained for the calculation of guaranteed power requirement.

Signature of Bidder

Company Seal

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POWER GUARANTEE SCHEDULE –VII

For Part 'A' & Part B

Incoming sewage flow (Average flow per day in the month)	Guaranteed Power KwH/per MLD for 600 BOD
upto 10 MLD	**375 KWH per MLD per day**
More than 10 & upto 20 MLD	**360 KWH per MLD per day**
More than 20 & upto 30 MLD	**355 MLD per MLD per day**
More than 30 & upto 40 MLD	**350 KWH per MLD per day**

Note :-

1. **Total guaranteed power is calculated as sum of Net value of non-process (B) and process (A) power consumptions.**
2. **Excess power consumption in the month shall be recovered from the contractor @ two times of prevailing power rates.**
3. **The guaranteed power requirement (in KWH per day) shall be sum of power consumption for process & non process units considering 5% line losses (as per Schedule-VI).**
4. **Details of process/non process consumption shall be filled as per schedule-VI.**

Signature of the Bidder

Seal of the Company

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8. DRAWINGS

Following drawings are enclosed along with bid.

SR. NO.	DRAWINGS
1.	PROCESS FLOW DIAGRAM
2.	PLANT LAYOUT
3.	HYDRAULIC FLOW DIAGRAM

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Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

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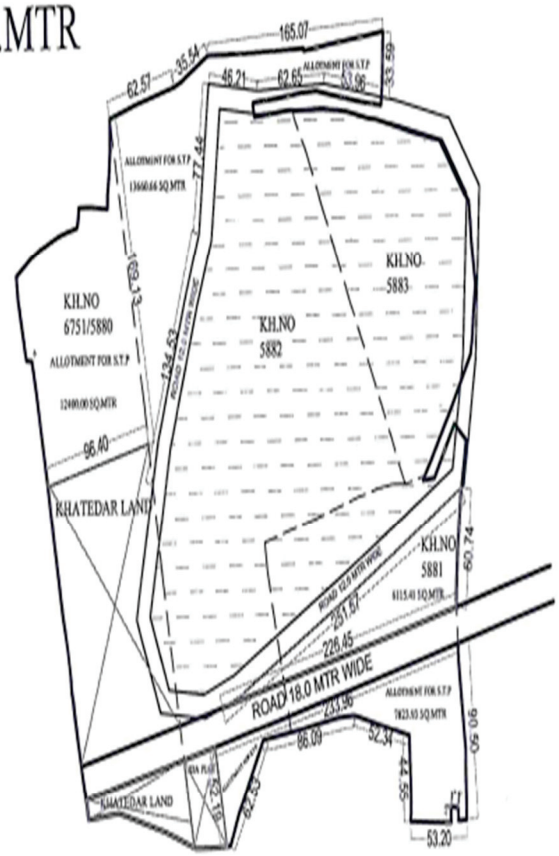
PROPOSED LAND OF STP

AT VILLAGE CHANDLAI TEH- CHAKSU, JAIPUR

KH.NO - $\frac{6751}{5880}$,5881,5882

S.T.P AREA = 40000.00 SQ.MTR

N



PATWARI	JEN	TDR	DTP	DC
ZONE-14	ZONE-14	ZONE-14	ZONE-14	ZONE-14

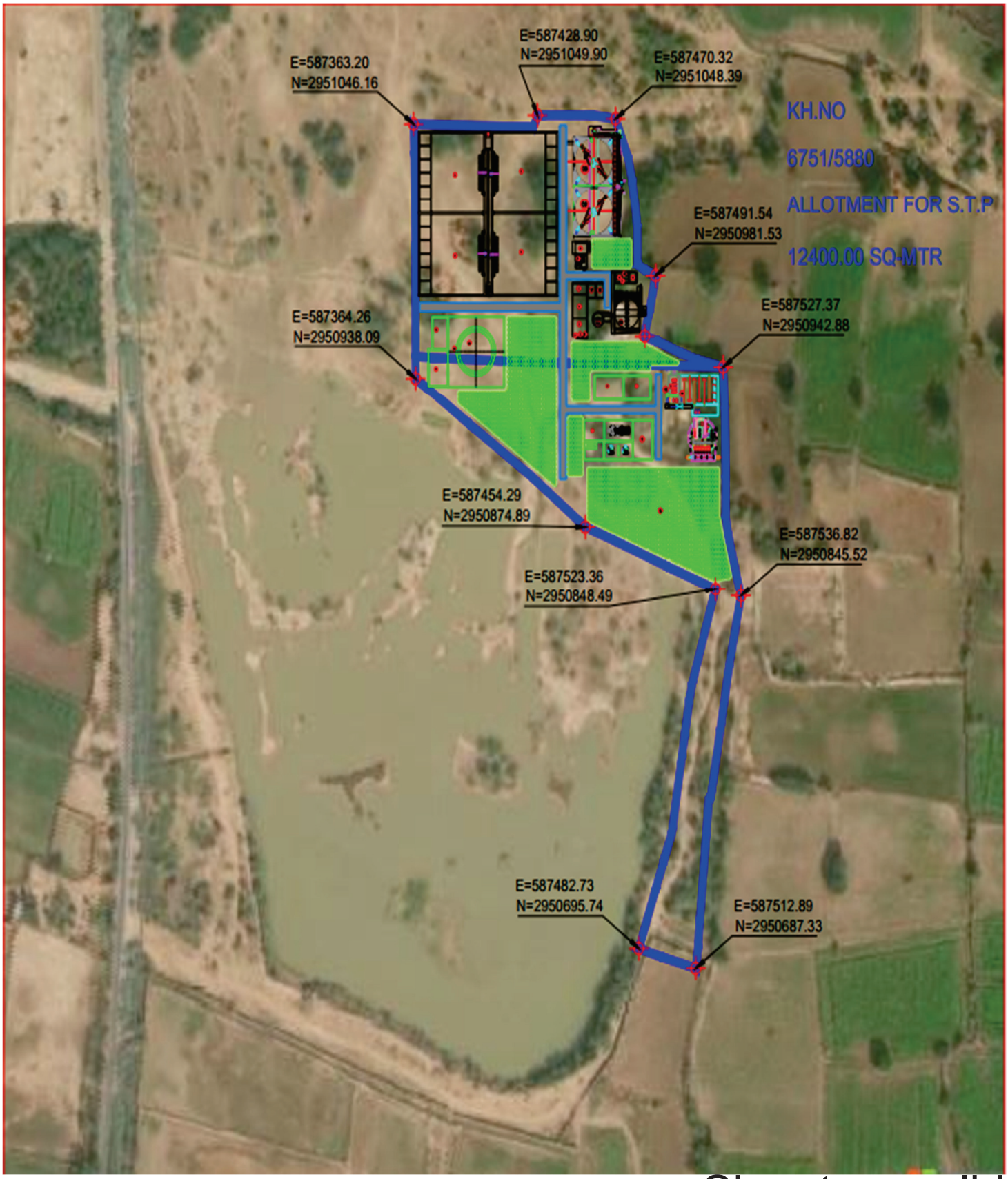
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LEGEND

VD	DIAPHRAGM VALVE	SG	SLUICE GATE	MANUAL HOIST	
VC	CHECK VALVE				
BV	BALL VALVE	SC	COARSE SCREEN	ELECTRICAL HOIST	
VK	KNIFE EDGE GATE VALVE				
VB	BUTTERFLY VALVE	SF	FINE SCREEN- MECHANICAL	WB	WASTE BIN (WITH WHEEL)
DJ	DISMANTLING JOINT				
VP	PRESSURE RELEASE VALVE	PC	CENTRIFUGAL PUMP	GC	GRID COARSE DIFFUSER
VS	STRAINER- Y TYPE				
ST	STRAINER- BUCKET TYPE	-	VARIABLE FREQUENCY DRIVE	GD	GRID DISK DIFFUSER
-	FLOW DIRECTION				
RM	ROTA METER	PS	SCREW PUMP- RECIPROCATING	GT	GRID TUBULAR DIFFUSER
CD	CHANGE OVER	PD	DOSING PUMP- RECIPROCATING	AR	AIR BLOWER MOTOR WITH VFD OPERATED
-	MOTORIZED / MOTOR	GC	GRIT CLASSIFER	SF	SBR DECANTER-FIXED TYPE
LI	LEVEL INDICATOR	SW	SCREEN WASH PRESS	BB	BELT FILTER PRESS
LIT	LEVEL INDICATOR / TRANSMITTER	WB	WASTE BIN (WITHOUT WHEEL)	-	OIL & GREASE (OG)
FIT	FLOW INDICATOR / TRANSMITTER	SS	SCREEN CONVEYOR (WITH SCREW MECHANISM)	-	LEACHATE LINE (LL)
PI	PRESSURE INDICATOR	SC	SCREEN COMPACTOR	-	SEWER LINE (SW)
DLIT	DIFFERENTION LEVEL INDICATOR TRANSMITTER	MI	STATIC MIXER-FABRICATED	-	SLUDGE LINE (SL)
	VALVE TAGGING-MANUAL / HAND WHEEL			-	UTILITY WATER (UW)
	MANUAL / HANDWHEEL TAG. NO. TYPE OF VALE			-	AIR LINE (AR)
	VALVE TAGGING-MOTORIZED			-	CHEMICAL LINE (CL)
	MOTORIZED TAG. NO. TYPE OF VALE			-	PLC INTERLOCK
DO	DISSOLVED OXYGEN			-	DUCTILE IRON
pH	- pH ANALYZER			MS	MILD STEEL
CONT	- CONDUCTIVITY ANALYZER			-	STAINLESS STEEL
LS	- LEVEL SWITCH			-	POLY PROPLENE
TI+pH	- TEMPERATURE INDICATOR + pH ANALYZER			GI	GALVANIZED IRON
	INSTRUMENT TAGGING			uPvc	UNPLASTICIZED POLYVINYL CHLORIDE
	TYPE OF INSTRUMENT INSTRUMENT TAG NO.				
	MOTORIZED MANUAL / HANDWHEEL				
	TAG. NO. TYPE OF EQUIPEMNT				

PT	VESSEL TANK	SL	SAND/ GRIT- CLASSIFIER
MS	MIXER	CB	AERATED BRIDGE WITH GRIT REMOVABLE PUMP
-	RCC CHANNEL	-	RCC TANK
TP	TONER FOR CL2		

PROJECT : PROVIDING, LAYING, JOINTING, TESTING AND COMMISSIONING OF SEWERAGE RELATED WORKS AT SEWAGE PUMPING STATION (IF ANY) AND ALL ANCILLARY WORKS INCLUDING 10 YEARS O&M FOR ZONE-8, JAIPUR TOWN.

TITLE PIPING AND INSTRUMENT DIAGRAM OF STP-30 MLD

CLIENT : Jaipur Development Authority

CONSULTANTS : GREEN CITY SURVEYOR'S (P) LTD
Regd. Office : 303-304 Jagdish Enclave, Opp. Ram mandir, Gopalpura Bypass Road, Jaipur (Raj.)
E-Mail :greencitysurveyors.jaipur@gmail.com

DRAWING No.

RELEASE FOR: TENDER | INFORMATION | APPROVAL | CONSTRUCTION

SHEET 1 OF 6 | SIZE A1 | REV R0

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RajKaj Ref No.: 18852392
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UNITS			
SL.NO	DESCRIPTION	SIZE	QTY.
01	MANUAL SCREEN	CHANNEL SIZE: 1.40M WIDE	01
02	MECHANICAL SCREEN	CHANNEL SIZE: 1.40M WIDE	01
03	BELT CONVEYOR	N.A	
04	WASTE BIN	CAP: Cu.m-0.5 (1W+1S)	02

SUBMERSIBLE PUMPS		
SL.NO	CAPACITY	QTY.
01	835.0 M3 /Hr @ 24 M Head	5

PROJECT : PROVIDING, LAYING, JOINTING, TESTING AND COMMISSIONING OF RISING MAIN, SEWERAGE PUMPING STATION (IF ANY) AND ALL ANCILLARY WORKS INCLUDING 15 YEARS O&M FOR ZONE-2, JAIPUR TOWN

TITLE : PIPING AND INSTRUMENT DIAGRAM OF STP-30 MLD

CLIENT : Jaipur Development Authority

CONSULTANTS : GREEN CITY SURVEYORS (P) LTD
Regd. Office : 333-334, Jagatiki Enclave, Opp. Ram mandir, Delhi-Jaipur Highway, Jaipur (Raj.)
E-Mail: greencitysurveyors.jaipur@gmail.com

DRAWING No.:

RELEASE FOR: ☑ TENDER ☐ INFORMATION ☐ APPROVAL ☐ CONSTRUCTION

SHEET 2 OF 6

SIZE: A1 REV: R0

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Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392
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PROJECT : PROVIDING, LAYING, JOINTING, TESTING AND COMMISSIONING OF PRESSURE RAISING MAIN FROM SEWAGE PUMPING STATION (IF ANY) AND ALL ANCILLARY WORKS INCLUDING 10 YEARS O&M FOR ZONE-8, JAIPUR TOWN.

