



**State Bank of India
PREMISES & ESTATE DEPARTMENT,
2nd FLOOR, LOCAL HEAD OFFICE, PLOT NO-53A, SBI TOWER,
Gift City, Gandhinagar - 382355
Notice Inviting Tender
Comprising Technical Bid (TB) & Online Price Bid (PB)**

Tender ID - SBI/GNR/25-26/03

For the Composite Construction works of Civil, Plumbing, Sanitary, Electrical, Firefighting, HVAC, SECURITY EQUIPEMENTS, LIFTS, IBMS, Landscaping, and Allied Services, etc.

For the work of:

“Construction of Residential Twin Towers at Block No 41, Gift City, Gandhinagar, Gujarat”

Architect

VK:a architecture,

5th Floor, Next Gen Avenue S.No 103(p), CTS no 2850, Off, Senapati Bapat Rd, near ICC Trade Tower, Bahiratwadi, Pune, Maharashtra 411016

Tender Submitted By:

Name of Vendor : _____

Address of Vendor: _____

GSTN No. of Vendor: _____

Date : _____

The Assistant General Manager (Premises & Estate),
State Bank of India
Premises & Estate Dept.,
Local Head Office, SBI Tower, 2nd Floor, Block No. 53-A,
Gift City, Gandhinagar – 382355, Gujarat

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1.0 General Information

1. Single Stage **Two Envelope System (1S2E)** Notice Inviting Tender Comprising of Technical Bid (TB) & Price Bid (PB) are invited as **Item Rate e- Tender** by VK: a architecture for and on behalf of SBI for the *Construction works of Civil, Plumbing, Sanitary, Electrical, Firefighting, HVAC, SECURITY EQUIPMENT ,LIFTS, IBMS, Landscaping, and Allied Services, etc.* for the Proposed Construction of Residential Twin Towers at **Block No 41, Gift City, Gandhinagar, Gujarat”**

2. The Tender Document Comprises of;
 - i) Volume-I: Technical Bid & Drawings (TB)
 - iii) Volume-II: Price Bid (PB)

2.0 NOTICE INVITING TENDER

Item Rate e- Tender comprising of Technical Bid & Price Bid are invited by M/S VK: a architecture for and on behalf of SBI for the *Construction works of Civil, Plumbing, Sanitary, Electrical, Firefighting, HVAC, SECURITY EQUIPMENT, LIFTS, IBMS, Landscaping, and Allied Services, etc.* for the Proposed Construction of Residential Twin Towers at **Block No 41, Gift City, Gandhinagar, Gujarat”**

Documents to be submitted as per Clause No. 7.2.1 of Technical Bid **of Instructions to Bidders.**

The details of Tender are as under:

1	Name of work	Composite Construction works of Civil, Plumbing, Sanitary, Electrical, Firefighting, HVAC, SECURITY EQUIPMENTS, LIFTS, IBMS, Landscaping, and Allied Services, etc. Proposed Construction of Residential Twin Towers at Block No 41 A & B, Gift City, Gandhinagar.
2	Estimate cost of work	₹. 2,53,32,55,034.00 (Rupees Two Fifty-Three Crores Thirty-Two Lakhs Fifty-Five Thousand Thirty-Four Only.) Plus, GST
3	Time allowed for Completion of Work	42 months including monsoon & Holidays period from the date of work order + 15 Days (Mobilisation period) or handing over of site to the Contractor, whichever is earlier.
4	Earnest Money Deposit	<p>₹. 2,53,33,000.00 (Rupees Two Crore Fifty-Three Lakhs Thirty-Three Thousand Only) in the form of Demand Draft or Banker's Cheque drawn in favor of State Bank of India Payable at Gift City, Gandhinagar of any scheduled bank in India. (Valid for a period of 90 Days from the date of Opening of Price Bid)</p> <p>EMD to be deposited on or before the last date and time of submission of the technical bid.</p> <p>Note: It is sole responsibility of the bidder to ensure submission of their EMD Physically by stipulated date and time as specified failing which they will not be allowed to participate in E-Tendering. The proof of the same is to be uploaded</p>

		www.tenderwizard.in
5	Security Deposit (SD) –	As per Part B-Point 10.5 &10.6 of Information and Instruction to Bidders of Technical Bid
6	Date of availability of Tender Documents on website	From 22.12 .2025 to 28.01.2026 till 5 PM Available at M/S. Antares System Ltd, Bengaluru, our Service Provider's portal, https://www.tenderwizard.com/SBIETENDER & www.sbi.co.in/web/sbi-in-the-news/procurement-news
7	Cost of Tender Documents	NIL
8	Pre – Bid Meeting (Date, time & Place of Meeting)	On 12.01.2026 at 02:00 PM at the following address: The Assistant General Manager. Premises & Estate Dept., Local Head Office, SBI Tower, 2 nd Floor, Block No. 53 A, GIFT City Gandhinagar- 382355, Gujarat
9	Last date & time for submission of e-Tender & hard Copy of Tender Document	Up to 5.00 PM on 28.01.2026 Note: It is sole responsibility of the bidder to ensure submission of their EMD Physically by stipulated date and time, failing which they will disqualify to participate in E-Tendering. The proof of the same is to be uploaded at www.tenderwizard.in ,
10	Place, Time & Address for submission of original integrity pact with EMD	up to 5.00 PM on 28.01.2026 The Assistant General Manager. Premises & Estate Dept., Local Head Office, SBI Tower, 2 nd Floor, Block No. 53-A, GIFT City, Gandhinagar – 382355, Gujarat
11	Date and opening time of Online Technical Bid along with hard copy.	12.30 PM on 29.01.2026
12	Date and time of opening of Online Price Bid	Will be communicated through email separately to the technically qualified bidders as of Information & Instructions to Bidders.
13	Price bid	Price bid to be submitted online only, no hard copy submission is allowed, Price bid will be opened of qualified Bidders only.
14	Defects Liability period	As per Clause No. 1.1.18 (a) of GCC.
15	Liquidated Damages	As per Clause No 8 of GCC. -
16	Validity period of the Tender:-	As per Point 9.5 of Part A- of Information and Instruction to Bidders. –

17	Value of Interim Certificate	Minimum 4.0 Crore for first 3 RA Bill and Rs. 7.0 Crore, 4th RA Bill onward and Not More than One Bill Per Month. No advances on materials / plant / machinery or mobilization advance shall be paid under any circumstances.
18	Eligible Taxes	<p>A) Income Tax will be deducted at source as per Govt. Guidelines.</p> <p>B) Payment of GST will be Done as applicable. The contractor should comply with the following. Contractor should have GST Registration Number.</p> <p>Invoice should specifically/separately disclose the amount of GST levied at applicable rate as per GST provisions/Rules.</p> <p>Contractor should timely file his GST return in accordance with GST provisions to enable the bank to claim the credit of GST paid to the contractor.</p>
19	Submission of Online Technical Bid, Integrity pact & Hard Copies.	<p>1) Contractors shall download the entire Technical Bid to get acquainted with the terms and conditions and shall upload compulsorily the technical bid without fail in the e-tendering portal after putting the digital signature of their authorized signatory on submitted documents/ bid. (Participating through e-tender portal they must have class III digital certificate.)</p> <p>2) Failing to upload as stated above, the tender will be rejected.</p> <p>The Bidder shall enclose the original copy of the duly executed Pre-Contract Integrity Pact and the required EMD, along with Technical Bid in a spirally bound and securely compiled document arranged in serial order, as uploaded online, containing all pages duly signed by the authorized signatory with the company seal. The same shall be sealed in an envelope clearly marked "Technical Bid," which shall also bear the name of the Tender Document and the name and address of the Bidder, and shall be submitted at the address and within the time specified in Sr. No. 10 of the NIT, failing which the Bid will be treated as non-responsive.</p>

20	Agency for arranging e-tender/online bidding, contact numbers:	You are requested to contact the agency for further guidance for e-tendering.
a	Bidder Support:	M/S. Antares System Ltd, Bangalore Contact Person: Mr. Kushal Bose Mobile No: 96747-58719
b	Bidder Support	9708966660/9044314492/9073677150/9073677151/9073677152/ 033-46046611
c	Email Address	helpdesk857@etenderwizard.com
d	Website Address	https://www.tenderwizard.com/SBIETENDER
e	Address	137/3, 'Honganasu' Kengari, Bangalore – 560060. You are requested to contact the agency for further guidance on E- tendering.
21	Any additional Information	The quoted rate should be inclusive of materials, labour, wages, fixtures, transportation, installation, wastage, Octroi, levies, all cess, royalties, all taxes (but excluding GST), machinery, temporary works such as scaffolding, cleaning, overheads, profit, statutory expenses, incidental charges and all related expenses to complete the work. In addition to the above contractors should also consider all preambles mentioned in Tender BOQ and prevailing norms of GIFT City while quoting Tender Item rates. GST shall be as applicable on actual.
22	Additional Performance Deposit (ASD) /Additional Performance Guarantee (APG)	<p>Additional Security deposit (ASD)/Additional performance Guarantee (APG) shall be applicable if the bid price is below 10% of the estimated cost put to tender.</p> <p>The amount of such ASD/ APG shall be the difference between 90% of estimated cost put to tender and the quoted price. ASD in the format of DD / Banker's Cheque / Bank Guarantee shall be submitted within 15 days of intimation of award of work / work order, without which the contractor will not be allowed to start the work and failure of submission of ASD will result in forfeiture of EMD and cancellation of tender.</p> <p>Additional security deposit Will be refunded or Bank Guarantee to be released to the contractor without any interest within 30 days after issue of Virtual Completion certificate by the APMCF.</p>

23. The contractor has to provide their E-mail id, contact nos. and postal address in the bid documents. Henceforth, all official communication from the Bank shall be through E-mail. The SBI reserves the right to cancel or postpone or modify the Tender at any stage without assigning any reason.

24. The digitally signed technical bid document, by authorized signatory of contractor, has to be uploaded on specified web portal of M/s Antares Systems Ltd through Website <https://www.tenderwizard.com/SBIETENDER>. It shall be the responsibility of the contractor to arrange and ensure that all pages of Tender Document digitally signed & uploaded.

25. No conditions other than mentioned in the Tender will be considered, and if given bid will be summarily rejected. There should not be any deviation or assumption in terms and conditions as stipulated in the Tender Documents. Prior to the detailed evaluation, the Bank will determine the responsiveness of each Bid to the Tender Document. For purposes of these clauses, a responsive Bid is one which conforms to all the terms and conditions of the Tender Document in toto, without any deviation or assumption.

26. The SBI reserve their rights to accept or reject any or all the Bids/Tenders either in whole or in part without assigning any reason for doing so and any claim / correspondence shall be entertained in this regard.

27. Participants who are presently involved in, or have a past record of, any dispute or adverse legal claim against the Bank, including ongoing litigation, arbitration, or any matter which has the potential to culminate into an adverse legal claim against the Bank in future, shall be ineligible for participation in this tender. The Bank reserves its absolute, unrestricted, and final right to determine and decide on the disqualification of any participant under this clause, and such decision shall be binding on the participant without any obligation on the Bank to assign reasons therefor.

28. In case the date of opening of tenders is declared as a holiday, the Tender will be opened on the next working day at the same time.

29. Tenders received without EMD and Integrity pact shall be summarily rejected, and such tenders shall not be allowed for evaluation and will be considered disqualified.

30. Bidders are also required to submit latest CIBIL Score of their Company and all Directors, Promoters, Partners as applicable, which must not be older than one (1) month. Preference may be given to entities with higher CIBIL Scores.

31. For any clarifications regarding E-Tendering procedure, System requirements etc. please contact M/S. Antares System Limited, Bangalore, whose address is mentioned in the NIT.

Yours Faithfully,

Division Leader
APMCF, VK:a Architecture, Pune.

2.1 Pre – Requisite for e - Tendering

All documents related to the Tender are available on the e-tendering portal sbi.co.in/web/sbi-in-the-news/procurement-news/www.tenderwizard.in. Contractors must note that this, being E-tender, Bids received online on E-tendering portal shall be considered. In addition to it, hard copies of Technical bid along with all relevant documents are to be submitted, duly spirally bound securely and in serial order as uploaded containing all pages duly signed by authorized signatory with company seal and date to this Office on or before due date & time. To participate, Contractor(s) is/are advised to register with following steps:

Step 1: Contractor's Registration

- Go to website: sbi.co.in/web/sbi-in-the-news/procurement-news/www.tenderwizard.in.
- Click on “Register for e-Tender” button.
- Create your desired User ID and fill in Company Details.
Vendor in possession of DSC Class III may insert Digital Signature Certificate token in computer's USB drive, and click on “Update Digital Signing Certificate Serial No. From USB token”. A new PKI based “Signer Certificate” window will open. Browse your Signer Certificate, enter token password and click on Register.
- For those without DSC, it is advised to apply for the DSC.
- Do not enter special character(s) in any field except “Email Address”, “Website (URL)” and “Alternative Email Address”.
- Then click on “Create profile”.
- You will be forwarded to “Document Upload” screen. Upload documents as specified in previous page. After uploading is completed, click on “Finish Upload”.
- The User ID and system generated password with payment confirmation
- will appear on the next screen which can be printed for future reference.
- Check registered email ID. Click in the link “Click to verify” to validate the email ID.
- To enable the User ID, forward the registration acknowledgment copy to help desk from registered email ID.

Step 2: Digital signature (known as “Digital Signature Certificate”)

- Applying Class III Digital Signature Certificate: (token issued upon registration)
- It is mandatory for all the Contractors to have class-III Digital Signature Certificate (DSC) (in the name of person who will sign the Bid) from any of the licensed certifying agencies to participate in this Tender Document. DSC should be in the name of the authorized signatory. It should be in corporate capacity (that is in Contractor capacity).
- Contractor's manual & system requirement is available on website [www.tenderwizard.in / sbi.co.in/web/sbi-in-the-news/procurement-news](http://www.tenderwizard.in/sbi.co.in/web/sbi-in-the-news/procurement-news)
Contractors may contact e-tendering representative at (7666563870 / Landline- 080-4598 2100) for any assistance.

3.0 BRIEF PARTICULARS OF THE WORK

a. SBI proposes Construction of Residential Twin Towers comprising of (3 Common Basements + Ground + 25 Floors of A -Wing and 26 Floors of B -Wing), approximate **Construction area 51588.00 sq.mts. (Built up Area-22472.00 Sq mts.), at Block No 41, Gift City, Gandhinagar, Gujarat.** The Estimated cost of the project is inclusive of Foundation, Composite Construction works of Civil, Plumbing, Sanitary, Electrical, Firefighting, Security Equipment, IBMS, Landscaping, Stack Parking, Garbage Chute and Allied works, etc.

b. **Brief Scope of Work:** The scope of work comprises of composite construction works of civil, plumbing, sanitary, electrical, firefighting, HVAC, Security Equipment, IBMS, LIFTS, landscaping and including site development and other allied work for the "Proposed Construction of Residential Twin Towers (3 Common Basements + Ground + 25 Floors of A -Wing and 26 Floors of B -Wing), **at Block No 41, Gift City, Gandhinagar, Gujarat**

c. The proposed work must be completed in all respects on FAST TRACK. The **time allowed** for completion of the project is **42 months** including monsoon & **Holidays** period from the date of work order + 15 Days (Mobilisation period) or handing over of site to the Contractor, whichever is earlier. Both the towers work mandatorily to be carried out simultaneously.

SBI intends to pre-qualify and select competent Building Contractors having requisite qualifying experience and infrastructure and financial capability to undertake the work as specified in the pre-qualification documents for completion of the project in the prescribed scheduled time.

d. The salient features of the captioned project are as under: -

- (i) Total 173 flats are proposed to be constructed as per approved plans in 2 adjoining/Connected towers.
- (ii) Residential Twin Towers (3 Common Basements + Ground + 25 Floors of A - Wing and 26 Floors of B -Wing)
- (iii) All flats are proposed to be provided with vitrified tiles flooring and UPVC windows with provision of wire mesh shutter.
- (iv) Firefighting systems including sprinkle systems are proposed as per the fire norms of Gift City, in conjunction with Regional Fire Officer and NBC for high rise building.
- (v) Landscaping and site development work.
- (vi) HVAC System as per approval of Gift City Authority
- (vii) Provision of CCTV surveillance for common areas, staircase, lifts etc.
- (viii) Provisions of necessary cables for power back-up for lifts and common area in each tower through GIFT Co. Ltd.
- (ix) The buildings are proposed for IGBC Platinum rated certification
- (x) Garbage Chute
- (xi) Stack Car Parking

4.0 DECLARATION

(TO BE GIVEN BY THE BIDDER WHO HAVE DOWNLOADED THE TENDER
DOCUMENT FROM THE WEB ON THE COMPANY LETTERHEAD)

To,

The Assistant General Manager (Premises & Estate),

State Bank of India

Premises & Estate Dept.,

Local Head Office, SBI Tower, 2nd Floor, Block No. 53-A, GIFT City, Gandhinagar – 382355,
Gujarat

Sub: Submission of Expression of Interest (EOI) for Pre-qualification of Building Contractors for the *Construction works of Civil, Plumbing, Sanitary, Electrical, Firefighting, HVAC, SECURITY EQUIPMENT, LIFTS, IBMS, Landscaping, and Allied Services, etc.* for the Proposed Construction of Residential Twin Towers at *Block No 41, Gift City, Gandhinagar, Gujarat*”

Dear Sir,

It is to certify that:

1. I / We have submitted the Tender Document in the proforma as downloaded directly from the web site & there is no change in formatting, number of pages etc.
2. I / We have submitted Tender Document which are same / identical as available in the website.
3. I / We have checked that no page is missing and all pages as per the index and checklist are available & that all pages of Tender Document submitted by us are clear & legible.
4. I / We have signed (with stamp) all the pages of the Tender Document before submitting and uploading the same.
5. I / We have sealed the Tender Documents properly before submitting them.
6. I / We have read carefully & understood the instructions to the Bidders.
7. I / We have not made any modification / corrections / additions / deletions etc. in the Tender Documents downloaded from web by me / us. In case at any stage later, it is found there is difference in our downloaded Tender documents from the original and / or any documentation, SBI shall have the absolute right to disqualify / reject the application out- rightly and also debar me / us in participating in any future Tender / EOI without any prior intimation to me / us and EMD will be forfeited including Security Deposit.

In case of any wrong certification or information provided by undersigned, tender will be treated as canceled at any stage and EMD & ASD will be forfeited.

I hereby accept all terms and conditions of tender documents.

Place:

Date:

Sign & Stamp of Authorized Signatory/Bidder

5.0 ELIGIBILITY CRITERIA FOR PRE-QUALIFICATION:

The intending contractor should comply with the following minimum eligibility criteria for pre-qualification for the proposed project which is to be supported by all valid documentary proofs: -

5.1 ELIGIBILITY CRITERIA:

Only technically & financially sound companies / firms / PSU / Contractors / having required experience in construction of buildings meeting the following eligibility criteria shall be eligible to apply. Experience in minimum one Completed Composite project of RCC frame structure of specified magnitude which includes

(i) Civil and

(ii) MEPF works i.e., Plumbing, Electrical, Fire Fighting, HVAC, Security equipment, LIFTS, IBMS, and Allied Services (at least 4 or more services mandatorily including Plumbing, Electrical and Fire-fighting works) with Minimum 45 Meter Height from ground level and consisting of minimum 1 Basement in any one single contract works in Residential/ Office / Hospital / Institutional/ Hotel or commercial building projects in India.

The bidder should have executed similar project for Public Sector Banks/ Central Government / State Government / Central Autonomous body/ State Autonomous body/ Central Public Sector Undertaking/ State Public Sector Undertaking/ Public Limited (Listed) Companies in Indian Stock Exchanges or multinational Companies in reputed International Stock Exchanges.

Joint Ventures and Consortia are not permitted to participate in Bidding

5.1.1 The Building Constructed by the Contractor for their own use shall not be considered for eligibility criteria.

5.1.2 Project completed by the above firms/ company exclusively for their sister concern, subsidiary, etc. too will be considered.

5.2 The Bidder shall be eligible to participate only if they have satisfactorily completed “similar works” only in India of the magnitude specified below and all such similar works must have been fully completed within the last seven (7) years, ending on the 30th Nov 2025.

A - “CONSTRUCTION OF MULTI-STORIED BUILDING”

i) Three similar completed Composite works Project executed for Rs. 101.33 crore (Excluding GST) including Civil work costing not less than Rs.76.17 crore (Excluding GST) under single contract covering all major civil work mentioned as per clause no 5.3.4 (i) under single contract covering all major works from

each trade mentioned above.