TITLE : PIPING AND INSTRUMENT DIAGRAM OF STP-30 MLD

CLIENT : Jaipur Development Authority

CONSULTANTS : GREEN CITY SURVEYORS (P) LTD
Regd. Office : 303-304, Jagdish Enclave, Opp. Ram mandir, Queens Road, Jaipur (Raj.)
E-Mail: greencitysurveyors.jaipur@gmail.com

DRAWING NO.

RELEASE FOR: ☑ TENDER ☐ INFORMATION ☐ APPROVAL ☐ CONSTRUCTION

SHEET 1 OF 6

SIZE: A1 REV: R0

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Digitally signed by Dilip Lamba
Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392
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Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.:
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Date: 2025.11.14 10:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392
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RajKaj Ref No.:
18852392
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Signature valid
Digitally signed by Dilip Lamba
Designation : Executive Engineer
Date: 2025.11.14 10:25:31 IST
Reason: Approved

PROJECT: PROVIDING, LAYING, JOINTING, TESTING AND COMMISSIONING OF SEWERAGE RISING MAIN, GRAVITY MAIN, MANHOLES, PUMPING STATION AT ANY LAND ALL INCIDENTAL WORKS INCLUDING 10 YEARS O&M FOR ZONE-2, JAIPUR TOWN.

TITLE: PIPING AND INSTRUMENT DIAGRAM OF STP-30 MLD

CLIENT: Jaipur Development Authority

CONSULTANTS: GREEN CITY SURVEYORS (P) LTD
Regd. Office: 303-304, Jagdish Enclave, Opp. Ram mandir, Civil Lines(22 Godown Circle Home Sodala Jaipur (Raj.)
E-Mail: greencitysurveyors.jaipur@gmail.com

DRAWING No.:

SHEET 6 OF 8

SIZE: A1

REV: R0

RELEASE FOR: ☑ TENDER ☐ INFORMATION ☐ APPROVAL ☐ CONSTRUCTION

Signature valid

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Designation: Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392

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For Tender Purpose Only

CLIENT :
Jaipur Development Authority

CONSULTANT :
GREEN CITY SURVEYOR'S (P) LTD
Regd. Office : 303-304 Jagdish Enclave, Opp. Ram mandir, Civil Line22 Godown Circle Hawa Sadak Jaipur (Raj.)
E-Mail: greenconsultants.jaipur@gmail.com

PROJECT :
PROVIDING, LAYING, JOINTING, TESTING AND COMMISSIONING OF SEWER SYSTEM, SEWAGE TREATMENT PLANT, SEWAGE PUMPING STATION (IF ANY) AND ALL ANCILLARY WORKS INCLUDING 10 YEARS O&M FOR ZONE-8 JAIPUR TOWN.

DRAWING TITLE :
PROCESS FLOW DIAGRAM

SCALE : NTS
SIZE : A3

DRAWING No. :JPR/JDA/ZO8/02

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Designation : Executive Engineer
Date: 2025.11.14 10:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392
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General Requirements

The Contractor shall ensure the Operation and Maintenance of the STP, Sewerage Network, Pumping Stations and other allied works in compliance to the guidelines contained in the Manual on —Sewerage & Sewage Treatment¦, latest edition as published by the Central Public Health Environmental Engineering Organization (CPHEEO), Ministry of Urban Development, Government of India, New Delhi and the prescription laid down hereunder.

The Contractor shall operate and maintain the entire Sewage Treatment Plants (STP) provided in the Project by him, all the Sewage Pumping Systems (SPS) established, all sewerage lines laid by him, all tapping points for sewage established by him, Electric Supply System, including all ancillary works that are carried out in the Project. The cost of such maintenance will be included within its contract price for a total operation and maintenance for a period of 3650 days from the date of taking over of the plant by the Employer after completion. The operation and maintenance period shall include the Retention Period and shall commence from the date of taking over by the Employer. All necessary repairs, maintenance, overhaul, replacements etc., shall be made during the O & M to maintain the Plant at the status of formal handing over after the Performance tests on completion of works. At the end of O & M period the plant shall be handed over to the Employer in fully functional and new condition except normal wear and tear.

The price for O & M bill shall include supply of all tools, tackles, spares, lubricants, laboratory chemical, glassware and polyelectrolyte including all incidentals. The power supply shall be made by the Contractor. The power bills shall be refunded by the Employer as per actual after check for the power guarantee compliance. **The power consumed shall be within the calucalted figures as fixed by the JDA in the schedule in the tender. Power consumption exceeding this is subject to penalty as said in the above section. The scope shall include but not limited to the following items. Cost of diesel will be borne by agency itself.**

General Scope

To Operate and maintain the sewage treatment plant, all instruments and mechanical, electrical equipment in accordance with the aim and purpose of treatment. The plant &equipment covered under the above contract will be totally attended to, by the Contractor including any

—Troubleshooting¦ to ensure smooth and trouble free operation.

The Contractor shall monitor the performance of the sewage treatment plant; conduct the analysis of the inlet sewage and water quality after treatment. Contractor shall initiate and take adequate actions to ensure smooth and satisfactory performance / running of the plants on a 24 hours / round the clock basis.

The Contractor shall prepare and implement an effective plant maintenance programme in consultation with the Employer. It is an absolutely Contractor‘s responsibility to look after all sorts of maintenance whether preventive, Minor, Major, or break-down

The Contractor shall determine operating parameters, select settling (Chemical doses etc.) and generally optimize the process, and working of the treatment plant. Excessive chemical dozing i.e. dose more than normal should be avoided otherwise penalty shall be levied and recovered from the Contractor.

The Contractor should plan & procure all spares, Polyelectrolyte and all

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consumables including chemicals, grease, lubricating oil, cleaning agents, laboratory reagents etc. Further the Contractor shall plan about the requirement well in advance (At least 4 months) and procure the material from the market.

The Contractor shall be responsible for keeping up-to-date record of documents including History Card for equipment and maintaining every day log book relating to various analysis performed.

The Contractor shall maintain and update logbook, in which details of operational parameters are recorded in every shift and at regular interval say hourly or as decided mutually.

The Contractor shall prepare and submit a daily report of plant performance and will assist the Employer in preparing the necessary documents for their purpose and records.

The Contractor shall be responsible to carry out day to day periodic maintenance, necessary to ensure to smooth and efficient performance / running of all equipment / instruments comprising the sewage treatment plant and maintaining the record of the same.

The Contractor shall have to issue identity cards with photographs to all the staff employed for Operation and Maintenance. The list of the same shall be submitted to the Employer mentioning qualification & experience.

The Contractor shall also be responsible to carry out day to day Maintenanceof the rising main inside the STP premises.

The Contractor shall employ minimum staff for operation and maintenance of the Plant as per the list mentioned in the detailed scope of work.

The above staff shall be distributed in three shifts as per mutual agreement between Contractor and Employer As per agreement the number of staff in each shift should always remain present otherwise penalty towards absence of any staff shall be recovered from the Contractor as per Volume-I GCC. The Contractor shall make the arrangement of reliever for weekly off/holiday etc. Absence on any ground like weekly off or holiday shall not be considered. The presence of staff in each shift should be marked in muster to be maintained at office of shift in charge at Sewage Treatment Plant that shall be considered as final. The Contractor‘s staff must mark their presence in this muster. The Contractor may maintain a separate register for his own purpose.

The staff of Contractor shall always remain in contact with the Junior Engineer, Assistance Engineer/Electrical Supervisor, in charge of the Plant deployed by the Employer and follow their instruction.

Unsatisfactory and inefficient running of the plant and unnecessary and excessive usage of spare, consumable, etc. supported by the reasons which are under control of Contractor shall be highly objected. In such cases Employer's decision will be final and binding to the Contractor.

It is required that at least once in every one month a technical expert other than the Monthly Staff of the Contractor shall visit the plant and will suggest if required, to improve the efficiency and working of the plant etc. No separate payment will be made for such visits. The visit must be recorded and outcome of the visit/minutes of the meeting should be got signed by Employer authorities without which the visit shall not be considered.

Contractor shall comply with all safety rules and regulations as followed by the Employer.

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The Employer will not be responsible for any accident /injury to the staff of the Contractor. Further the Employer will not provide any insurance or medical facility to the staff of Contractor. The responsibility lies with the Contractor.

All Central/State Government / Semi-Government / Local Body‘s Rules and Regulations pertaining to this contract shall be followed and observed by the Contractor without any extra cost to the Employer.

The duration of the O&M shall be 120 months from the date of successful completion of 1 year O&M after 03 months trial run and commissioning of the STPs. The Contractor shall provide the necessary tools and tackles required for day-to-day maintenance.

The scope of work also includes cleaning of complete plant area including floor, toilet block railing, door, windows, light fixtures and ceiling etc. The entire premises of the plant area shall also be cleaned and maintain by the Contractor regularly.

This work is inclusive of but not limited to operation, maintenance, housekeeping, cleaning, removing sludge by its own carrier arrangement & disposes it off as per Employer‘s instructions. Preparing data recording, correspondence work to Employer and Government Departments, etc. All this work should be done as per standard practices and by following labour, factory, electrical, RSPCB, and all other latest updated regulations, Indian standards etc. as applied of Local, State and Central Government of India.

The Contractor shall not employ persons who are, pronounced guilty or charged with indiscipline.

Right is reserved by Employer of suspension, dismission, termination of any officer / staff employed by Contractor. He shall have taken prior permission to employ or to terminate his personals.

No watch and ward, safety insurance, security, storage, housing accommodation etc. will be provided by Employer. This will be responsibility ofContractor.

Consumable items like rubber bush, graphite packing, rubber sheet, nut-bolts, material required for cleaning and housekeeping etc. are to be brought by the Contractor.

Monitoring should be done as per guideline given by Employer's representative. Contractor has to maintain all the parameter of effluent within stipulated limit or he will be penalized for not maintaining the parameters given by RSPCB and Employer. All expenditure incurred for the same like, suite fee, court fee, case fee, or the penalty as decided by Employer's Representative and penalty charged by RSPCB will be charged to Contractor and deducted from his bills, SD etc.

Contractor shall have to test the effluent / influent at his own cost at the plant lab on daily basis. The same be verified by and checked by Employer whenever required. The Contractor shall also have to test the effluent / influentat RSPCB lab for different parameter on weekly basis at his own cost.

No equipment shall remain ideal or un-attended or damaged for the period of 3days..

The payment of O & M charges will be made as per the tender conditions. The other terms and condition described in these complete tender documents, wherever applicable shall remain unchanged. In case of any discrepancy the decision of Employer's Representative will remain final & binding on the Contractor.

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During Operation & Maintenance period, Contractor has to supply all the spares, at his cost during preventive, major-minor breakdown, replacement and maintenance work. No extra payment will be made for such maintenance on any ground. The payment for the same will be made strictly as per tender document irrespective of the number of break down / minor, major repairs replacements. During the O & M Contractor shall have to enter annual maintenance agreement with Manufacturers of all major Mechanical Equipments like Centrifuge, Air Blowers, Screens, Decanters etc.