OR

ii) Two similar completed Composite works Project executed for Rs.126.66 crore (Excluding GST) including Civil work costing not less than Rs.95.21 crore (Excluding GST) under single contract covering all major civil works mentioned as per clause no 5.3.4 (i). (Excluding GST) under single contract covering all major works from each trade mentioned above.

OR

iii) One similar completed Composite works Project, executed for Rs.202.66 crore (Excluding GST) including Civil work costing not less than Rs.152.34 crore (Excluding GST) under single contract covering all major civil works mentioned as per clause no 5.3.4 (i) under single contract covering all major works from each trade mentioned above.

And

B- MEPF Works

i) Three similar completed MEPF Composite works Project executed for Rs. 25.15 crore (Excluding GST) under single contract covering all major works mentioned as per clause no 5.3.4 (ii)

OR

ii) Two similar completed MEPF Composite works Project executed for Rs.31.45 crore (Excluding GST) under single contract covering all major works mentioned as per clause no 5.3.4 (ii)

OR

iii) One similar completed MEPF Composite works Project executed for Rs.50.32 crore (Excluding GST) under single contract covering all major works mentioned as per clause no 5.3.4 (ii)

Notes: -

i) The MEPF work mentioned above can be a part of the same work mentioned in clause '5.2-A' above or any other single Contract MEPF work satisfying the criteria mentioned in clause '5.2-B'.

ii) The bidders shall possess a valid Class-A Electrical License. In case a tenderer does not hold such a license, the tenderer shall associate with an agency holding a valid Class-A Electrical License issued by the Chief Electrical Inspector (or his office) for undertaking electrical works in the State of Gujarat. The arrangement letter with such a contractor to be submitted along with the tender.

5.3 : DEFINITIONS OF SIMILAR WORKS

SIMILAR WORK SHALL MEAN

5.3.1 “CONSTRUCTION OF MULTI-STORIED BUILDING” any Single composite Work Completed Project experience in minimum one Completed Composite project of RCC frame structure which includes (i) Civil and (ii) MEPF works i.e., Plumbing, Electrical, Fire Fighting, HVAC, Security equipment, LIFTS, IBMS, and Allied Services (at least 4 or more services mandatorily including Plumbing, Electrical and Fire-fighting works) with Minimum 45 Meter Height from ground level and consisting of minimum 1 Basement in any one single contract works in in last 7 years ending on 30th Nov 2025 of Residential/ Office / Hospital / Institutional/ Hotel or commercial building projects in India. The bidder should have executed similar project for Public Sector Banks/ Central Government / State Government / Central Autonomous body/ State Autonomous body/ Central Public Sector Undertaking/ State Public Sector Undertaking/ Public Limited (Listed) Companies in Indian Stock Exchanges or multinational Companies in reputed International Stock Exchanges.

5.3.2. “MEPF Work” of any Single composite Work Completed Project: - “Construction /Installation of MEPF Works” experience in minimum one Completed Composite project of RCC frame structure which includes MEPF works i.e., Plumbing, Electrical, Fire Fighting, HVAC, Security equipment, LIFTS, IBMS, and Allied Services (at least 4 or more services mandatorily including Plumbing, Electrical and Fire-fighting works) with Minimum 45 Meter Height from ground level and consisting of minimum 1 Basement in any one single contract works in last 7 years ending on 30th Nov 2025 of Residential/ Office / Hospital / Institutional/ Hotel or commercial building projects in India. The bidder should have executed similar project for Public Sector Banks/ Central Government / State Government / Central Autonomous body/ State Autonomous body/ Central Public Sector Undertaking/ State Public Sector Undertaking/ Public Limited (Listed) Companies in Indian Stock Exchanges or multinational Companies in reputed International Stock Exchanges.

Note:

- a. Godowns/Warehouses/factory sheds/industrial building shall not be considered as eligible similar works.
- b. Mumty and machine room shall not to be considered in building height.
- c. For the purpose of similar works, works executed in India only shall be considered.

5.3.3. “Cost of work” shall mean actual gross value (Excluding GST) of completed “similar’ work including all the components executed under the contract. The Bidder shall submit the documents as per clause 5.3.3.1 and clause 5.3.3.2 as mentioned below, of each project

executed by them, during the said period duly supported by performance certificates of clients.

5.3.3.1 A copy of Tax invoice of Final Bill Submitted to their client and completion certificate

or

5.3.3.2 A copy of Final Bill approved by the Client (With receipt) and Virtual Completion certificate

5.3.3.2.1 Virtual Completion/Completion Certificate, Performance Certificate should be certified by an Officer not below the rank of Executive Engineer / Chief Engineer or equivalent of the Organization.

5.3.3.2.2 "Bidder" means proprietary concern, partnership firm, technically & financially sound companies / firms / PSU / Contractors bidding this Tender.

5.3.3.2.3 "Employer" or "Client" means for whom the similar works are carried out by the Bidder.

5.3.4. Project executed under single contract covering all major works from each trade headed as under.

i) Civil Works: all means Structural RCC, Civil, Fabrication, Civil Finishes, and Landscaping etc.

ii) ALL MEPF Works: - Mechanical, Electrical, Plumbing, Firefighting, PAS, HVAC, Solar PV, LIFT, Puzzle Car park, BMS System, Security System & Garbage Chute Works.

5.4 TURNOVER: The Bidder should have average minimum annual financial turnover of Rs. 76.00 Crore during the last 3 financial years ending 31/03/2025. This should be duly audited and certified by a Chartered Accountant (Copy to be attached). Year in which no turnover is shown will also be considered for working out the average.

5.5 The Bidder should not have incurred loss in last three or more consecutive years during the last five years ending 31.03.2025, duly certified by a Chartered Accountant (Copy to be attached). The firm should not be under liquidation, court receivership or similar proceedings.

5.6 The Bidder should have a solvency of **Rs. 76.00 Crore** certified by a Scheduled Bank (Original copy to be attached). The Solvency Certificate should not have been issued earlier than 31.03.2025,

5.7 The Bidder should have adequate in-house plant and machinery required for the proper and timely execution of the job. The details of the same shall be furnished duly authenticated as per the format enclosed in the Form G.

5.8 The Bidder should have enough Technical and Administrative employees on their roles for the proper execution of the contract as per the format enclosed in the Form F.

5.9 Contractor applying for this tender should have Registration of EPF and ESIC., GST, PAN NO., PROF. TAX (as applicable) submit proof of the same.

6.0 EVALUATION CRITERIA FOR PRE-QUALIFICATION:

For pre-qualification, applications will be evaluated in the following manner:

6.1 The eligibility criteria prescribed herein above (in respect of experience of similar class of works completed) shall be scrutinized and the Bidder's eligibility for pre-qualification for the work be determined. Only the Bidders who meet the eligibility criteria specified as above will be further evaluated based on details furnished by them.

6.2 If necessary, the authorized representatives of SBI & Architect will visit Projects sites which are Completed in all respect by the Bidders, in order to evaluate the performance of the Bidders and Quality of work. In such case, the Bidder will be required to obtain/give them necessary permission / Facilities and arrangements for site visit as required. If it is found that the performance of the bidder for the inspected works is not satisfactory in terms of quality/ overall performance etc., the bidder may get disqualified even though the documents submitted by them will meet the eligibility criteria as laid down

6.3 On the basis of the prequalification criteria mentioned above and after the valuation of the Bidders based on the site visit, credentials submitted by the Bidders, satisfactory Virtual Completion / completion certificates in respect of "Similar work" as spell out above, confidential reports obtained from various clientele (wherever necessary) etc., applications will be shortlisted. Further bidders have to accept the Technical Bid and shall upload the signed copy of the same as token of acceptance, on the website. These shortlisted Bidders will be considered as the pre-qualified vendors subject to verification of relevant documents. Price Bid for the captioned Project shall be considered of these post-qualified vendors only.

6.4 Merely fulfilling the prescribed minimum prequalification criteria does not entitle the Bidder for shortlisting, which is subject to the verification of documents/information furnished by the Bidders, inspection of work, quality, and timely execution of project, seeking confidential performance reports from the client, etc.

6.5 The broad criteria inter-alia for prequalification will also include the following parameters:

- Quality Consciousness.
- Quality of finishes.
- Timely execution.
- Integrity as regards working.
- Ease in setting extra work, if any.
- Litigation, if any involving Arbitration/court of Law.
- Financial soundness.
- Magnitude of work undertaken.

- List of work executed.
- Establishment, plant and equipment.
- Performance report from other employers

6.6 Bank reserves the right to accept or reject any or all applications without assigning any reason thereof. **This prequalification does not bind SBI to award any job/project to the pre-qualified vendors.**

6.7 Contractors shall score minimum 60% to Pre-qualify / Eligible for participation in main tender process as per Scoring Matrix at Annexure 'K'.

A bidder shall not use the credentials of the original/ parent entity of the bidder from which it has been demerged and come into existence, to meet the turnover, profit, experience or other eligibility criteria of Tender. Joint Venture and Consortia are not permitted to participate in the bidding

Note: - To validate the work Completed, SBI may ask additional documents like TDS Certificates, Original Invoices copies etc. against bills produced by the Bidders to their respective clients.

7.0 INSTRUCTIONS TO BIDDERS

7.1) GENERAL INSTRUCTIONS:

- i. Please read these instructions carefully before filling up the application form.
- ii. The application must be submitted in the proforma to be downloaded from sbi.co.in/web/sbi-in-the-news/procurement-news/www.tenderwizard.in without editing the text whatsoever. Any violation of this condition shall render the application invalid.
- iii. Letter of Transmittal along with all the annexures and necessary documents / details as sought in separate sealed cover supported by prescribed annexures containing other details etc. as mentioned.
- iv. In accordance with the compliance of adoption of Integrity Pact (As per CVC order No.41/12/07) an Independent External Monitor (IEM) will monitor and review the entire Tendering and procurement process. The details of the IEM are as under:

NAME	Shri Satyajit Mohanty
CADRE	IPS (Retd)
E-MAIL ID	Satyajitmohanty88@gmail.com

The Bidder shall be bound to execute the integrity pact as per the format attached as Annexure XVIII

7.2 Contents of Tender Documents:

- (i) The Documents are to be submitted online by uploading, signed by authorized signatory, stamped & dated i.e. scanned copies of Technical Bid and Price Bid along with all relevant documents and annexures, in addition to above documents, certified and self-attested true copies of following documents too need to be uploaded.
 - Proof of establishment / constitution of the Company.
 - List and addresses of their offices.
 - List of works executed during last 7 years ending on 30th Nov 2025 as per clause no 5.1, 5.2 along with details and supporting proof viz., copies of work orders, satisfactory completion certificates mentioning all trades of work, etc.
 - Certificate/ proof of empanelment / enlistment in other Organizations / Govt. / Semi-Govt. / Public sector undertakings / Banks (if any).
 - Satisfactory completion certificate in respect of “Similar work” as mentioned above (during last 7 years ending on 30th Nov 2025) from clients. (To be furnished as per the format enclosed in Annexure D).

- Audited balance sheets and P & L Account - for last 3 years certified by Chartered Accountants.
 - Details of tools and equipment, if any, to be used in the project.
 - Declaration (To be furnished in the letter head of organization as per the format enclosed in Annexure-E).
- (ii) The Bidder/authorized signatory should sign & stamp each page of this Tender Document and its annexures / documents and submit the same online and in hard copies. The duly filled-in documents shall be as per NIT 9 & 10 in sealed envelope super-scribed *Technical bid For the Construction works of Civil, Plumbing, Sanitary, Electrical, Firefighting, HVAC, Security Equipment, IBMS, LIFTS, Landscaping, and Allied Services, etc. for the Proposed Construction of Residential Twin Towers at Block No 41, Gift City, Gandhinagar, Gujarat*
- (iii) The Bidders are advised to visit the site at his/their own cost to examine the site & local conditions and collect all information that is considered necessary before participating in the tender process.
- (iv) All information called for in the enclosed forms should be furnished against the relevant columns therein. If, for any reason, information is required to be furnished on separate sheets, this fact should be mentioned against the relevant column. Even if no information is to be provided in a column, a "Nil" or "no such case" or "Not Available" entry should be made in that column. If any particulars/queries are not applicable in case of the Bidder, it should be stated as "Not Applicable".
- (v) The Bidders may please note that giving false/misleading-information called for in application forms, or making any changes in the prescribed forms, or deliberately suppressing any information, may result in disqualification of the Bidder summarily **at any stage and EMD shall be forfeited in this case.**
- (vi) Overwriting and using correcting fluid should be avoided. Corrections, if any, should be made by neatly crossing out and should be rewritten with initials and date.
- (vii) All Pages of the document must be numbered. Additional sheets, if any added by the vendor, should also be numbered by him. They should be uploaded as a package with signed letter of transmittal. The documents uploaded should be indexed and numbered. If uploaded documents are in unstructured and in orderly manner, such applications may be summarily rejected.

- (viii) The Bidder may furnish any additional information, which he thinks is necessary to establish his capabilities to successfully complete the envisaged work. He is, however, advised not to furnish superfluous information. No information shall be entertained after submission of Tender unless it is called for by the Employer. However, Bank /Architect may request for additional, supporting documents, details in relation to tender process from the Bidders during evaluation process.
- (ix) References, information, and certificates from the respective clients certifying suitability, technical know-how or capability of the Bidder should be signed by an officer not below the rank of Executive Engineer / Chief Project Manager or equivalent of the Organization or to be certified by Director/Proprietor, in case of Private Clients, for whom the work has been done.
- (x) Documents submitted in connection with Tender will be treated as confidential and will not be returned.

7.2.1 List of Documents to be uploaded & Hard Copies to submitted within the period of bid submission.

Sr. No.	Digitally Signed Documents to be Uploaded at https://www.tenderwizard.com/SBIETE/NDER	Documents to be submitted in Original Hard Copies on address as per Clause no. 10 of NIT.
1	Technical Bid Document	Technical Bid Document with Drawings
2	Price Bid to be uploaded online only.	Not Allowed
3	Corrigendum, if any	Corrigendum, if any
4	Scan copy of the original, duly executed Pre-Contract Integrity Pact on requisite non judicial stamp paper.	Original, duly executed Pre-Contract Integrity Pact on requisite non judicial stamp paper.
5	Scan copy of duly executed original letter of Declaration.	Duly executed original Letter of Declaration
6	Scan copy of Proof of remittance of EMD.	Original Demand Draft or Banker Cheque of EMD as mentioned in

		NIT.
7	Scan copy of Duly executed original LETTER OF TRANSMITTAL	Duly executed original LETTER OF TRANSMITTAL.

7.2.1.1 Bidders may please note:

- (a) The Bidder should quote for the entire package on a single responsibility basis for the services required under this Tender Document.
- (b) Care should be taken so that the Technical Bid shall not contain any price information. Such proposal, if received, will be rejected.
- (c) The Bid document shall be complete in accordance with various clauses of the Tender Document or any addenda/corrigenda or clarifications issued in connection thereto, duly signed by the authorized representative of the Bidder. Board resolution authorizing representatives to Bid and make commitments on behalf of the Bidder is to be attached.
- (d) It is mandatory for all the Bidders to have class-III Digital Signature Certificate (DSC) (in the name of person who will sign the Bid) from any of the licensed certifying agencies to participate in this Tender Document. DSC should be in the name of the authorized signatory. It should be in a corporate capacity (that is in Bidder capacity).
- (e) Bids are liable to be rejected if only one Bid (i.e. Technical Bid or Price Bid) is received.
- (f) If deemed necessary, the Bank may seek clarifications on any aspect from the Bidder. However, that would not entitle the Bidder to change or cause any change in the substances of the Bid already submitted or the price quoted.
- (g) The Bidder may also be asked to give a presentation at no extra cost to the Bank for the purpose of clarification of the Bid.
- (h) The Bidder must provide specific and factual replies to the points raised in the Tender Document.
- (i) The Bid shall be typed or written and shall be digitally signed by the Bidder or a person or persons duly authorized to bind the Bidder to the Contract.
- (j) All the enclosures (Bid submission) shall be serially numbered.
- (k) Bidder(s) should prepare and submit their online Bids well in advance before the prescribed date and time to avoid any delay or problem during the bid submission process. The Bank shall not be held responsible for any sort of delay, or the difficulties faced by the Bidder(s) during the submission of online Bids.

(l) Bidder(s) should ensure that the Bid documents submitted should be free from virus and if the documents could not be opened, due to virus or otherwise, during Bid opening, the Bid is liable to be rejected.

(m) The Bank reserves the right to reject Bids not conforming to above.

7.2.1.2 Evaluation of Bids:

- i. The bidders who submit the above documents without any conditions, fulfilling pre-qualification requirements and in compliance with the Tender Document, shall be treated as technically qualified bidders.
- ii. Price Bid shall be opened only of those bidders who qualify as per various clauses of Technical Bid Document.

7.3) Technical Bid Document (TB)

- i. The **Technical Bid** document is available on the web site of SBI, www.sbi.co.in under procurement news.

7.4) LETTER OF TRANSMITTAL

The Bidder should submit the letter of transmittal on the letter head of the Bidder attached/appended with Application form along with annexures of Tender document as mentioned / necessitated.

7.5) ORGANIZATIONAL INFORMATION – BIO DATA

Bidder is required to submit the information in respect of his organization (**in Application form**) and Biodata of the Directors / Partners / Key associates.

7.6) Miscellaneous Instructions: -

- i) Registration under the contract labour Act: The registration for on-going project may be provided for consideration
- ii) Special awards: Appreciation letters from Govt. client shall be considered in Scoring matrix.
- lii) Joint ventures and/or consortium are not allowed and shall not be accepted.

7.7) FINANCIAL INFORMATION

Bidder should furnish the following financial information as per the format mentioned **in Form 'A'**:

- (a) Banker's Details, Chartered Accountant, Annual financial statement for the last seven years. It should be supported by audited balance sheets and profit and loss accounts (of last three years ending on **31.03.2025**) duly certified by a Chartered Accountant, as submitted by the Bidder to the Income Tax Department to be supported by respective IT

Return Acknowledgment.

(b) Name and address of the banker's identification of individuals familiar with the Bidder's financial standing and a banker's statement.

(c) Solvency Certificate.

7.8) EXPERIENCE IN SIMILAR WORKS HIGHLIGHTING MAJOR PROJECTS

Bidder should furnish the following:

- i. List of all "Similar" works successfully completed during the last *seven years* (**in Form "B"**). Further supplementary information on completed major works is to be submitted in Form B (SUP).
- ii. This list is to be substantiated with documentary evidence such as certified copies of work orders, certified final bill copy, satisfactory completion certificate obtained from client etc. without which, the projects mentioned in the format **shall** not be considered for scrutiny.
- iii. List of works completed before seven years may be mentioned in separate sheets if the Bidder intends to do so.
- iv. List of the 'Similar' works under execution or awarded (**in Form "C"**).
- v. **Form D** – Performance Report Particulars of '**Similar CONSTRUCTION OF MULTI-STORIED BUILDING WORK**' and '**Similar MEPF WORK**', Major projects completed (as mentioned in **Form B**) should be furnished separately for each major work completed.

7.9) The SBI reserves the right to: -

- (a) Reject any or all the applications without assigning any reason.
- (b) Amend the scope and value of contract to the Bidder.
- (c) Verify the particulars furnished by the Bidder independently. If any information furnished by the Bidder is found incorrect at any stage of the project, the SBI will be at liberty to debar such Contractor(s) from participation in future Tendering / taking up of work in SBI in future, besides cancellation of their Application Forms/ Tender.

In such cases EMD shall be forfeited. Moreover, the SBI will not pay any damages/compensation to such vendor or firm or the person concerned. Further, any breach of this condition by the Bidder would also render him liable to be removed from the approved list of vendors of SBI.

(d) Cancel the Tender process without specifying any reason whatsoever.

7.10) Even though a Bidder may satisfy the above requirements, he would be liable for disqualification if he has: -

- (i) Made misleading or false representation or deliberately suppressed the information in the forms, statements and enclosures required in the Tender document.
- (ii) Records of poor performance such as abandoning work, delaying the project, not properly completing the contract, or financial failures / weaknesses etc.

7.11) Corrigendum / addendums (if any) to this notice shall only be available / posted on SBI's website.