Contractor shall have to maintain required Power Factor as per JVVNL rules and regulations. Incase penalty is levied by JVVNL for not maintaining the Power Factor the same will be recovered from the. Contractor

Maintenance of Garden, Lawns, Plants, Bushes, Plantation of new Plants, Lawns etc. and feeding, gardening, cleaning etc. is in the scope of the Contractor. No separate payment will be made for the same.

The Contractor during his O&M period will have to follow all the guidelines set by RSPCB for Operation & Maintenance of STP.

Operation and maintenance of all General facilities and utility services including all other components of work done under this contract.

Operation and maintenance of PLC based automation system and all instruments installed in the STPs including all repairs, replacements towards the entire instrumentation works during the O & M period shall be in the scope of Contractor.

Any other services required for smooth running of the scheme.

The Contractor shall also dispose off the sludge, screenings, grit and any other material, as per specifications and to the satisfaction of the Employer's Representative. It is to be noted that all costs during the O&M period of (1+10) year, excluding the cost of power only are to be borne by the Contractor. The cost of chlorine during O&M shall be in the scope of bidder. The Contractor is to ensure that the following guarantees are maintained during the operation & maintenance period:for quality of treated effluent

for consumption of chemicals

for automation

The Contractor shall provide on job training to the Employer's staff as per specifications.

At the end of every 2(1/2) year of operation & maintenance period, an assessment of the condition of the plant has to be done by the Employer through third party inspection at Employer‘s cost and based on that assessment the Contractor shall, at no extra cost to the Employer, repair and re-condition all the mechanical equipment in the concluding year of the O&M contract to a condition so that they are in running condition with regular preventive and recommended maintenance as per manufacturer's recommendations or as per CPHEEO manual.

Variability of through output: If the quantity of treated sewage from the Facility can be increased in the existing system without impacting the annual fixed costs to the Contractor, the Contractor shall comply with such requirements. For a sustained requirement of higher throughout from the Facility, the Contractor may be required to frame and submit a proposal that shall be implemented if mutually acceptable.

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Down time

Any STP shall never be operated at less than 50% of its design capacity due to maintenance and repair reasons. The period of such exceptional operation shall not exceed two consecutive days and shall not be more than three days a week. The maximum downtime of the whole Plant shall not exceed 8 hours. The periods for repairs and maintenance have to be communicated to the Employer‘s Representative at least one month in advance. For machinery and equipment which requires maintenance to be carried out by manufacturer/ manufacturer‘s authorized representative, the down time shall not exceed 30 days. Employer reserves the right to impose penalty, should there be any default by Contractor on this account. The penalty amount will be deducted in the next O & M bill if adequate resins are not furnished by the Contractor for delay.

Operation of the Plant as per O&M Manual:

The Contractor shall prepare a detailed program (referred to as O&M Manual) covering the operation and maintenance of the Sewerage Network as a whole. This program shall include the work and activities described in this Chapter, as relevant to the specific items and technology.

The Contractor shall provide 6 copies of draft O&M Manual to the Employer, at the time of the commissioning of the project and on approval of draft, 10 copies of operation &maintenance manual shall be supplied by the Contractor.

The O&M Manual shall include the daily, weekly, monthly, quarterly, half yearly and

annual checks and remedies if necessary to be performed for effective operation of the plant, elaborate detail, all operating and maintenance procedures and policies which are required, advisable and / or necessary for the Facility to achieve full compliance with the operational guarantees and to achieve maintenance and repair standard for the Facility which will ensure compliance with the maintenance specifications. The O&M manual shall include interalia full explanation of all plant procedures and processes.

Without limiting the generality of the foregoing the O&M Manual shall include descriptions, procedures; schedule of maintenance, and shall comply with the requirements, set forth in the provisions of the Bid Documents.

The draft of the O&M Manual shall be subject to the review and approval of Employer, which shall have the right to make any changes and revisions to the O&M Manual as it may deem appropriate. The Contractor shall revise such draft O&M Manual prior to the commencement of the O&M period.

At the end of the construction period, the Contractor shall revise the draft O&M Manual to reflect any updates, changes or revisions it deems appropriate, inter-alia based on

its experience and as necessary to reflect any modifications or adjustments to the plant. Without limiting the above, the Contractor shall annually fully review, revise, update and modify the draft O&M Manual as may be necessary or appropriate. Any revision to the draft O&M Manual shall be subject to the review and approval of Employer.

Employer shall have the right to require revisions to the draft O&M Manual asit may deem appropriate. The Contractor shall prepare and submit to Employer, for its review and approval, 30 days prior to the proposed date of commencement of O&M, a revised draft O&M Manual which reflects all changes, revisions and modifications. The Contractor shall prepare the O&M Manual, as approved by the Employer, prior to the start of O&M.

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During the term of this Agreement, the Contractor shall promptly notify Employer of any revisions, additions or modifications which he, in his professional opinion, believes should be made to the O&M Manual, whether as a result of additional experience in operating and maintaining the Facility, changes in influent quality or volume, changes or modifications to any equipment part, component or structure incorporated in the Facility.

Such notification shall set forth the reason for the proposed revision. Any proposed revision shall be subject to the approval of the Employer. In addition, during the term of this Agreement, Employer shall have the right to require relevant changes, revisions, or additions to the O&M Manual as it, shall deem appropriate to ensure full compliance with the O&M Standards.

The Contractor shall submit 10 copies of the final O & M manual along with a soft copy in Microsoft Word Format.

Maintenance schedules

The Contractor shall prepare and follow a Maintenance plan, detailing the maintenance activities scheduled for each of the component of the Sewerage Network on a periodic approved by Employer's Representative and / or the Employer.

Every part of the works and all the materials to be used therein shall be subjected to such tests from time to time during the execution of the work as the Employer may direct and the whole of such tests shall in all cases bemade at the Contractor‘s sole expense.

The work shall be carried on and completed under the exclusive control direction and supervision and to the satisfaction of the Employer. The Employer shall likewise have full power to reject or condemn any work or material that he may deem unsuitable. In case of any work or material being rejected by the Employer's Representative, the Contractor shall immediately remove and replace the same to the satisfaction of the Employer or the Employer shall have full powers to get the same removed and replaced and deduct the expenditure incurred in the process from any amount due or that may become due to the Contractor.

The Contractor shall use only the original and genuine spares of the original equipment as per recommendations given in the maintenance booklet of the manufactures/as per directions of the Employer. Adequate stock of such spares is to be maintained by the Contractor. Test certificate of manufacturer is required for bearings along with supplies. Test certificate of all major equipment will be submitted from the manufacturer.

If any material brought to the site of works, be in the judgment of the Employer's Representative, found inferior or improper & not as per described standards, the said materials or workmanship shall where required by the Employer shall be removed or amended by the Contractor forthwith or within such period for every breach by the Contractor in this clause.

All the steel structures and machines, if installed in open areas, should be painted after every monsoon period after cleaning the surface as per the instructions of the Employer's Representative. Entire plant including all civil structures, mechanical equipment, HT panel and Transformers etc. shall be repainted after every 2(1/2) years as per original painting specifications.

All leakages should be attended and all network blockages shall be removed within three days of them being identified and reported. All the valves/gates which are not used regularly should be operated at least once a week and make sure that they are properly lubricated

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/greased.

All safety valves should be checked daily and ensure that they are working properly. In case of any fault the same should be attended immediately withoutany wait. The maintenance of the plant shall be as per maintenance manuals of the manufacturer for all equipment. Contractor shall keep all the safety devices in working order.

The Contractor should make sure that no unwanted material should float/grow in and around different units. In case it is found the same shall be removed

/cleaned immediately. He shall also be responsible for cleaning/sweeping the plant buildings inside and outside, roads, foot path etc.

Launders/Weirs etc. of reactors etc. to be maintained clean round the clock. During preventive/ breakdown maintenance, the Contractor has to visit the unit/units as and when needed. The pumping units or other machineries required if any shall have to be arranged by the Contractor at his own costs for completing the work. In case of battery operated auto system panels and also system alarm etc., batteries are required to be maintained and replaced as and when needed by the Contractor.

The Contractor shall maintain the Supervision, Control and Data Acquisition System (SCADA) in working condition for the 10 years of O & M period. The Contractor shall not remove/ shift any equipment/ machinery even temporarily without written permission of the Employer or authorized representative. Though the Contractor has to operate and maintain all the equipment/machineries, lighting (plant area, boundary walls, gate lightening etc.) but the machine of the equipment under warranty should not be dismantled without prior permission of the Employer. The list of such equipment (Under warranty), if any, will be given by the Contractor.

Consumables such as Manhole covers, POL (petrol/Diesel Oil & Lubricants) etc. has to be arranged by the Contractor as and when needed as per manufactures recommendations for periodical maintenance of entire Network. The Employer shall not provide such items.

The Contractor shall carry out biannual cleaning of network before and after the monsoon season including cleaning of all manhole chambers and collection network.

In case of major repair due to normal wear and tear/break down, the Contractor should bring the same to the notice of the Employer immediately and necessary measures for its repair should be taken simultaneously. Breakdown, all repairs of any kind are to be attended by the Contractor. Any unit/equipment being irreparable in the opinion of the Employer will be replaced by the Contractor at no cost to Employer. However, if there is any unexpected population growth / high flows are observed due to urban growth, which warrants replacement of sewer with higher diameters, such cases will be brought to the attention of the Employer. Upon Employer‘s approval, at Employer‘s cost, the same shall be executed and commissioned by the Contractor. In these cases no supervision or design and estimation chargeswill be paid by the Employer.

The Contractor shall give his telephone no., contact addresses, etc. to the Employer as well as shift duty shift to contact him during emergency/odd hoursetc.

The Contractor shall be responsible to carry day to day as well as periodic maintenance, necessary to ensure smooth and efficient performance/running of all equipment instruments installed at the Sewage Pumping Stations. He shall be

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responsible for maintenance/replacement of street light poles and light etc. also. All the plant, building, land, etc. shall remain the property of Employer.

Operation

Operational services

The Contractor shall operate the complete sewage treatment Plant and associated services on a continuous 24-hour basis.

The Contractor shall operate and utilize the control and monitoring systems provided. If found necessary, he shall make adjustments (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/ abnormalityin the Plant functioning and report to the Employer‘s Representative and seek his directives on the necessary corrective action to be taken/adopted.

The Contractor shall be required to furnish the details of electricity consumption in the format prescribed by the Employer‘s Representative.

All consumables, Polyelectrolyte, and spare required operating and maintaining the Contractor shall provide the Plant in good condition. The grit, Screenings, Wet sludge and other garbage generated in the plant shall be removed from the site on daily basis. No accumulation of such residues shall be permitted within the Plant campus without express application by Contractor giving adequate reasons as well as permission of Employer‘s Representative. The Contractor shall such residues in conformity to Environmental regulations/ rules in force. The Employer‘s Representative may, if required, decide the mode and timing of disposal of such residues in consultation with concerned Environmental and Civic Authorities. Such directions shall be followed by the Contractor promptly, both in letter and spirit, without any reservations and without any increase in O&M /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.

The Contractor at his own expense shall provide all tools, cleaning, and housekeeping equipment, security and safety equipment

Laboratory services

The Contractor shall perform all tests, sampling and analyses regularly as approved by the Employer‘s requirement and as per the O & M standards

The Contractor shall submit in his offer a complete list of laboratory equipment and materials in accordance with the analysis program required, if in addition to the mandatory list of laboratory equipment said in Annexure 8

Manpower

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The minimum personnel required for O & M is as given below. However, the Contractor shall mention the personnel required for O&M in his bid. The work shall be carried out on a 24 hour basis without intermission and the staff deployed by the Contractor shall be in accordance with this contract.

S. N.	Key Staff	Nos. Required	Minimum Qualifications
1	Manager	1	Degree / Diploma in Civil Engineering / Mechanical Engineering / Electrical Engineering with minimum 10 years' experience in Operating & Maintaining a STP and Sewerage Network
2	Foreman	3	Degree / Diploma in Civil Engineering / Mechanical Engineering / Electrical Engineering with minimum 5 years' experience or ITI _C'
3	Pump Operators	10	Certification with minimum 10 years experience in Operating & Maintaininga Sewerage System
4	Electrician	1	ITI _C' certification with minimum 3 years' experience in Operating Sewerage System
6	Plumbers/ Fitters	3	(ITI _C' certification with minimum 5 years' experience in Operating /Maintaining any Sewerage System

The Contractor shall give or provide all necessary superintendence during the O&M and as long thereafter as the Employer may consider necessary. Such superintendence shall be given by a competent person having adequate knowledge of the operation and Maintenance to be carried out (including the methods and techniques required), the hazards likely to be encountered and methods of preventing accident) as may be required for the satisfactory working of the entire plant.

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No labor below the age to 18 years shall be employed on the work. List of staff is to be given by the agency to the Employer and advance intimation to be given before deputing/removing any staff from site during the period of contract. Not more than one of the Contractor's key staff shall be absent from the project site at any given time. In case it is necessary for more than one of the key personnel to be absent at a given time, the Contractor shall provide replacement of equivalent or better qualifications. The CVs of such key staff replacements shall be got approved from Employer in advance.

Employer shall be authorized to direct the contracting agency to remove anyor all staff employed on O&M of the sewerage network if in his opinion continued presence of such staff is detrimental to safety or proper O&M of the sewerage network. The Contractor shall comply with such directions & post suitable substitute(s) thereof. Whenever the Engineer has to inform the Contractor in writing that any person on the work is in his opinion unsatisfactory or/incompetent or unfaithful or dishonest, untruthful or disorderly or to be otherwise unsuitable/such person shall be discharged by the Contractor from the work and shall not be employed again on it.

Safety

The Contractor shall take all safety precautions under various Acts/Rules under central/State Govt. from time to time and he shall be responsible for safety of its staff and the consequences thereof. The Contractor shall deploy round the clock security personnel

at entrance of plant‘s premises and in the compound for the safety of the plant and premises for the safety of the plant, equipment and personnel during this period.

(A) Responsibility for damages

The care of the whole of the permanent works shall remain with the Contractor who shall be responsible for all accidents or damages from whatever cause arising and chargeable for anything that may be stolen, removed destroyed or damaged to whomsoever belonging and also for making good all defects and damages to the said works or to any property adjoining or any cause whatever, whether such damage or defects were occasioned by the negligence of the Contractor or not or may be or might have been discovered during the progress to be known after the completion whereof or whether payment may wholly or partially have been made or the works approved as supposed to have been properly done and no certificate of approval of any works by any officers or members of the Board shall affect or prejudice the right of the RSPCB against the Contractor or be considered or held as at all conclusive as to the sufficiency of any work materials.

Adequate safety precautions against fire, flooding, lightening, electrical shocks, accident due to moving/non-moving heavy/light equipments shall be strictly observed by the Contractor at his own cost. Suitable safety measures like gumboots, gloves, safety belts, ladders, safety lamps, gas masks, Oxygen apparatus, insulated tools, alarms etc. shall be provided by the Contractor. Necessary medical first aid kit shall be made available all the time. In absence of observance of above safety precautions, the Contractor shall be responsible for any unforeseen loss of the equipments or persons dealing with it. Special care shall be taken by the Contractor while carrying out the work in sewage gas zone. Any incidence of human life or accident will be totally Contractor‘s responsibility.

The Contractor shall ensure that the staff employed takes all necessary precautions while carrying out the work either in shift duties or any general shift as per Indian Electricity Rules/Factory Act/CPHEEO Manual/ manufacturer's special

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instruction for safety / gas handling. The staff should use Gas masks, Oxygen apparatus, Gum Boots, Safety Belts and Safety Lamps, etc. while carrying out the work in Bar Screens, sumps etc.

The Contractor shall make arrangement for all necessary safety equipments for persons working at STP as per Factory Act/Safety Rules. In the event of any accident on or off site, in which the Contractor or his personnel areinvolved, in which an injury occurs to any person whether directly concerned with the project or a third party, the Contractor shall inform Employer within 24 hrs. of the occurrence of the event. The plant will be open to local/state/central agencies for verification of safety/emission/ acts compliance.

During night hours, the main gate should be locked. However, shift duty staff should be alert and open the gate during surprise checking of Employer staff or any other Government Authorities or his nominee without any wait. Only bona-fide persons be allowed in the plant premises being a prohibited area. Smoking and drinking are prohibited in the plant. The staff engaged shall wear common uniform with name plate indicating name and designation during dutyhours.

Reporting

The Contractor shall prepare consolidated daily reports, weekly and monthly reports on Plant operation and maintenance and submit to the Employer‘s Representative. The daily reports are to be submitted within first working hour of the next day. The monthly reports shall be submitted on the first day of the next month and within two working hours.

Overall reporting formats shall be approved by Employer‘s Representative and may have to be modified from time to time as required and approved by Employer‘s Representative. Contractor may have to prepare and submit additional reports on particular matters and incidents as and when required by the Employer‘s Representative for each significant occurrence.

Maintenance

Maintenance of Installed Plant

The Contractor shall ensure the continuity of the Plant operations and the breakdown or the deterioration in performance of the Plant under normal operating conditions of any items of the Plant and equipment and component parts thereof shall be minimized.

The classes of maintenance provided shall comprise full Operational maintenance and standby Maintenance.

Full operational maintenance comprises the 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.

Standby maintenance comprises the planned and regular maintenance carriedout by the Contractor including cleaning, lubricating, periodic, and minor adjustment of all items of Plant and equipment within the treatment works which have been installed but have not yet been made operational.

The Contractor shall carry out the maintenance of the Plant installations in accordance with the requirements of the O & M Manual and to the approved maintenance plan. The Contractor shall strictly adhere to the manufacturers‘

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recommendations with respect to equipment maintenance, and only use types and grades of lubricants to be used. The frequency of lubrication, adjustments to be made regularly, and recommended spare parts by the equipment/machine/instrument manufacturer/supplier shall be carried out and appropriate inventory shall be held in store.

Building and Site Maintenance

The Contractor shall be responsible for:

The full maintenance of building and all electrical, ventilation, plumbing anddrainage installation in the building.

Building and housekeeping maintenance.

Full maintenance of the site water and wastewater services, cabling andearthing systems, and the site road lighting system.

Site maintenance including the upkeep of landscaped areas/ tree Plantationetc.,

The telephone installations in all buildings.

The building services and housekeeping maintenance shall be undertaken on all buildings and services installations.

Routine housekeeping maintenance shall be carried out in accordance with procedures specified in the Operation and Maintenance Manual which shall beapproved by the Employer‘s Representative.

Preventive Maintenance

The Contractor shall plan the day-to-day and the preventive maintenance. This planning must include for each equipment the estimated necessary hours in preventive maintenance and break down maintenance. It shall also include the qualification of the foreseen maintenance personnel.

The Contractor shall provide the yearly requirement of spare parts and consumable needed for the maintenance of each piece of equipment for the day-to-day maintenance, preventive maintenance, and foreseen break down maintenance/ overhaul, if any.

Training

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General

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. The Contractor shall also be responsible for training personnel designed by the Employer who will operate the Plant at the expiry of thecontract.

The Contractor shall make available for this purpose competent staff and as well as propose schedule information that may be necessary for effective execution of the training programme.

The training shall be organized in two (2) stages as follows:

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.

Intensive on-the- job training during commissioning and maintenance period.

By the end of this training period these personnel should be able to carry out their respective duties efficiently under the supervision of Employer‘s Representatives and supervisory staff of the Employer.

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.

Towards end of O & M contract period, training shall be conducted once again to Employer‘s personnel or their authorized personnel. This training shall befor a duration of 30 working days.

Operation and Maintenance Records & Reporting

(A) Reporting and Record Keeping:

Maintain a periodical reporting system to provide access and retrieval of Sewage Treatment Plant operating data including all such

information which is necessary to verify costs and expenses incurred and otherwise to confirm that the Contractor is in compliance with its obligations under the terms and conditions of this Contract;

The Contractor shall prepare daily and monthly reports (in Employer format) of pumping/treatment and project performance and submit to the Employer's Representative and will assist the department in preparing the necessary documents for their purpose and record as per proforma given from time to time. The reports shall contain, inter-alia, the following:

Raw Sewage quantity and quality and effluent quality as per the on-line monitoring programme and other tests and print outs of online monitoring shall be submitted to Employer's Representative.

A description of the maintenance work carried out in the reporting period.

A report on major failures, if any, their causes and remedial actions taken.

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Sludge quality and quantity (daily basis) in the reporting period.

Power and chemicals consumed in the reporting period.

An inventory of the chemicals and spare parts available at the end of thereporting period.

O&M staff deployed by the Contractor during the reporting period. Any majorrepair works, if any.

Contractor shall maintain separate register/computerized records at all sites offollowing information:

Pumping register

Quantity of sewage treatment and performance register D

Working hours register

Electric break down register

Maintenance register

Staff attendance register

Equipment breakdown, repair record and extent of repair

Chlorination equipment and chlorine toner operating and using register

The Contractor shall maintain a record for the entire Term of the following:

status or progress report of the operation and maintenance of each of theSewage Treatment Plant components;

record of all consumables, tools, equipment's manhole covers, etc. used / replaced towards operations and maintenance of the STP;

report certifying that the quality and quantity of the Residual Treated Waterat the Discharge Point;

Report certifying the reuse (quantity and quality) of treated effluent.

daily readings of the meters at the Receipt Point;

daily readings of the meters at the Discharge Point;

methods of disposal used for Residual Matter; and

Nature and scope of any ancillary activities being carried out in accordancewith the terms and conditions of this Contract.

Provide reports on accidents in respect of the Sewage Treatment Plant, ifany.

Daily readings of the meters at the inlet of the STP;

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Nature and scope of any ancillary activities being carried out in accordancewith the terms and conditions of this Contract; and

Provide reports on accidents in respect of the Sewage Treatment Plant, if any.

The Contractor shall provide an accurate, complete and up-to-date record, report or document in relation to any aspect of modernization, expansion, operation, maintenance and management of the Sewage Treatment Plant to Employer as and when a request is made as soon as reasonably practicable and in any event within any time limit prescribed by Employer for the production of such record, report or other document.

Provide a copy to Employer of its annual audited accounts of expenditure by the Contractor in the implementation of the Project as at the end of and for thataccounting period.

Report to Employer regarding any litigation or material claims, disputes or actions, threatened or filed, concerning the Sewage Treatment Plant or the obligations to be performed by the Contractor under this Contract;

Report to Employer any refusal or threatened refusal to grant, renew or extend or any action pending or threatened that might affect the granting, renewal or extension of any Applicable Approval;

Report to Employer any material information concerning new or significant aspects of the operations, maintenance and management of the Sewage Treatment Plant, any material complaint about the Sewage Treatment Plant from any person or any other information received by the Contractor which is material to the Operation and Maintenance of the Sewage Treatment Plant

Fulfillment of the Operational Guarantees

The Contractor shall be responsible for ensuring that the entire system operates and fulfills the guarantees stipulated in the document during the operation and maintenance period. The guarantees to be fulfilled for satisfaction of this clausewill be related to:

the quality standards of the effluent, sludge and the nuisance generated byany of the STP

the power consumption in the STP

Quality Monitoring

Variations allowed in treated effluent quality during O & M period of (1+10) yrs and during Retention Period, and penalty for not maintaining the standards:

Liquidated Damages for failure in performance

During Retention Period of 12 months and O&M period of 10 yrs, The Employer will impose following penalties/liquidated damages for not maintaining the guaranteed parameters, as described below:

(Note: The O&M Cost for this purpose will not include the Power Charges)

Liquidated Damages for non-compliance of treated effluent

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standards

Event Triggering the recovery of Liquidity Damages	Liquidated Damages	Frequency
Non-conformance with MAC forC OD/BOD Standard	Rs. 2000/-	For every event of non-conformance*
Non-conformance with MAC for TSS Standard	Rs. 2000/-	For every event of non-conformance*
Non-conformance with MAC for Total Nitrogen	Rs. 2000/-	For every event of non-conformance*
Non-conformance with MAC for Ammonia Nitrogen	Rs. 2000/-	For every event of non-conformance*
Non-conformance with MAC for Fecal Coliform Standard	Rs. 2000/-	For every event of non-conformance**

* An event is defined as online reporting duration, not exceeding 3 minutes i.e. a maximum of total 30 minutes a day i.e. 98% system reliability.