7.12) The Bidders who have downloaded the Tender Document from the website should read the following important instructions carefully before Uploading the Tender Documents: -

- i. The Bidders should see carefully & ensure that the Downloaded/Uploaded Tender Document contains all the pages of the Tender Document.
- ii. The printout of Tender Document should be taken on 'A 4' size paper only & the printer settings, such that document is printed as appearing in the web & there is no change in formatting, number of pages etc.
- iii. The Bidder should ensure that no page in the Uploaded Tender Document is missing.
- iv. The Bidder should ensure that all pages in the uploaded Tender Document are legible & clear & are printed on good quality paper.
- v. The Bidder should ensure that every page of the Uploaded Tender Document is signed by Bidder with stamp (seal) of the Bidder company and all the blanks are filled by the Bidder, suitably.
- vi. The Bidder should ensure that the filled in Tender Document along with all supporting

documents, annexures, certificates, etc. are uploaded in structured manner with proper index and numbering of pages. Any correction / addition / alteration / omission made in the Tender Document by the Bidder; it shall be treated as non – responsive and the application may be summarily rejected.

vii. The Bidder shall furnish a declaration that to this effect no addition / deletion / corrections have been made in the Tender Document submitted and it is identical to the Tender Document appearing on Website.

viii. The Bidder who has downloaded the Tender Document from website should read carefully & sign the declaration given before Uploading the Tender Document.

ix. In case of any doubt in the Tender Document, the same should be got clarified from the SBI/APMCF before Uploading the Tender Document.

x. The Company or firm or any other person shall not be permitted to seek pre-qualification for the work, in case, his near relative(s) (directly recruited or on deputation in SBI /SBI & is / are posted in any capacity either non-executive or executive employee in SBI PAN India. Near relative(s) for this purpose is/are defined as

- i) Member of Hindu Undivided family (HUF).
- ii) They are Husband and wife.
- iii) The one is related to other in the manner as father, mother, son(s) & son's wife (daughter-in-law), Daughters(s), Daughter's husband (son-in- law), brother(s), brother's wife, sister(s), sister's husband (brother-in-law).

xi. The Bidder (principal vendor) shall also intimate the names of people who are working with him in any capacity or are subsequently employed by him or who are near relative to any executive employee/officer in the SBI.

xii. The contractor shall declare any relationship with any Officials/ Executives of State Bank of India who is associated with the project, if any, to avoid any 'Conflict of Interest'. Any breach of this condition by the contractor would disqualify him from participation and consideration in the tender process.

xiii. No Officer / Executive of the Bank is allowed to work as a contractor (or with the contracting firm) for a period of one year after his retirement from Bank's service, without the prior permission of the Competent Authority in writing. This contract is liable to be cancelled if either the contractor or any of his employees is found any time to be such a person who had not obtained the permission of the Competent Authority of the Bank as

a foresaid before submission of the tender or engagement in the contractor's service.

xiv. Efforts on the part of the Bidder or his agent to exercise influence or to pressurize the employer would result in rejection of application. Canvassing of any kind is prohibited. In Such case Tender shall be summarily rejected.

xv. Based on Prebid meeting, addendum / Corrigendum if any will be issued and the same shall form a part of tender document

Date:

Place:

Sign & Stamp of Bidder/
Authorized Signatory

8.0 Forms & Annextures

8.1 Application Form

1	Name of the contractor Firm/ company:																			
2	Address Phone No. (a) Landline with STD code (b) Mobile (c) Email-ID																			
3	Year of establishment of the Firm/company																			
4	Status of the firm whether company/firm/ proprietary.																			
5	Name of Directors/Partners/Proprietor																			
6	Whether registered with the registrar of companies / registrar of firms if so, mention number & date.																			
7	Name/s of Partners / Proprietor/ Directors/ Key Person of The Firm (Details of address, contact number, qualification etc. to be submitted as per the Bio data form)	<table border="1"> <thead> <tr> <th>Sr. No</th> <th>Mobile No</th> <th>Email</th> </tr> </thead> <tbody> <tr> <td>i.</td> <td></td> <td></td> </tr> <tr> <td>ii.</td> <td></td> <td></td> </tr> <tr> <td>iii.</td> <td></td> <td></td> </tr> <tr> <td>iv.</td> <td></td> <td></td> </tr> <tr> <td>v.</td> <td></td> <td></td> </tr> </tbody> </table>	Sr. No	Mobile No	Email	i.			ii.			iii.			iv.			v.		
Sr. No	Mobile No	Email																		
i.																				
ii.																				
iii.																				
iv.																				
v.																				
8	Name and address of Bankers																			
9	Whether registered for sales tax purpose. If so, mention TIN number and date																			
10	Whether an assesses of Income Tax. If so, mention PAN number. (Furnish copies of I.T. clearance certificate)																			
11	Whether registered for service tax. If so, mention service tax registration number & date																			
12	Whether registration/obtention of license from Govt authorities e.g., labour dept., ESIC, etc are in place:																			
13	If, you are registered in the panel of other organizations/statutory bodies such as CPWD, PWD, MES, Banks etc., furnish their Names, category, and date of registration																			

14	Detailed description of high value of three works done during the last 7 years ending on 30 th Nov 2025, as per the criteria given. (i.e. name of organization, value of work done and date of completion)- copies of work orders, completion certificates must be enclosed	As per format Form: B, B (SUP) 1 & C;
15	Average annual turnover of the Company as per Audited Balance Sheets as on 31st March 2023, 2024, 2025. (details of turnover during previous F.Y. to be submitted as per format given in Annexure A)	2022-23: 2023-24: 2024-25 ----- Average:
16	Names and addresses of the persons who will be in a position to certify the quality as well as performance of your organization	
17	Whether willing to work anywhere in the States of Gujarat and..... or mention places where you are willing to work.	
18	Declaration regarding near relatives working in the Bank	
19	Year since the firm/ company is in the line of business/ activity of construction of multi Story residential/ commercial buildings.	
20	Name, mobile number & email ID of contact person: i. ii. iii. iv. v.	
21	Address of office in Ahmedabad/Gandhinagar, if available.	
22	Whether Firm has ISO Certification? Mention details	
23	Whether member of any professional Body / Association. Please give details & enclose certificate viz. IGBC	
24	GST Registration number (Photocopy to be attached)	
25	Registration for EPF/ RPFC (Photocopy to be attached)	

26	Registration under the Contract Labour Act																			
27	Registration number under Labour Welfare Act																			
28	Professional Tax registration no.																			
29	Educational qualification of the Proprietor/ Partner/ Director/Key Person i) ii) iii) iv) v)	<table border="1"> <thead> <tr> <th>Sr.</th> <th>Name</th> <th>Education Qual.</th> </tr> </thead> <tbody> <tr> <td>i</td> <td></td> <td></td> </tr> <tr> <td>ii.</td> <td></td> <td></td> </tr> <tr> <td>iii.</td> <td></td> <td></td> </tr> <tr> <td>iv.</td> <td></td> <td></td> </tr> <tr> <td>v.</td> <td></td> <td></td> </tr> </tbody> </table>	Sr.	Name	Education Qual.	i			ii.			iii.			iv.			v.		
Sr.	Name	Education Qual.																		
i																				
ii.																				
iii.																				
iv.																				
v.																				
30	Total number of Similar Works of Residential projects completed in last seven years.																			
31	Value of Single Largest Project for Similar Work for Residential project completed in the last 7 years.																			
32	Details of IGBC certification availed for Similar Work for Residential project completed in the last 7 years ending on 30 th Nov 2025, should be either of the following.																			
33	Details of Similar work under execution	As per format Form C.																		
34	Financial Information as per format given at Form A (Enclose copies of audited balance sheet and profit & loss statements and CA Certificate)	As per format Form A.																		
35	Number of years of experience in the construction of Residential buildings.																			
36	Financial soundness (Enclose solvency certificate or other relevant papers/documents, refer Annexure J).	As per Annexure J.																		
37	Details of skilled workforce provided.	As per format Form F Annexure E:																		
38	Details of equipment, tools, plants & machinery, etc. available with the firm –	As per format FORM G.																		
39	Mention if blacklisted and / or blacklisting proceedings pending with any client. Details of the same, with reasons, to be furnished.																			
40	Details of disputes /litigation, if any, during the period of last 07 years ending on 30th Nov 2025 should be either of the following. If yes, please provide details thereof, with reasons.																			

41	Whether any penalty imposed by law enforcing agencies such as Labour Department, Sale Tax, GST, Municipal Corporations, Development Authorities, etc.	
42	Details of penalty / liquidated damage imposed by any client for defective / delayed / non-completion of work or violation of terms of the contract, during the last 7 years ending on 30 th Nov 2025 should be either of the following. If yes, please provide details thereof, with reasons.	
43	Whether firm had been barred from participating in the bidding process or kept in cooling period/under suspension by any client, during the last 7 years, ending on 30 th Nov 2025. If yes, please provide details thereof, with reasons.	
44	Please indicate details of any Bankruptcy /winding up proceedings at any point of time in past.	
45	Covering cum declaration / confirmation letter as per Annexure-E	
46	Enclose copy of valid Electrical Contractor's License. (Mention Class)	
<p>I/We hereby confirm that all information, particulars, copies of certificates and testimonials in connection with my empanelment are correct and genuine. I am, therefore, liable to face appropriate actions as deemed fit by the Bank in the event of any of the information, particulars, copies of certificates and testimonials are not found correct and genuine.</p>		
<p>Place: Date: Sign & Stamp of Authorized Signatory/Bidder Name: Designation:</p>		
<p>Note: Furnish certified photocopies of all relevant documents in support of the Information furnished above.</p>		

8.2 BIO-DATA OF THE DIRECTORS/PARTNERS/ KEY ASSOCIATES

- 1. Name :
- 2. Date of Birth :
- 3. Associates with the organization since:
- 4. Professional Qualification :
- 5. Professional Experience :
- 6. Professional Affiliation :
- 7. Membership in :
- 8. Details of Published papers in Magazine / Journals (if any) :
- 9. Details of cost-effective methods/ innovative techniques adopted in the projects : :
- 10. Exposure to new materials/ Technology.
- 11. Details of address, email ID & Contact No.