** An event is defined as daily composite sample, not exceeding one non-conforming sample in 30 days i.e. 97% system reliability.

The cumulative of above liquidated damages shall not exceed 10% of the monthly O&Mcost (Maximum Liquidated Damages).

Breakdown of Equipment:

In case of breakdown of equipment for more than the stipulated time period as below, on discretion of Employer's Representative, the Contractor shall be penalized as mentioned below:

Equipment	Breakdown Time	Liquidated Damages

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	Period	Imposed
Critical Equipment/ Instrumentation (Critical equipment shall mean those ensure the plants performance and it shall include all flow and treated water quality measuring instruments and systems including submersible mixers , blowers, sludge and MLSS recirculation pumps, disinfection (chlorination system), filters panels etc.)electrical systems such as critical electrical system such transformers, electrical	beyond 72 hours i.e. 72 hours	3% of Monthly O&M Cost per dayof defaultbeyond permitted breakdown time period
Semi-Critical Equipment Semi Critical equipment shall mean those necessary to ensure the plants performance and they shall include all screens, grit removal systems, primary clarifiers, bio reactors (aeration system), secondary clarifiers, sludge thickening, and digestion systems etc.	beyond 7 days	2% of Monthly O&M Cost per day of default beyond permitted breakdown time period
Non Critical Equipment Non Critical equipment shall mean those equipment at the plant are but are not critical in for delivering the plants performance, such as area lighting, air conditioners, Instruments not critical towards operation of the plant.	beyond 10 days	1% of Monthly O&M Cost per day of default beyond permitted breakdown time period

The cumulative of above liquidated damages shall not exceed the monthly O&M cost (Maximum Liquidated Damages).

However, if pollutants load (kg/day) exceeds the design pollutant load per day basis, or total flow exceeds (total of STP capacity provided on 24 hr basis), no penalty shall be applicable.

During trial run and commissioning, no penalties will be applied and Contractor shall rectify the plant to ensure successful commissioning.

Note: In case the non-conformance, on a continuous basis, due to Condition A and Condition B becomes equal to or more than 50% of the monthly O&M value for a period more than 3 months in a year i.e. 90 days in a year, then the

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Employer reserves the right to terminate the Contractor after en- cashing all the Security Deposits, retention Money and Performance Guarantees.

Grid Power Failure:

In any case if the grid power failure is more than 8 hrs in a single occasion in aday or cumulative grid power failure is more than 8 hrs in a day.

No treatment standards will be compulsory. However, Contractors are encouragedto maintain standards as far as possible. No penalties will be imposed on Contractor. Above relaxation shall be applicable only for a period of 24 hours after resuming regular grid power.

Use of Electrical Energy:

Contractor shall give complete details of total power consumption, Power consumption in STP and the acceptable power consumption as per the agreement for the same along with the power cost refund claim. The refund forthe power shall be made only after deducting the cost of 2 times the u nit consumed in excess of the guaranteed consumption.

During Operation and Maintenance, damages payable by Contractor to Employer on excess consumption of net electrical energy shall be equal to the actual cost of the excess energy used for Operation and Maintenance of the Works for STP and SPS under the Contract, based on the guaranteed consumption provided by the Contractor and the current rates charged to the Employer for electricity consumed.

The guarantees for power consumption would come into effect after the Completion Test.

Residual Handling & Disposal

The Plant Residuals shall conform to the following specifications:

Screenings

The screening shall comprise of all particles of an effective size in excess of 5 mm and be free of dripping water when disposed from the plant.

Grit

The grit removed shall contain less than 3% organic matter on dry basis of an average particle size between of more than 100 microns but less than 1000microns and be free of dripping water

Excess Bio Solids (Sludge)

The sludge shall comply with the standards and the cakes can be disposed by the Contractor as he wishes to the land fill site or may be sold by him, the value recovered will be his property. However it should be periodically removed from the plant site to avoid any foul atmosphere.

Screenings & Grit: Disposal to the Sanitary Land fill (the tipping charges shall be borne by the Contractor.

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Operation and Maintenance Manual

The Contractor shall prepare a detailed program (referred to as O&M Manual) covering the operation and maintenance of the treatment plants as a whole. This program shall include the work and activities described in this Chapter, as relevant to the specific items and technology.

The Contractor shall provide 6 copies of draft O&M Manual to the Employer, at the time of the commissioning of the Project and on approval of draft, 10 copies of operation &maintenance manual shall be supplied by the Contractor.

The O&M Manual shall include the daily, weekly, monthly, quarterly, half yearly and annual checks and remedies if necessary to be performed for effective operation of the plant, elaborate detail, all operating and maintenance procedures and policies which are required, advisable and / or necessary for the Facility to achieve full compliance with the operational guarantees and to achieve maintenance and repair standard for the Facility which will ensure compliance with the maintenance specifications. The O&M manual shall include interalia full explanation of all plant procedures and processes.

Without limiting the generality of the foregoing the O&M Manual shall include descriptions, procedures and shall comply with the requirements, set forth in the provisions of the Bid Documents.

The draft of the O&M Manual shall be subject to the review and approval of Employer, which shall have the right to make any changes and revisions to the O&M Manual as it may deem appropriate. The Contractor shall revise such draft O&M Manual prior to the commencement of the O&M period. At the end of the construction period, the Contractor shall revise the draft O&M Manual to reflect any updates, changes or revisions it deems appropriate, inter-alia based on its experience and as necessary to reflect any modifications oradjustments to the plant. Without limiting the above, the Contractor shall annually fully review, revise, update and modify the draft O&M Manual as may be necessary or appropriate. Any revision to the draft O&M Manual shall be subject to the review and approval of Employer.

Employer shall have the right to require revisions to the draft O&M Manual asit may deem appropriate. The Contractor shall prepare and submit to Employer, for its review and approval, 30 days prior to the proposed date of commencement of O&M, a revised draft O&M Manual which reflects all changes, revisions and modifications. The Contractor shall prepare the O&M Manual, as approved by the Employer, prior to the start of O&M.

During the term of this Agreement, the Contractor shall promptly notify Employer of any revisions, additions or modifications which he, in his professional opinion, believes should be made to the O&M Manual, whether as a result of additional experience in operating and maintaining the Facility, changes in influent quality or volume, changes or modifications to any equipment part, component or structure incorporated in the Facility.

Such notification shall set forth the reason for the proposed revision. Any proposed revision shall be subject to the approval of the Employer. In addition, during the term of this Agreement, Employer shall have the right to require relevant changes, revisions, or additions to the O&M Manual as it, shall deem appropriate to ensure full compliance with the O&M Standards.

The Contractor shall submit 10 copies of the final O & M manual along with a soft copy in Microsoft Word Format.

Technical Audit

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The Employer has the right to conduct a technical audit of the Facility and to perform any analysis or inspection he deems necessary. The Contractor shall at his cost provide all assistance the Employer required to complete these inspections. Such audits may cover all or any of the obligations of the Contractor, including without limitation,

Verification of the system capacity and save for normal wear and tear during the O&M Period

Verification of the performance standards and useful life of the individual

assets of the Facility, save for normal wear and tear during the O&M Period

Verification of the capacity of the Facility to meet Output Standards during the residual life of the Facility and save for normal deterioration expected during such residual life

Sampling, testing and verification of the Output Standards for treated sewage, sewage losses

Facility Visits

At any time or at the end of each twelve month period, or at the initiative of the RSPCB, a visit shall be organized so that both parties can check the condition of the installations at the facility.

A report shall be drawn up to record the opinions of the both parties. The RSPCB reserves the right to call the equipment manufacturers or specialized technicians for these visits. All expenses are to be borne by the Contractor for the purpose.

Maintenance Schedules

The Contractor shall prepare and follow a Maintenance plan, detailing the maintenance activities scheduled for each of the component of the STP on a periodic approved by Design-Build- Operations Engineer and / or the Employer.

Every part of the works and all the materials to be used therein shall be subjected to such tests from time to time during the execution of the work as the Employer may direct and the whole of such tests shall in all cases bemade at the Contractor‘s sole expense.

The work shall be carried on and completed under the exclusive control direction and supervision and to the satisfaction of the Employer. The Employer shall likewise have full power to reject or condemn any work or material that he may deem unsuitable. In case of any work or material being rejected by the Employer's Representative, the Contractor shall immediately remove and replace the same to the satisfaction of the Employer or the Employer shall have full powers to get the same removed and replaced and deduct the expenditure incurred in the process from any amount due or that may become due to the Contractor.

The Contractor shall use only the original and genuine spares of the original equipment as per recommendations given in the maintenance booklet of the manufactures/as per directions of the Employer. Adequate stock of such spares is to be maintained by the Contractor. Test certificate of manufacturer is required for bearings along with supplies. Test certificate of all major equipment will be

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submitted from the manufacturer.

The Contractor shall also be responsible to maintain cleanliness in around the plant including machineries, disposal of floating removed from the Bar Screens/reactors, etc. Grit and other unwanted material.

If any material brought to the site of works, be in the judgment of the Employer's Representative, found inferior or improper & not as per described standards, the said materials or workmanship shall where required by the Employer shall be removed or amended by the Contractor forthwith or within such period for every breach by the Contractor in this clause.

All leakages should be attended promptly to avoid any nuisance etc. Chokages should be removed at once. All the valves/gates which are not used regularly should be operated at least once a week and make sure that they areproperly lubricated /greased.

All safety valves should be checked daily and ensure that they are working properly. In case of any fault the same should be attended immediately withoutany wait. The maintenance of the plant shall be as per maintenance manuals of the manufacturer for all equipment. Contractor shall keep all the safety devices in working order.

All the steel structures and machines installed in open areas should be paintedafter every monsoon period after cleaning the surface as per the instructions of the Employer's Representative. Entire plant including all civil structures, mechanical equipment, HT panel and Transformers etc. shall be repainted after every 2(1/2) years as per original painting specifications.

All safety valves should be checked daily and ensure that they are working properly. In case of any fault the same should be attended immediately withoutany wait. The maintenance of the plant shall be as per maintenance manuals of the manufacturer for all equipment. Contractor shall keep all the safety devices in working order.

The Contractor should make sure that no unwanted material should float/grow in and around different units. In case it is found the same shall be removed/cleaned immediately. He shall also be responsible for cleaning/sweeping the plant buildings inside and outside, roads, foot path etc.

Launders/Weirs etc. of reactors etc. to be maintained clean round the clock. During preventive/ breakdown maintenance, the Contractor has to visit the unit/units as and when needed. The pumping units or other machineries required if any shall have to be arranged by the Contractor at his own costs for completing the work. In case of battery operated auto system panels and also system alarm etc.,

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batteries are required to be maintained and replaced as and when needed by the Contractor.

Consumables such as POL (petrol/Diesel Oil & Lubricants) etc. has to be arranged by the Contractor as and when needed as per manufactures recommendations for periodical maintenance of entire Network. The Employer shall not provide such items.

In case of major repair due to normal wear and tear/break down, the Contractor should bring the same to the notice of the Employer immediately and necessary measures for its repair should be taken simultaneously. Breakdown, all repairs of any kind are to be attended by the Contractor. Any unit/equipment being irreparable in the opinion of the Employer will be replaced by the Contractor at no cost to Employer.

The Contractor shall give his telephone no., contact addresses, etc. to the Employer as well as shift duty shift to contact him during emergency/odd hoursetc.

The Contractor shall be responsible to carry day to day as well as periodic maintenance, necessary to ensure smooth and efficient performance/running of all equipment instruments installed at the STP. He shall be responsible for maintenance/replacement of street light poles and light etc. also. All the plant, building land, Sewage treated/untreated/sludge, etc. shall remain the property of Employer.

Oil & Grease Schedule: Routine & preventive maintenance of electrical/Mechanical/ hydraulic/ machines & equipments is to be carried out as per the operation & maintenance manual. Minimum oil & grease requirement for one year Operation & maintenance of the Plant to be procured by the Contractor well in advance

Routine, Preventive, Minor & Major maintenance of all Civil,

Electrical,Mechanical, hydraulic machines & Equipment of the plant

The Contractor should prepare schedule of daily maintenance & preventive maintenance of all the equipment & machineries operated & run by him in the premises of the plant. The schedule should be as per the guidelines mentioned in the tender & as per the O& M manual. The scope covers Routine, Preventive, Minor & Major maintenance of all major minor equipment and machines in the Plant like Submersible pumps, Coarse &Fine screens Grit Removal Mechanism, Channel gates, Decanters, Sludge pumps, Centrifuge feed pumps, Centrifuges, All dosing systems including Chlorine Dosing equipment, etc.

The scope also covers Routine, Preventive, Minor & Major maintenance of all the instrumentation system installed like PLC, Actuators, Flow meters level indicators etc. The Contractor should also carry out Routine, Preventive, Minor& Major maintenance of all major minor electrical equipment like Electrical Panels, Switch Gears, Power Cables, Control cables, Changeover switches DG set etc. so as to ensure uninterrupted round the clock operation of the Plant.

The Contractor should maintain all civil structures including Administrative building, Store room, Storm Drains, fencing etc. in a neat manner. He should maintain all civil structures of the plant sturdy to complete the natural/Designed lifetime.

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The Contractor should carry out the safety audit of the plant & necessary certificate from the competent authorities. This item includes all types of Routine, Preventive, Minor & Major maintenance of all Civil, Electrical, Mechanical, hydraulic machines & equipment of the plant covering supply erection test & trial run of the part/machine to be repaired/ replaced with material &labor expenses, necessary hardware's, sundry materials, lubricant oils, power oils, grease other materials plus machining charges etc.

The Contractor should procure all the spares required for all types of maintenances in advance. The part/equipment/machine to be repaired/replaced should be as per the Employer approved list & as per the O& M manual or as per the existing manufacturer's brand.

The Contractor, after first notifying the UPCB shall be responsible for fulfilling all requirements associated with any release of any substance into the environment (form the facility or the site) as required by Applicable law or by any Legal Entitlement including but not limit to the notification or reporting of releases /

Hazardous substances or Hazardous Waste. The Contractor shall prepare a memorandum evidence such notification or reporting and provide copies thereof to the Employer, along with any documents provided to the relevant regulatory agency regarding such release.

The Contractor shall process and obtain the clearance of all such agencies as required for the purpose, including all clearances during O&M period. He shall be fully responsible to comply with all requirements of Laws including hazardous substances, emission standards for air, discharge standards for effluent oil, sub-soil pollution. The contracting agency shall not release any hazardous/toxic materials inside the premises.

Site Order Book

Site order Book shall be kept by the Employer's Representative at the plant site. Orders entered in this Book by the Employer's Representative or his authorized representative shall be held to have been formally communicated to the Contractor. The Employer's Representative or his authorized representative shall sign each order as it is entered and will hand over the duplicate to the Contractor or his agent, who shall sign the original in acknowledgment of having received the order.

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Jaipur Development Authority Jaipur

Name of Work : **Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur".**

VOLUME - III

PRICE BID

Executive Engineer –(PHE-I)

Jaipur Development Authority

Jaipur

568

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Designation : Executive Engineer
Date: 2025.11.14 10:25:31 IST
Reason: Approved

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FORM OF PRICE PROPOSAL

To : The Executive Engineer (PHE-I),

Jaipur Development Authority

Jawahar Lal Nehru Marg,

Jaipur – 302015

(Rajasthan)

SUB: **Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur".**

We have examined the Conditions of Contract, Employer's Requirements, Addenda and the matters set out in the Schedules hereto. We have understood and checked these documents and have not found any errors in them. We accordingly offer to design, execute commission and to maintain for the Ten years the said works and remedy any defects, fit for purpose in conformity with these documents and the enclosed Proposal, for a lump sum total price as quoted in the price schedule or other such sums as may be determined in accordance with the terms and conditions of the Contract.:

We confirm our agreement with the appointment of Standing Committee for Settlement of Disputes as per General Condition of Contract.

We agree to abide by this Bid until 120 days and it shall remain binding upon us and maybe accepted at any time before that date. We acknowledge that the Appendix forms part of our Bid.

If our bid is accepted, we will provide the specified security deposit, commence the works as soon as reasonably possible after receiving the Employer's Representative's notice to commence, and complete the Works in accordance with the above-named documents within the time stated in the tender document.

570

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Unless and until a formal Agreement is prepared and executed, this Bid, together with your written, acceptance thereof, shall constitute a binding contract between us.

We understand that you are not bound to accept the lowest or any bid you may receive.

Signature of Contractor :		Executive Engineer (PHE-I)
Name	:	Jaipur Development Authority
Company's Seal :	Jaipur	
Date	:	Date :

PREAMBLE TO PRICE SCHEDULE

Price Schedule for Work

The Contract is of lump sum turnkey nature on single responsibility basis for conceptualization, design, supply, construction, commissioning, testing, 03 months trial run followed by O&M of 1year and operation and maintenance and repairs for ten years thereafter.

Bidder has to quote percentage rate for the construction, testing and 03 months trial run followed by O&M of 1year for the entire work as per the detailed scope of work and specifications and percentage rate price for operation and maintenance and repairs for ten years in the Form of Price Proposals. The major items envisaged in the contract are given in the scope of work and are also stipulated in the break up of schedule of prices. The rates quoted for construction phase and O&M must be logical as they can be negotiated individually.

The Bidder is to quote percentage rate price for the entire work including Operation & Maintenance for 10 years in the Form of Price Proposals. The indicative price breakup under major components is attached in Schedule 'A', 'B' & sub breakup in Schedule B-2 for intermediate payments. The successful bidder on Acceptance of LOA shall submit the price breakup as indicated in the schedules. However the appropriation of break-up of payment in schedule B-2 shall be as per JDA & shall be got approved from Executive Engineer (PHE-I), JDA, whose decision shall be final and binding to the contractor.

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Each item of Schedule B has been divided into broad components. The Employer's Representative shall assess the value of each component as indicated in paragraph 1.6 herein below.

Percentages shown in schedule B-1 are indicated against each component of each item of Civil Mechanical/Electrical/Instrumentation works specified in Schedule B, based on the Employer's best appreciation of the value of the component as related to the total costs of the concerned item as whole. A head titled (any other unforeseen work(s) / item(s)) is included in each breakdown of schedule B-2 and the bidder shall at the time of tendering indicate any additional items which he considers necessary but cannot be covered by any of the heads indicated in the breakup.

The percentage breakup as indicated in the Schedule may differ from that corresponding to the bidder's scheme and design and he should take this into account while quoting his lump sum prices for the items specified in Schedule-B-2

The contractor shall, after approval of his detailed hydraulic as well as structural designs and drawings, furnish to the Employer's Representative an initial bill of quantities to all major items, to be reviewed and updated periodically with the Employer's Representative. This bill of quantities will be used for assessment of percentage progress of the component at any stage. By measurement jointly taken by the Employer's Representative and the Contractor, mutually agreed and entered in the measurement books in the form and by the method approved by the Employer's Representative, and signed jointly by both the parties.

The payment of running bills & final bill will be regulated as per percentage shown in each item in Schedule B-3.

Items not specifically listed in this PRICE BREAKUP SCHEDULES but are required to be executed for satisfactory working/commissioning of the Plant as specified in scope of work, will not be separately paid for by the JDA when executed and shall be deemed to be covered by other items and rates listed in the price sheets and Lump sum prices quoted.

The Bidder is advised to examine all instructions, forms, terms, specifications and other information in the Tender documents and consider and evaluate fully the price implications therein contained before filling the Lump sum contract amount.

The Bidder should acquaint himself with the site conditions including the access to Work site. The successful Bidder shall have to make suitable access to work sites at his own cost.

The Bidder shall be deemed to have allowed in his price, provision for, designs, field investigations, site clearance, maintenance and final removal of all temporary works of whatsoever nature required for construction including temporary bunds, diverting water, pumping, dewatering, availability of material of required quality etc. for the proper execution of works. The rates shall also be deemed to include any works and setting out that may be required to be carried out for laying out of all the works involved.

It will be entirely at the discretion of JDA to accept or reject the Bidder proposals without giving any reasons whatsoever. The Bidder's must carefully go through the provisions laid down in the ITB regarding the deviations allowed, and the likely reasons, which may lead to the rejection of Tenders and / or forfeiture of the earnest money.

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The Bidder shall include in his Price Bid, Trade Tax, Income Tax, GST, any surcharge and all other Central Govt. and State Govt. Taxes and Duties as applicable. Any payment will not be reimbursed for any new Tax or any increase in Tax during execution of the Works.

Signature of Contractor :			Executive Engineer (PHE-I)
Name	:		Jaipur Development Authority
Company's Seal :		Jaipur	
Date	:		Date :

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Note :- Not to be filled at the time of bidding. These are indicative price breakups which may be adopted on award of Work Order to the successful bidder.

GRAND SUMMARY

Price Schedule - A

S. No.		Item		
I)	Construction Phase:			
	Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur.			
II)	Operation & Maintenance phase:			
	Operation and maintenance of the entire sewage treatment facilities (Excluding Electricity) at the site for 10 years after satisfactory commissioning and 03 months trial run & O&M of 1 year of entire system (STP) including plant acceptance.			

Signature of Contractor :

Name :

Company's Seal :

Date :

Executive Engineer(PHE-I)

Jaipur Development Authority

Jaipur (Rajasthan)

Date :

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GUIDE LINES FOR BREAK-UP B-1

JAIPUR DEVELOPMENT AUTHORITY

NAME OF WORK: **Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur.".**

The successful bidder on acceptance of LOA shall quote break-up of prices as Percentage of lump sum cost within the following range:

1	Civil Works	45%
2	Inter connecting piping works	7%
3	Mechanical works,	23%
4	Electrical works	10%
5	Instrumentation	5%
6	03 months Trial run, Testing & commissioning of entire plant & etc. complete	7.5%
7	After succecessfull completion of one year O&M	2.5%
	Total	100%

The non-compliance of above guide lines shall be treated as deviation from the schedule and the decision of JDA in such case shall be final and binding to the contractor.

I / We agree to abide by the above conditions fully.

Signature of Contractor: Executive Engineer (PHE-I)

Name : Jaipur Development Authority

Company's Seal : Jaipur

Date : Date:

575

Signature valid

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Designation: Executive Engineer
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PRICE SCHEDULE - B

SUMMARY OF SCHEDULE OF PRICE

(CONSTRUCTION PHASE)

S. No.	Item Description
1.	Civil Works
2.	Inter-connecting piping works
3.	Mechanical works,
4.	Electrical works
5.	Instrumentation works
6.	03 months Trial run, Testing & commissioning of entire plant etc. complete.
7.	After succecessfull completion of one year O&M

Signature of Contractor: Executive Engineer (PHE-I)

Name : Jaipur Development Authority

Company's Seal : Jaipur

Date : Date:

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PRICE SCHEDULE – B-2

(Excluding "Design" & "Trial Run, Testing & Commissioning of Entire Plant" Price)

Sub Break up of Price to facilitate interim (running) payments.

Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur.".