Signature of Bidder/Authorized Signatory

8.3 FINANCIAL INFORMATION

Form A

i) Banker Details

Name of the Bank :
 Branch with Address :
 City :
 Contact person in the Bank :
 Contact Details :

ii) Details of Chartered Accountant

Name :
 Address :
 Registration details of accountant :
 Contact Number :
 E-mail address :

iii) Financial Analysis – Details to be furnished of the Annual financial statement for the last seven years. It should be supported by audited balance sheets and profit and loss accounts (for the last three years ending on **31.03.2025**) duly certified by a Chartered Accountant, as submitted by the Bidder to the Income Tax Department.

YEAR S	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
(i) Gross Annual turn-over in Construction works							
(ii) Profit/Loss							
(iii) Financial position:							
(a) Cash							
(b) Current Assets							
(c) Current Liabilities							
(d) Working capital (b-c)							
(e) Current Ratio: (Current Assets/Current Liabilities (b/c))							
(f) Acid Test Ratio (Quick Asset/Current Liabilities (a/c))							

iv. Income Tax Clearance Certificate

v. Solvency certificate from Bankers (Schedule Bank) of Bidder.

vi. Financial arrangements for carrying out the proposed work

Signature of Chartered Accountant

Sign & Stamp of Authorized Signatory/Bidder

with seal

8.4 FINANCIAL YEAR WISE TURNOVER DETAILS FOR THE LAST 7 YEARS.

FORM A-1

Sr. No. (A)	Financial year (B)	Turnover Amount of the firm (in Rs.) (C)	Remarks/ reason for abnormal fluctuations in two continuous F.Y.
1	2024-25		
2	2023-24		
3	2022-23		
4	2021-22		
5	2020-21		
6	2019-20		
7	2018-19		

FORM 'B'

8.5 DETAILS OF ALL 'SIMILAR' WORKS COMPLETED DURING THE LAST SEVEN YEARS ENDING ON 30th Nov 2025 MENTIONING ALL TRADES OF WORKS (5.1 & 5.2)

1	2	3	4	5	6	7	8	9	10	11	12
S. No.	Name of work/ Project & location	Owner or sponsoring organizations	Date of Agreement with the owner	Scope of work executed	Built up area of the project in sqm.	Cost of project work in Crores	Date of commencement as per contract & actual date of commencement	Stipulated Date of Completion & Actual Date of completion	Litigation / Arbitration pending/ In progress with details (if any)	Name and address with contact No. of Officer of client to whom reference shall be made	Remarks

Note:

Actual date of completion of the project should be within 7 years, **ending** on 30th Nov 2025 for taking into eligibility consideration. The projects mentioned in the above format shall be sorted in the order of cost of the project (Descending order)

Signature of Bidder/ Authorized Signatory

FORM B1 (SUPL)**8.6 SUPPLEMENTARY INFORMATION ON COMPLETED MAJOR WORKS MENTIONING ALL TRADES OF WORKS**

1. Name of work
2. Location
3. Client's name and address
4. Consultants' name and address.
5. Scope of work.
 - a. Number of floors in Basement.
 - b. Number of floors in Superstructure.
 - c. Height of the building (m).
 - d. Built up area. (Sqm)
 - i. Basement.
 - ii. Superstructure
6. Type of power supply system.
7. Type of equipment in substation & for internal works.
8. Time taken for
 - 1.Substation.
 2. Internal works.
 3. Total Project.
9. Specialized service, if any, provided, with cost details,
10. Specialized Tools & Plant deployed for the project.
11. Project Management organization structure.
12. Number of shift and its duration adopted in execution.
13. Systems adopted for timely completion of the project.

Signature of Bidder/ Authorized Signatory

FORM 'C'

8.7 'SIMILAR' PROJECTS ON HAND - UNDER EXECUTION OR AWARDED

1	2	3	4	5	6	7	8	9	10	11	12	13
Sl. No.	Name of work/ project & location	Client / Owner or sponsoring organizations	Type of Client / Owner (Mention Govt/ / Semi Govt / PSU / Autonomous / Private)	Date of Agreement with the owner	Built up area of the project in sq m	Cost of project work in Crores	Date of commencement as per contract & actual date of commencement	Stipulated Date of completion	Up to date percentage of progress of work completed	Delay in progress (if any) and reasons thereof	Name and address with contact No. of Officer of client to whom reference shall be made	Remarks (Indicate whether any show-cause notice issued or Arbitration initiated during the progress work)

Signature of Bidder/ Authorized Signatory

Note: The projects mentioned in the above format shall be sorted in the order of cost of the project (Descending order)

8.8 PERFORMANCE REPORT FOR 'SIMILAR' MAJOR COMPLETED WORKS INCLUDING MEPF WORK (REFERRED TO IN FORM 'B')

1. Name of the work/ Project & Location-

Scope of work. –

(Shall Clearly Mention Each Tarde of Works)

2. Agreement No & Date.

3. Estimated Cost / Tendered Cost

(Shall Clearly Mention Cost of Each Tarde of Works, Separately)

4. Actual Value of work done

4.1 Value of Extra Items Executed

5. Date of commencement

a. Stipulated date of commencement.

b. Actual date of commencement.

6. Date of completion

a. Stipulated date of completion.

b. Actual date of completion.

7. Amount of compensation levied for delayed completion if any.

8. Performance report based on

Quality of Work, : Very Good / Good / Fair / Poor

Time Management, : Very Good / Good / Fair / Poor

Resourcefulness : Very Good / Good / Fair / Poor

Financial Soundness : Very Good / Good / Fair / Poor

Technical Proficiency : Very Good / Good / Fair / Poor

QA / QC at Works. : Very Good / Good / Fair / Poor

Safety & Health Measures at Work : Very Good / Good / Fair / Poor

Ability to Work within Contract's Allotted Cost : Very Good / Good / Fair / Poor

Superintending Engineer /
Chief Project Manager or Equivalent

Date:

(Name of Organization):

Note:

1. The performance report is to be submitted separately for all major works mentioned in Form 'B'.
- 2. The performance report preferably be submitted in the above Performa. In case, different proforma is used, the Bidder shall ensure that the report / certificate shall contain all the above information / details.**

ANNEXURE 'E'
FORM-F

8.9 DETAILS OF KEY TECHNICAL AND ADMINISTRATIVE PERSONNEL EMPLOYED IN THE ORGANIZATION

Sr. No.	Designation	Total Number	Names	Educational Qualification	Professional Experience	Length of continuous service with employer in years
1	2	3	4	5	6	7

Signature of Bidder/ Authorized Signatory

Note:

1. Details of Technical personnel shall be provided qualification-wise.
2. Organization chart of the company, additional information about Technical and administrative personnel, if any, may be submitted on separate sheet.

FORM-G

8.10 DETAILS OF PLANT & MACHINERY, MANUFACTURING UNITS, TOOLS, AND EQUIPMENT LIKELY TO BE USED IN CARRYING OUT THE WORK.

Sr. No	Name of the Tools / Machinery / Equipment	Unit	Make / Model / Capacity or Type	Age in years	Condition of the unit	Ownership Status (mentioning the quantity)			Current location	Remarks
						Presently Owned	To be purchased	Leased		
1	2	3	4	5	6	7	8	9	10	11

Signature of Bidder/ Authorized Signatory

Annexure - '1'

8.11 Declaration-Cum- Certificate

on the Letter Head of Contractor Regarding Restrictions on Procurement from Contractors From A Country Or Countries, On Grounds Of Defense In India, Or Matters Directly Related Thereto, Including National Security.

Restrictions under Rule 144 (XI) of General Financial Rules 2017 of Ministry of Finance, India order no. F. No 6/18/2019/PPD dated 23rd July 2020

I/We have read the clause regarding restrictions on procurement from a Contractor of a country which shares a land border with India.

I/We, the Contractor (Specify full name) _____

certify that we are NOT from such a country OR, if from such a country, has been registered with Competent Authority.

I/We hereby certify that we fulfill all requirements in this regard, and it is eligible to be considered.

(Signature of Authorised Signatory along with Seal)

Name of authorised signatory:

Designation of Authorised signatory:

List of Evidence enclosed:

1. Copy of certificate of valid registration with the Competent Authority (Score out if not applicable)
2.
3.
4.

Date:

Place:

8.12 SOLVENCY CERTIFICATE WITH BANK'S DETAIL
ON BANK LETTER HEAD

No.....

To

This is to state that to the best of our knowledge and information, Mr. / Ms. / M/sa customer of our Bank is respectable and can be treated as good up to a sum of Rs..... (Rupees in words). It is clarified that this information is furnished without any risk and responsibility on our part in any respect whatsoever, more particularly either as guarantor or otherwise. This certificate is issued at the specific request of the customer.

Place:

Date:

For ___ Bank Name

Bank Manager

- 1. Banker's certificate should be on the letter head of the scheduled commercial bank. In case of partnership firm, certificate to include names of all partners as recorded with the bank.

**ANNEXURE 'I'
FORM K**

8.13 PROFORMA ON ISO CERTIFICATION OR OTHERS (IF ANY)

1. Year of Certification
2. Name and Address of Certifying Agency
3. Name of Management Representative
4. Validity of Certificate

ANNEXURE 'J'
Form L**8.14 DECLARATION**

I/We have inspected the site, i.e. plots of land at Block No 41, Gift City, Gandhinagar, Gujarat and I/We have made me/ us fully acquainted with the local conditions in and around the sites of works and the proposed work.

I/We hereby declare that I/ We have carefully gone through the conditions laid down in the Tender Document/Tender including Notice Inviting Tender, General notes, General Conditions of Contract, Special conditions, Schedule of approximate quantities and rates , Form of Agreement, General Specification, Approved manufacturers/ natural source of materials (i.e. all parts of Technical bid), Technical Specifications of schedule of quantities (i.e. all parts of Price bid), and clearly understood all it. Based on the same I/ We have quoted our rates in the Schedule of Quantities/ Price Bid attached with the Tender Documents.

We accept all the terms and conditions of Tender Documents. We will abide by the technical specification mentioned in the tender. We hereby undertake to use only specified material/ make as per the tender schedule.

I/ We hereby declare that, in particular, during execution of all works at site; it will be my/ our sole responsibility to strictly adhere to/ meticulously follow the General Specification, Approved manufacturers/ natural source of materials; Safety, Health and Environmental (SHE) guidelines; Labour Laws; Technical Specifications of schedule of quantities, all design & drawings and items specifications of all trades of work.