Sr. No.	Item Description
1	RAW SEWAGE TRANSFER SUMP & PUMP HOUSE
a.	Civil Works
b.	Piping Works
c.	Mechanical Works
d.	Electrical Works
e.	Instrumentation Works
2	INLET CHAMBERS
a.	Civil Works
b.	Piping Works
c.	Mechanical Works
d.	Electrical Works
e.	Instrumentation Works
3	SCREEN CHANNELS (FINE BAR SCREEN)
a.	Civil Works
b.	Piping Works
c.	Mechanical Works
d.	Electrical Works
e.	Instrumentation Works
4	GRIT CHAMBERS
a.	Civil Works

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Sr. No.	Item Description
b.	Piping Works
c.	Mechanical Works
d.	Electrical Works
e.	Instrumentation Works
5	SBR BASINS WITH DIFFUSED AERATION SYSTEM, DISTRIBUTION CHAMBER
a.	Civil Works
b.	Piping Works
c.	Mechanical Works
d.	Electrical Works
e.	Instrumentation Works
6	SBR AIR BLOWER/MCC & CONTROL ROOM/ADMI BUILDING
a.	Civil Works
b.	Piping Works
c.	Mechanical Works
d.	Electrical Works
e.	Instrumentation Works
7	CHLORINE CONTACT TANK
a.	Civil Works
b.	Piping Works
c.	Mechanical Works
d.	Electrical Works
e.	Instrumentation Works
8	CHLORINATION ROOM
a.	Civil Works
b.	Piping Works
c.	Mechanical Works

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Sr. No.	Item Description
d.	Electrical Works
e.	Instrumentation Works
9	TREATED WATER TANK & PUMP HOUSE
a.	Civil Works
b.	Piping Works
c.	Mechanical Works
d.	Electrical Works
e.	Instrumentation Works
10	OVERHEAD TANK
a.	Civil Works
b.	Piping Works
c.	Mechanical Works
d.	Electrical Works
e.	Instrumentation Works
11	COTDM FEED SLUDGE SUMP & PUMP HOUSE
a.	Civil Works
b.	Piping Works
c.	Mechanical Works
d.	Electrical Works
e.	Instrumentation Works
12	MECHANICAL SLUDGE DEWATERING (COTDM) BUILDING ALONG WITH POLYELECTROLYTE DOSING SYSTEM
a.	Civil Works
b.	Piping Works
c.	Mechanical Works
d.	Electrical Works

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Sr. No.	Item Description
e.	Instrumentation Works
13	D. G. PLATFORM
a.	Civil Works
b.	Piping Works
c.	Mechanical Works
d.	Electrical Works
e.	Instrumentation Works
14	SUB STATION / PCC ROOM/TRANSFORMER YARD
a.	Civil Works
b.	Mechanical Works
c.	Electrical Works (including HT/LT Panels)
d.	Instrumentation Works
15	SECURITY ROOM
a.	Civil Works
b.	Electrical Works
16	REST ROOM FOR CONTRACTORS USE
a.	Civil Works
b.	Electrical Works
17	PATHWAYS
a.	Civil Works
b.	Electrical works
18	ROADS& STREET LIGHTING
a.	Civil Works
b.	Electrical works
19	COMPOUND WALL WITH GATES
a.	Civil Works

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Sr. No.	Item Description
20	SITE GRADING, LAND SCAPING, GARDENING ETC.
a.	Civil Works
21	WATER SUPPLY (SERVICE / DRINKING / ETC.) / SITE DRAINAGE
a.	Civil Works
b.	Piping Works
c.	Electrical Works
22	ANY OTHER UNFORSEEN WORKS
a.	Civil Works
b.	Piping Works
c.	Mechanical Works
d.	Electrical Works
e.	Instrumentation Works

Signature of Contractor: Executive Engineer (PHE-I)

Name : Jaipur Development Authority

Company's Seal : Jaipur

Date : Date:

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SCHEDULE B-3

B-3 (1) MILE STONE PAYMENT BREAK-UP FOR CIVIL WORKS

Sr. No.	Item Description	Percentage Mile Stone Payment
1	RAW SEWAGE TRANSFER SUMP & PUMP HOUSE	
a.	On completion of Excavation	5%
b.	On completion of PCC	5%
c.	On completion of Bottom Raft.	20%
d.	On completion of 50% Side Walls	20%
e.	On completion of 100% Side Walls	20%
f.	On completion of Column/Beam up to Roof Slab	5%
g.	On completion of Roof Slab	5%
h.	On completion of Misc./Finishing Items	10%
i.	On completion of Hydraulic Test	5%
j.	On testing, commissioning and trial runs	5%
2	INLET CHAMBERS	
a.	On completion of Excavation	5%
b.	On completion of PCC	5%
c.	On completion of Columns	10%
d.	On completion of Slab	20%
e.	On completion of 50% Side Walls	20%
f.	On completion of 100% Side Walls	20%
g.	On completion of Finishing Items	10%
h.	On completion of Hydraulic Test	5%

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Sr. No.	Item Description	Percentage Mile Stone Payment
i.	On testing, commissioning and trial runs	5%
3	SCREEN CHANNELS (FINE BAR SCREEN)	
a.	On completion of Excavation	5%
b.	On completion of PCC	5%
c.	On completion of Columns	10%
d.	On completion of Slab	20%
e.	On completion of 50% Side Walls	20%
f.	On completion of 100% Side Walls	20%
g.	On completion of Finishing Items	10%
h.	On completion of Hydraulic Test	5%
i.	On testing, commissioning and trial runs	5%
4	GRIT CHAMBERS	
a.	On completion of Excavation	5%
b.	On completion of PCC	5%
c.	On completion of Columns	10%
d.	On completion of Slab	20%
e.	On completion of 50% Side Walls	20%
f.	On completion of 100% Side Walls	20%
g.	On completion of Finishing Items	10%
h.	On completion of Hydraulic Test	5%
i.	On testing, commissioning and trial runs	5%
5	SBR BASINS WITH DIFFUSED AERATION SYSTEM, DISTRIBUTION CHAMBER	
a.	On completion of Excavation	5%

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Sr. No.	Item Description	Percentage Mile Stone Payment
b.	On completion of PCC	5%
c.	On completion of Bottom Raft.	25%
d.	On completion of 25% Side Walls	10%
e.	On completion of 50% Side Walls	10%
f.	On completion of 75% Side Walls	10%
g.	On completion of 100% Side Walls	10%
h.	On Completion of Walkway	5%
i.	On Completion of Distribution Chamber	5%
j.	On completion of Misc./Finishing Items	5%
k.	On completion of Hydraulic Test	5%
l.	On testing, commissioning and trial runs	5%
6	SBR AIR BLOWER/MCC & CONTROL ROOM/ADMI BUILDING	
a.	On completion of Excavation	5%
b.	On completion of Columns up to G.L.	5%
c.	On completion of PCC	5%
d.	On completion of foundations/Bottom Raft.	10%
e.	On completion of Column/Beam up to Ist floor Roof Slab	10%
f.	On completion of Ist floor Roof Slab	10%
g.	On completion of Column/Beam up to IInd floor Roof Slab	10%
h.	On completion of IInd floor Roof Slab	10%
i.	On completion of Masonary in super Structure Ist floor	10%
j.	On completion of Masonary in super Structure IInd floor	10%
k.	On completion of Misc./Finishing Items	10%
l.	On testing, commissioning and trial runs	5%

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Sr. No.	Item Description	Percentage Mile Stone Payment
7	CHLORINE CONTACT TANK	
a.	On completion of Excavation	5%
b.	On completion of PCC	5%
c.	On completion of Bottom Raft.	20%
d.	On completion of 50% Side Walls	20%
e.	On completion of 100% Side Walls	20%
f.	On Completion of Baffle Wall	10%
g.	On completion of Misc./Finishing Items	10%
h.	On completion of Hydraulic Test	5%
i.	On testing, commissioning and trial runs	5%
8	CHLORINATION ROOM	
a.	On completion of Excavation	5%
b.	On completion of Column up to G.L.	10%
c.	On completion of PCC	5%
d.	On completion of Bottom Raft.	15%
e.	On completion of Column/Beam up to Roof Slab	15%
f.	On completion of Roof Slab	15%
g.	On completion of Masonary in super Structure	15%
h.	On completion of Misc./Finishing Items	15%
i.	On testing, commissioning and trial runs	5%
9	TREATED WATER TANK & PUMP HOUSE	
a.	On completion of Excavation	5%
b.	On completion of PCC	5%
c.	On completion of Bottom Raft.	15%

Signature valid
Digitally signed by Dilip Lamba
Designation : Executive Engineer
Date: 2025.11.14 16:25:31 IST
Reason: Approved

RajKaj Ref No.:
18852392
eSign 1.0

Sr. No.	Item Description	Percentage Mile Stone Payment
d.	On completion of 50% Side Walls	15%
e.	On completion of 100% Side Walls	15%
f.	On completion of Column/Beam up to Roof Slab	5%
g.	On completion of Roof Slab	10%
h.	On completion of Masonary in super Structure	10%
i.	On completion of Misc./Finishing Items	10%
j.	On completion of Hydraulic Test	5%
k.	On testing, commissioning and trial runs	5%
10	OVERHEAD TANK	
a.	On completion of Excavation	5%
b.	On completion of PCC	5%
c.	On completion of Bottom Raft.	20%
d.	On completion of 50% stagging with stairs	10%
e.	On completion of 100% stagging with stairs	10%
f.	On completion of Bottom Slab	10%
g.	On completion of Side Walls	10%
h.	On completion of Roof Slab	10%
i.	On completion of Misc./Finishing Items	10%
j.	On completion of Hydraulic Test	5%
k.	On testing, commissioning and trial runs	5%
11	COTDM FEED SLUDGE SUMP & PUMP HOUSE	
a.	On completion of Excavation	5%
b.	On completion of PCC	5%
c.	On completion of Bottom Raft.	15%

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Sr. No.	Item Description	Percentage Mile Stone Payment
d.	On completion of 50% Side Walls	15%
e.	On completion of 100% Side Walls	15%
f.	On completion of Column/Beam up to Roof Slab	5%
g.	On completion of Roof Slab	10%
h.	On completion of Masonry in super Structure	10%
i.	On completion of Misc./Finishing Items	10%
j.	On completion of Hydraulic Test	5%
k.	On testing, commissioning and trial runs	5%
12	MECHANICAL SLUDGE DEWATERING (COTDM) BUILDING ALONG WITH POLYELECTROLYTE DOSING SYSTEM	
a.	On completion of Excavation	5%
b.	On completion of Column up to G.L.	5%
c.	On completion of PCC	5%
d.	On completion of Bottom Raft.	15%
e.	On completion of Column/Beam up to First Floor Slab	10%
f.	On completion of First Floor Slab	10%
g.	On completion of Column/Beam up to Second Floor Slab	10%
h.	On completion of Second Floor Slab	10%
I.	On completion of Masonary in super Structure	15%
j.	On completion of Misc./Finishing Items	10%
k.	On testing, commissioning and trial runs	5%
13	D. G. PLATFORM	
a.	On completion of Excavation	10%
b.	On completion of Column up to G.L.	10%

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Sr. No.	Item Description	Percentage Mile Stone Payment
c.	On completion of PCC	20%
d.	On completion of Bottom Raft.	35%
e.	On completion of Misc./Finishing Items	20%
f.	On testing, commissioning and trial runs	5%
14	SUB STATION / PCC ROOM / TRANSFORMER YARD	
a.	On completion of Excavation	5%
b.	On completion of Column up to G.L.	10%
c.	On completion of PCC	5%
d.	On completion of Bottom Raft.	15%
e.	On completion of Column/Beam up to Roof Slab	15%
f.	On completion of Roof Slab	15%
g.	On completion of Masonary in super Structure	15%
h.	On completion of Misc./Finishing Items	15%
i.	On testing, commissioning and trial runs	5%
15	SECURITY ROOM	
a.	On completion of Excavation	5%
b.	On completion of Column up to G.L.	10%
c.	On completion of PCC	5%
d.	On completion of Bottom Raft.	15%
e.	On completion of Column/Beam up to Roof Slab	15%
f.	On completion of Roof Slab	15%
g.	On completion of Masonary in super Structure	15%
h.	On completion of Misc./Finishing Items	15%
i.	On testing, commissioning and trial runs	5%

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Sr. No.	Item Description	Percentage Mile Stone Payment
16	REST ROOMS FOR WORKERS	
a.	On completion of Excavation	5%
b.	On completion of Columns up to G.L.	5%
c.	On completion of PCC	5%
d.	On completion of foundations/Bottom Raft.	10%
e.	On completion of Column/Beam up to Ist floor Roof Slab	10%
f.	On completion of Ist floor Roof Slab	10%
g.	On completion of Column/Beam up to IInd floor Roof Slab	10%
h.	On completion of IInd floor Roof Slab	10%
i.	On completion of Masonary in super Structure Ist floor	10%
j.	On completion of Masonary in super Structure IInd floor	10%
k.	On completion of Misc./Finishing Items	10%
l.	On testing, commissioning and trial runs	5%
17	PATHWAYS	
a.	On completion of Pathways	95%
b.	On testing, commissioning and trial runs	5%
18	ROADS & STREET LIGHTING	
a.	On completion of 50% Roads	45%
b.	On completion of 100% Roads	50%
c.	On testing, commissioning and trial runs etc. complete	5%
19	COMPOUND WALL WITH GATES	
a.	On completion of excavation	5%
b.	On completion of 50% PCC	5%
c.	On completion of 100% PCC	5%

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Sr. No.	Item Description	Percentage Mile Stone Payment
d.	On completion of Foundation 50% Masonary	15%
e.	On completion of Foundation 100% Masonary	15%
f.	On completion of Super Structure 50% Masonary	15%
g.	On completion of Super Structure 100% Masonary	15%
h.	On completion of Fencing	15%
i.	On Completion of Gates	5%
j.	On testing, commissioning and trial runs	5%
20	SITE GRADING/LAND SCAPING & GARDENING ETC.	
a.	On completion of Work	95%
b.	On testing, commissioning and trial runs of all other works	5%
21	WATER SUPPLY (SERVICE / DRINKING / ETC.) / SITE DRAINAGE	
a.	On completion of Work	95%
b.	On testing, commissioning and trial runs	5%
22	ANY OTHER UNFORESEEN WORKS	
a.	On completion of Work	95%
b.	On testing, commissioning and trial runs of all other works	5%

Note: Interpolate payment stages-

Intermediate payment stages are also permitted. However, decision of JDA shall be final regarding payment stages.

Signature of Contractor : Executive Engineer (PHE-I)

Name : Jaipur Development Authority

Company's Seal : Jaipur

Date : Date :

Signature valid
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B-3 (2) Mile Stone Payment Breakup for Piping, Mechanical, Electrical & Instrumentation works along with spares as specified

S.No	Item Description	Percentage Mile Stone Payment
1.	On supply of equipment, pipes, specials, valves, accessories, instruments etc. including spares at site, after inspection, along with literature, drawings, operating pamphlets, manual etc. as required.	70%
2.	On erection of all equipment, pipes, specials, valves, instruments and necessary accessories including installation of mechanical / electrical / instrumentation system / equipment, cabling, etc. complete.	15%
3.	On testing of all equipment, pipes, specials, valves, instruments and necessary accessories	7.5%
4.	After Trial run & Commissioning of entire plant & 1 year of O&M.	7.5%
		100%

Signature of Contractor : Executive Engineer (PHE-I)

Name : Jaipur Development Authority

Company's Seal : Jaipur

Date : Date :

Signature valid
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JAIPUR DEVELOPMENT AUTHORITY, JAIPUR

www.jda.urban.rajasthan.gov.in

No. JDA/ E.E. & (TA to Dir. Engg.-I)/2022/D-194 Dated:- 6/9/2022

Office Order

In the standard bid document (Two bid system) of JDA, Clause 5: Rejection of Bids, subclause (iii) shall be replaced and read as under with immediate effect:-

S.N.	Provision as per standard Bid document	As per GoR orders F.8(15)Fin/SPFC/2020 dated 17.05.2022
1.	"If all the copies enclosed in support and affidavit is not duly attested by notary public/gazetted officer/Self (as per order No F 14(22)JDA/Estt./2014 Dated 01.01.2015) then bid of the bidder is to be rejected."	**The Bidder shall prepare bid in the digital/electronic mode for uploading on e-Procurement portal in the format/type of file specified in evaluation and Qualification criteria 'All the documents uploaded, should be digitally signed with the DSC of authorized signatory, deemed as all the pages of the uploaded documents are signed'.**

The following additional condition should be added in the standard Bid document (Two Bid system)

1. The Affidavits and Annexure 'B': be enclosed by the bidder regarding Qualification of RTPP Act-2012 & Rule-2013 along with Bid document, should be signed by the participating bidders before uploading the tender document otherwise the Bid of the bidder will be rejected.
2. In case of single Bid system Annexure 'B': be enclosed by the bidder regarding Qualification of RTPP Act-2012 & Rule-2013 along with Bid document, should be signed by the participating bidders before uploading the tender document otherwise the Bid of the bidder will be rejected.

This will be enforced with immediate effect.

Director Engineering-I
JDA, Jaipur

Copy to:-

1. Director (Engineering-I/II/III/IV), JDA, Jaipur.
2. Director (Finance), JDA, Jaipur.
3. C.F. JDA, Jaipur.
4. All Additional Chief Engineers, JDA, Jaipur.
5. All Superintending Engineers, JDA, Jaipur.
6. All Executive Engineers, JDA, Jaipur for include this in every bid instead of previous condition.
7. O.S.D. (RM)/A.D.R. , JDA, Jaipur.
8. Sr. Horticulture, JDA, Jaipur.
9. Sr. A.O., JDA, Jaipur.

Director Engineering-I
JDA, Jaipur

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Ram Kishor Vyas Bhawan, Indira Circle, Jawahar Lal Nehru Marg, Jaipur-302004
Direct Line- (+91-141-2563234) : EPABX - +91-141-2569696 Extn : (7203) : Fax - +91-141-2574555

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जयपुर विकास प्राधिकरण, जयपुर

www.jda.urban.rajasthan.gov.in

क्रमांक जविप्रा/निदे. (वित्त)/2022/डी–37 दिनांक 22-09-2022

कार्यालय आदेश

विषयः– जविप्रा में निविदाओं में BSR दरों से कम दर डालने पर अन्तर राशि जमा कराने बाबत्।

जयपुर विकास प्राधिकरण में आमंत्रित निविदाओं में अतिरिक्त परफोरमेन्स गारन्टी/सिक्योरिटी डिपॉजिट के संबंध में जविप्रा के आदेश क्रमांक जविप्रा/अधि. अभि./त.स. नि.अभि.–I /2021/डी–65 दिनांक 22.07.2021 तथा नगरीय विकास विभाग के आदेश प01 (24) नविवि/01/2020 लूज दिनांक 20.09.2021 को Withdraw करते हुए वित्त (GF&AR) विभाग की अधिसूचना नम्बर F2(1)FD/G&T(SPFC)/2017 दिनांक 22.10.2021 से RTPP Rule 75 "अ" के अनुसार लेने के प्रावधान को लागू किया जाता है।

निदेशक (वित्त)
जविप्रा, जयपुर

प्रतिलिपि निम्न को सूचनार्थ एवं आवश्यक कार्यवाही हेतु

1. निजी सचिव, प्रमुख शासन सचिव, नगरीय विकास विभाग, राजस्थान सरकार, जयपुर।
2. निजी सचिव, आयुक्त, जविप्रा, जयपुर।
3. सचिव, जविप्रा, जयपुर।
4. वन सरंक्षक, जविप्रा, जयपुर।
5. निदेशक (अभियांत्रिकी– I, II ,III IV), जविप्रा,जयपुर।
6. निदेशक (वित्त, विधि, नगर आयोजना), जविप्रा,जयपुर।
7. मुख्य नियन्त्रक (प्रवर्तन), जविप्रा जयपुर।
8. अतिरिक्त मुख्य अभियंता (अभियांत्रिकी प्रकोष्ठ– III, IV), जविप्रा,जयपुर
9. अतिरिक्त निदेशक (राजस्व एवं सम्पत्ति निस्तारण), जविप्रा, जयपुर।
10. समस्त अति. मुख्य अभियन्तागण/अधीक्षण अभियन्तागण, अधि. अभियन्तागण जविप्रा जयपुर।
11. समस्त व. लेखाधिकारी/लेखाधिकारी, जविप्रा, जयपुर।

निदेशक (वित्त)
जविप्रा, जयपुर

Signature valid
Digitally signed by Dilip Lamba
Designation: Executive Engineer
Date: 2025.11.14 10:25:31 IST
Reason: Approved

RajKaj Ref No.: 18852392
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सत्यमेव जयते

राजस्थान राजपत्र
विशेषांक

RAJASTHAN GAZETTE
Extraordinary

साधिकार प्रकाशित

Published by Authority

आश्विन 30, शुक्रवार, शाके 1943-अक्टूबर 22, 2021
Asvina 30, Friday , Saka 1943- October 22, 2021

भाग 4 (ग)

उप-खण्ड (I)

राज्य सरकार तथा अन्य राज्य-प्राधिकारियों द्वारा जारी किये गये (सामान्य आदेशों, उप-विधियों आदि को सम्मिलित करते हुए) सामान्य कानूनी नियम।

FINANCE (G&T) DEPARTMENT

NOTIFICATION

Jaipur, October 22, 2021

G.S.R.364 .-In exercise of the powers conferred by section 55 of the Rajasthan Transparency in Public Procurement Act, 2012 (Act No. 21 of 2012), the State Government hereby makes the following rules further to amend the Rajasthan Transparency in Public Procurement Rules, 2013, namely:-

1. Short title and commencement.- (1) These rules may be called the Rajasthan Transparency in Public Procurement (Fourth Amendment) Rules, 2021.

(2) They shall come into force from the date of their publication in the Official Gazette.

2. Insertion of new rule 75A.- After the existing rule 75 and before the existing rule 76 of the Rajasthan Transparency in Public Procurement Rules, 2013, the following new rule 75A shall be inserted, namely:-

"**75A. Additional Performance Security.**- (1) In addition to Performance Security as specified in rule 75, an Additional Performance Security shall also be taken from the successful bidder in case of unbalanced bid. The Additional Performance Security shall be equal to fifty percent of Unbalanced Bid Amount. The Additional Performance Security shall be deposited in lump sum by the successful bidder before execution of Agreement. The Additional Performance Security shall be deposited through e-Grass, Demand Draft, Banker's Cheque, Government Securities or Bank Guarantee.

Explanation : For the purpose of this rule,-

(i) Unbalanced Bid means any bid below more than fifteen percent of Estimated Bid Value.

(ii) Estimated Bid Value means value of subject matter of procurement mention in bidding documents by the Procuring Entity.

(iii) Unbalanced Bid Amount means positive difference of eighty five percent of Estimated Bid Value minus Bid Amount Quoted by the bidder.

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(2) The Additional Performance Security shall be refunded to the contractor after satisfactory completion of the entire work. The Additional Performance Security shall be forfeited by the Procuring Entity when work is not completed within stipulated period by the contractor. Provision for 'Unbalanced Bid' and 'Additional Performance Security' shall be mentioned in the Bidding Documents by the Procuring Entity."

[No. F.2(1)FD/G&T(SPFC)/2017]
By Order of the Governor,

Vimal Kumar Gupta,
Joint Secretary to the Government.

राज्य केन्द्रीय मुद्रणालय,जयपुर।

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Price Schedule

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Jaipur Development Authority, Jaipur

Estimate

Name of Work :- Engineering, Procuring, Construction & Commissioning (EPC) and Performance run followed by O&M of Sewerage Treatment Plant of 40 MLD capacity based on Sequential Batch Reactor SBR Technology near Chandlai Lake for Bambala area, Sanganer Sewerage work under EE (PHE-I), JDA, Jaipur.

Sr. No.	Particular	Unit	Qty.	Rate	Amount
1	Engineering, Procuring, Construction & Commissioning (EPC) and Performance of 40.00 MLD Sewage Treatment Plant based on (SBR Process), Pumping main including all Civil, Electrical, Mechanical, Pumping and other allied works including 3 months trial run & 1 year O&M near Chandlai Lake for Bambala area, Sanganer, Jaipur	Lumpsum	1.00	773300000.00	77,33,00,000.00
2	Operation and maintenance of the entire sewage treatment facilities (Excluding Electricity) at the site for 10 years after satisfactory commissioning and trial run and O&M of entire system (STP) including plant acceptance. **Note : O&M cost should not be less than 10% of quoted construction cost (To be quoted by bidder).**	Lumpsum	1.00	123814000.00	12,38,14,000.00
				Total Amount Rs	**897114000.00**

Executive Engineer (PHE-I)
JDA, Jaipur

I/We Quote as …….. % Above/ Below the schedule " G "

(In Words……..……..)'

Signature of Contractor

Signature valid
Digitally signed by Dilip Lamba
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RajKaj Ref No.: 18852392
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With full Address & Mobile No.

RajKaj Ref No.:
18852392

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