For any type of deviation (to any of above or subsequent instructions), it will be my/our responsibility to obtain the written instruction of the APMCF/SBI, appropriate Government Authorities, local bodies for the same failing which it shall be deemed that I have carried out any such deviations at my own risk & responsibility and I shall be duty bound to replace all the deviated material/ works from the site at my/ our cost as well as I shall be liable to penalized by the employer as deemed fit and for all such loses made thereof, I/ we shall not have any right to arbitrate in any manner.

I/ We hereby declare that I/ We shall obtain necessary clarifications, drawings of items from APMCF/SBI in time and shall uniformly maintain such progress as may be directed by the APMCF/SBI to ensure completion of same within the target date/ time as mentioned in the Tender Document.

Date: _____ Signature and seal of Authorized Signatory/ Bidder

Place: _____

Witness: (with Name)

1.

2.

8.15 Scoring Matrix / Evaluation Sheet

S. No.	Particulars	Maximum Marks	Marks Obtained
1	Average annual turnover of the Company as per Audited Balance Sheets as on 31st March: 2023, 2024 and of 2025 (Provisional/Audited). (INR)		
	> 200 crores or above	8	
	> 100 crores or above but <= 200 crores	5	
	> 76.00 crores or above but <= 100 crores	3	
2	Value of Largest single project of Residential/ Office / Hospital / Institutional/ Hotel or commercial Building with Minimum 45 Meter Height from ground level and consisting of minimum 1 Basement Completed in the last 7 years ending 30 th Nov 2025. (INR)		
	>= 202.66 crores	8	
	>= 126.66 crores < 202.66 crores	5	
	>=101.33 crores < 126.66 crores	3	
3	Construction of Residential/ Office / Hospital / Institutional/ Hotel or commercial Building, with maximum height, completed in the last 7 years ending 30 th Nov 2025.		
	75 m & above	8	
	60 m to <= 75 m	5	
	> 45 m to <= 60 m	3	
4	Number of years of experience in the construction.		
	above 15	8	
	above 10 <= 15	5	
	above 7 <= 10	3	

S. No.	Particulars	Maximum Marks	Marks Obtained
5	Position of financial soundness of the firm based on net worth of the company as per audited Balance Sheet as on 31.03.2025.		
	>= 202.66 crores	8	
	>= 126.66 crores < 202.66 crores	5	
	>=76.00 crores < 126.66 crores	3	
6	Availability of in-house engineers, etc. with minimum qualification of BE/B.Tech. Degree		
	QA/QC Civil Engineers (Minimum 10 Yrs experience)	2	
	Safety Engineer/ Officer (Minimum 7 Yrs experience)	2	
	PHE Engineer (Minimum 7 Yrs experience)	1	
	Billing Engineer (Minimum 7 Yrs experience)	1	
	Electrical Engineers (Minimum 7 Yrs experience)	1	
	Project Managers (Minimum 15 Yrs experience)	1	
	No. of Employees on payroll, who are technically qualified, (e.g. Project Managers, Resident Engineers, Site Engineers, QA/QC Engineer, QS Engineer, Safety Engineer, Billing Engineer, MEP, PHE engineer, etc.		
> 8 persons with diploma civil/ or 15 persons with Degree in engineering / architecture	6		
> 5 persons with a civil diploma or 12 persons with Degree in engineering /architecture	5		
3 persons with diploma civil or 10 persons with Degree in engineering	3		
8	Whether the Bidder firm had completed works of of Residential/ Office / Hospital / Institutional/ Hotel or commercial Building with Minimum 45 Meter Height from ground level and consisting of minimum 1 Basement, in the last 7 years ending 30 th Nov 2025 for the under-noted types of clients (subject to minimum 01 works). Constitution of the bidder firm		
	Government Body/PSU	4	
	Public Ltd. Companies Listed in Indian Stock Exchanges Multinational Company listed in	3	

S. No.	Particulars	Maximum Marks	Marks Obtained
	Reputed International Stock Exchanges		
9	Nos. of construction contracts executed during last 7 years ending 30 th Nov 2025, of Residential/ Office / Hospital / Institutional/ Hotel or commercial Building of with Minimum 45 Meter Height from ground level and consisting of minimum 1 Basement		
	above 15	4	
	above 10 <= 15	3	
	above 3 <= 10	2	
10	No. of key administrative personnel employed in the organization:		
	> 20 no.	2	
	> 10 but <= 20	1	
11	Whether Bidder firm has timely completed all the Projects?		
	100% of work completed within time Scheduled frame, without giving extension.	5	
	100% of work not completed within Scheduled frame, but extension of time was given by the Client & work completed.	3	
12	Whether firm is having under noted approvals / registrations / qualifications? (Photocopies to be attached: one mark for each sub-parameter) (Mandatory)		
	1) Registration under the Contract Labor Act.	1	
	2) Registration number under Labour Welfare Act.	1	
	3) EPF / RPFC - Registration number	1	
	4) ESI – Registration number	1	
	5) GST – Registration number	1	
	6) Professional Tax	1	
13	Construction Works of Residential/ Office / Hospital / Institutional/ Hotel or commercial Building with Minimum 45 Meter Height from ground level and consisting of minimum 1 Basement, where Green Certification was awarded (enclose copy/ies of certificates & completion certificates by IGBC/GRIHA etc.) in		

S. No.	Particulars	Maximum Marks	Marks Obtained
	last 7 years ending 30 th Nov 2025.		
	above 3	3	
	above 1 <= 3	2	
	At least 1	1	
	Nil	0	
14	Whether Bidder firm has independent office within Ahmedabad/Gandhinagar, with landline number in the name of firm?		
	Yes	1	
	No	0	
15	Whether firm is running in profit (before tax), during last 3 financial years? (ended on 31.03.2025).		
	All 3 Years	4	
	For 2 years Only	3	
	For 1 year Only	1	
16	In the completed qualifying project/s of constructing high rise building, whether electrical work was done in-house or through sub-contracting?		
	In-house	3	
	Through sub-contracting	2	
17	In the completed qualifying project/s, whether fire-fighting work was done in-house or through sub-contracting?		
	In-house	3	
	Through sub-contracting	2	
18	Performance Certificate from the Public Sector Banks/ Central Government / State Government / Central Autonomous body/ State Autonomous body/ Central Public Sector Undertaking/ State Public Sector Undertaking/ Public Limited (Listed) Companies. (Supporting documents/proofs if any).		
	(a) If outstanding Performance Certificate from more than three Principal Employer have been issued and submitted for Similar projects.	3	
	(b) If outstanding Performance Submitted from two employers for Similar projects.	2	

S. No.	Particulars	Maximum Marks	Marks Obtained
	(c) If outstanding Performance Submitted from one employer for Similar projects.	1	
19	Special Awards in Last 7 ending 30 th Nov 2025 from third party organizations/ institutions like CREDAI, AESA, BAI, etc. for similar works		
	above 3	5	
	above 1 <= 3	3	
	At least 1	2	
20	ISO Certification: QA/QC Policy:		
	Whether the Bidder Company has got any Documented Quality Policy for QA /QC for similar Works & proof of its implementation at Site:		
	Yes	2	
	No	0	
21	ISO Certification: HSE Policy:		
	Health and Safety Related Policies: Whether the Bidder Company has got any Documented Health and Safety Policy for similar works and proof of its implementation at Site:		
	Yes	2	
	No	0	
	Total Max. Marks (100) (qualifying marks: 60)		

Notes: -

Documentary evidence must be furnished against each of the above criteria.

Documents must be signed by the authorized signatory of the Contractor.

Relevant portions in the documents submitted in pursuance of eligibility criteria should be highlighted.

Bidders must score a minimum of 21 marks in Sr. No. 1 to 5, and a minimum of 60 marks in total to qualify in the scoring matrix.

8.16 CHECK LIST - A

Eligibility Criteria Requirements

(Put Tick Mark as applicable)

S. No.	Parameter	
1.	Do you satisfy requirement of Clause 5.1	Yes / No
2.(i)	Do you satisfy requirement of Clause. 5.2 A	Yes / No
(ii)	Do you satisfy requirement of Clause 5.2 B	Yes / No
3.	Do you satisfy requirement of Clause 5.3.1	Yes / No
4.	Do you satisfy requirement of Clause 5.3.2	Yes / No
5. (i)	Do you satisfy requirement of Clause 5.3.3.1 or	Yes / No
ii	Do you satisfy requirement of Clause 5.3.3.2	Yes / No
6.	Do you satisfy requirement of Clause 5.4	Yes / No
7.	Do you satisfy requirement of Clause 5.5	Yes / No
8.	Do you satisfy requirement of Clause 5.6	Yes / No
9.	Do you satisfy requirement of Clause 5.7	Yes / No
10	Do you satisfy requirement of Clause 5.8	Yes / No
11	Do you satisfy requirement of Clause 5.9	Yes / No

8.17 CHECK LIST - B

Details of Enclosures.

Sl. No.	Information	Confirmation of Submission	Page no.
1	Tender Document including Letter of Transmittal, Application Form and Forms A to L.	Yes/No	
2	Proof of constitution:	Yes/No	
	(a) In case of sole proprietorship/HUF: an affidavit executed before a 1 st Class Magistrate that the Bidder is the sole proprietor of the firm/Karta of HUF		
	(b) In case of partnership firm: (Submit attested copies)		
	In case of private/Public Ltd. Co. Article of Association duly attested by Notary Public		
	Power of attorney, if any, attested by Notary Public		
3	Certificate of Registration as contractor	Yes/No	
4	Certificate of Registration with taxation authorities	Yes/No	
5	Certificate of Tax Clearance (ITCC, GST, etc)	Yes/No	
6	Details of requisite licenses	Yes/No	
7	Registration with EPF	Yes/No	
8	Proof of eligibility of essential criteria including Plumbing, Electrical, HVAC, IBMS, Fire Fighting works & Security Equipment	Yes/No	
9	Financial Information	Yes/No	
	A) Balance sheets for the last 7 years	Yes/No	
	B) Calculation sheets of net worth	Yes/No	
	C) Solvency Certificate in original	Yes/No	
10	Details of completed work as given in Form B	Yes/No	
11	Attested copies of award letters/work orders/LOI for completed work	Yes/No	
12	Original or attested copies of certificate for works done, from concerned clients	Yes/No	
13	Performance report of completed works given in form D	Yes/No	
14	Details of work on hand as given in Form C	Yes/No	
15	Attested copies of award letters/work orders/LOI for on Going projects / Works on Hand	Yes/No	
16	Details of key personnel as given in Form F	Yes/No	
17	Details of plants and machinery etc as given in Form G	Yes/No	
18	Declaration Annexure I & Form L	Yes/No	

9.0 PART-A - INFORMATION & INSTRUCTIONS FOR BIDDERS FOR e-BIDDING**9.1 DISCLAIMER:**

- i. The information contained in this Tender Document or information provided subsequently to Bidder(s) whether verbally or in documentary form/email by or on behalf of SBI, is subject to the terms and conditions set out in this Tender Document.
- ii. This Tender Document is not an offer by State Bank of India, but an invitation to receive responses from the eligible Bidders qualified through of Prequalification of Bidders.
- iii. The purpose of this Tender Document is to provide the Bidder(s) with information to assist preparation of their Bid proposals. This Tender Document does not claim to contain all the information each Bidder may require. Each Bidder should conduct its own investigations and analysis and should check the accuracy, reliability and completeness of the information contained in this Tender Document and where it is necessary to obtain independent advice/clarifications. Bank may in its absolute discretion, but without being under any obligation to do so, update, amend or supplement the information in this Tender Document.
- iv. The Bank, its employees and advisors make no representation or warranty and shall have no liability to any person, including any Bidder under any law, statute, rules or regulations or tort, principles of restitution or unjust enrichment or otherwise for any loss, damages, cost or expense which may arise from or be incurred or suffered on account of anything contained in this Tender Document or otherwise, including the accuracy, adequacy, correctness, completeness or reliability of the Tender Document and any assessment, assumption, statement or information contained therein or deemed to form or arising in any way for participation in this bidding process.
- v. The Bank also accepts no liability of any nature whether resulting from negligence or otherwise, howsoever caused arising from reliance of any Bidder upon the statements contained in this Tender Document.
- vi. The Bidder is expected to examine all instructions, forms, terms and specifications in this Tender Document. Failure to furnish all information required under this Tender Document or to submit a Bid not substantially responsive to this Tender Document in all respect will be at the Bidder's risk and may result in rejection of the Bid.
- vii. The issue of this Tender Document does not imply that the Bank is bound to select a Bidder or to award the contract to the Selected Bidder, as the case may be, for the Project and the Bank reserves the right to reject all or any of the Bids or Bidders without assigning any reason whatsoever before issuance of purchase order/LOI and/or its acceptance thereof by the successful Bidder as defined in Award Criteria and Award of Contract in this Tender Document.

9.2. COST OF BID DOCUMENT:

i) The participating Bidders shall bear all the costs associated with or relating to the preparation and submission of their Bids including but not limited to preparation, copying, postage, delivery fees, expenses associated with any demonstration or presentations which may be required by the Bank or any other costs incurred in connection with or relating to their Bid. The Bank shall not be liable in any manner whatsoever for the same or for any other costs or other expenses incurred by a Bidder regardless of the conduct or outcome of the bidding process.

ii) The Bidder shall also submit PRE-CONTRACT INTEGRITY PACT along with technical Bid as prescribed in Annexure- XVIII duly signed by the Bidder on each page and witnessed by two persons. The Pre-Contract Integrity Pact shall be stamped as applicable in the State where it is executed. Bid submitted without Pre-Contract Integrity Pact, as per the format provided in the Tender Document, shall not be considered.

9.3 CLARIFICATION AND AMENDMENTS ON Tender Document/PRE-BID MEETING:

i. Bidder requiring any clarification on Tender Document may notify the Bank in writing strictly as per the format given in **Annexure XIX** at the address/by e-mail within the date/time mentioned in the Notice Inviting Tender (NIT).

ii. A pre-Bid meeting will be held in person or online on the date and time specified in the Notice Inviting Tender (NIT) which may be attended by the authorized representatives of the Bidders interested in responding to this Tender Document.

iii. The queries received (without identifying source of query) and response of the Bank thereof will be posted on the Bank's website only..

iv. The Bank reserves the right to amend, rescind or reissue the Tender Document, at any time prior to the deadline for submission of Bids. The Bank, for any reason, whether, on its own initiative or in response to a clarification requested by a prospective Bidder, may modify the Tender Document, by amendment which will be made available to the Bidders by way of corrigendum/addendum. The interested parties/Bidders are advised to check the Bank's website regularly till the date of submission of Bid document specified in the Notice Inviting Tender (NIT)/email and ensure that clarifications / amendments issued by the Bank, if any, have been taken into consideration before submitting the Bid. Such amendments/clarifications, if any, issued by the Bank will be binding on the participating Bidders. Bank will not take any responsibility for any such omissions by the Bidder. The Bank, at its own discretion, may extend the deadline for submission of Bids in order to allow prospective

v. Bidders have a reasonable time to prepare the Bid, for taking the amendment into account. Nothing in this Tender Document or any addenda/corrigenda or clarifications issued in connection thereto is intended to relieve Bidders from forming their own opinions and conclusions in respect of the matters addressed in this Tender Document or any addenda/corrigenda or clarifications

issued in connection thereto.

vi. No request for change in commercial/legal terms and conditions, other than what has been mentioned in this Tender Document or any addenda/corrigenda or clarifications issued in connection thereto, will be entertained and queries in this regard, therefore will not be entertained.

vii. Queries received after the scheduled date and time will not be responded/acted upon.

9.4 MODIFICATION AND WITHDRAWAL OF BIDS:

i) The Bidder may modify or withdraw its Bid after the Bid's submission, provided modification, including substitution or withdrawal of the Bids, is received on <https://www.tenderwizard.com/SBIETENDER>, prior to the deadline prescribed for submission of Bids.

ii) No modification in the Bid shall be allowed, after the deadline for submission of Bids.

lii) No Bid shall be withdrawn in the interval between the deadline for submission of Bids and the expiration of the period of Bid validity specified in this Tender Document. Withdrawal of a Bid during this interval may result in the forfeiture of EMD submitted by the Bidder and other action as per terms of Tender Document.

9.5 PERIOD OF BID VALIDITY:

i) Technical Bid shall remain valid for duration of 90 days from the date opening of Price Bid. If the Bidder withdraws his/her offer during the validity period or makes modifications in his/her original offer which are not acceptance to the Bank without prejudice to any other right or remedy the Bank shall be at liberty to forfeit the EMD.

ii) In exceptional circumstances, the Bank may solicit the Bidders' consent to an extension of the period of validity. The request and the responses thereto shall be made in writing. A Bidder is free to refuse the request. However, in such case, the Bank will not forfeit its EMD. However, any extension of validity of Bids or price will not entitle the Bidder to revise/modify the Bid document.

iii) Once Purchase Order or Letter of Intent is issued by the Bank, the said price will remain fixed for the entire Contract period and shall not be subjected to variation on any account except as explicitly mentioned in this Tender Document. A Bid submitted with an adjustable price quotation will be treated as non-responsive and will be rejected.

9.6 BID INTEGRITY:

Willful misrepresentation of any fact within the Bid will lead to the cancellation of the contract without prejudice to other actions that the Bank may take. All the submissions, including any accompanying documents, will become property of the Bank. The Bidders shall be deemed to

license, and grant all rights to the Bank, to reproduce the whole or any portion of their Bid document for the purpose of evaluation and to disclose the contents of submission for regulatory and legal requirements.

9.7 WAIVER OF RIGHTS:

Each Party agrees that any delay or omission on the part of the other Party to exercise any right, power or remedy under this Tender Document will not automatically operate as a waiver of such right, power or remedy or any other right, power or remedy and no waiver will be effective unless it is in writing and signed by the waiving Party. Further the waiver or the single or partial exercise of any right, power or remedy by either Party hereunder on one occasion will not be construed as a bar to a waiver of any successive or other right, power or remedy on any other occasion.

9.8 BANK'S RIGHT TO ACCEPT ANY BID AND TO REJECT ANY OR ALL BIDS:

The Bank reserves the right to accept or reject any Bid in part or in full or to cancel the bidding process and reject all Bids at any time prior to contract award as specified in Award Criteria and Award of Contract, without incurring any liability to the affected Bidder or Bidders or any obligation to inform the affected Bidder or Bidders of the grounds for the Bank's action.

9.9 CODE OF INTEGRITY AND DEBARMENT/BANNING:

i. The Bidder and their respective officers, employees, agents and advisers shall observe the highest standard of ethics during the bidding Process. Notwithstanding anything to the contrary contained herein, the Bank shall reject Bid without being liable in any manner whatsoever to the Bidder if it determines that the Bidder has, directly or indirectly or through an agent, engaged in corrupt / fraudulent / coercive / undesirable or restrictive practices in the bidding Process.

ii. Bidders are obliged under code of integrity to Suo-moto proactively declare any conflicts of interest (pre-existing or as and as soon as these arise at any stage) in Tender Document process or execution of contract. Failure to do so would amount to violation of this code of integrity.

iii. Any Bidder needs to declare any previous transgressions of such a code of integrity with any entity in any country during the last three years or of being debarred by any other procuring entity. Failure to do so would amount to violation of this code of integrity.

iv. For the purposes of this clause, the following terms shall have the meaning hereinafter, respectively assigned to them:

(a) "**Corrupt practice**" means making offers, solicitation or acceptance of bribe, rewards or gifts or any material benefit, in exchange for an unfair advantage in the procurement process or to otherwise influence the procurement process or contract execution.

(b) **“Fraudulent practice”** means any omission or misrepresentation that may mislead or attempt to mislead so that financial or other benefits may be obtained or an obligation avoided. This includes making false declarations or providing false information for participation in a Tender Document process or to secure a contract or in execution of the contract.

(c) **“Coercive practice”** means harming or threatening to harm, persons or their property to influence their participation in the procurement process or affect the execution of a contract.

(d) **“Anti-competitive practice”** means any collusion, bid rigging or anti-competitive arrangement, or any other practice coming under the purview of the Competition Act, 2002, between two or more bidders, with or without the knowledge of the Bank, that may impair the transparency, fairness and the progress of the procurement process or to establish bid prices at artificial, non-competitive levels.

(e) **“Obstructive practice”** means materially impede the Bank’s or Government agencies investigation into allegations of one or more of the above mentioned prohibited practices either by deliberately destroying, falsifying, altering; or by concealing of evidence material to the investigation; or by making false statements to investigators and/or by threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation; or by impeding the Bank’s rights of audit or access to information;

v. Debarment/Banning

Empanelment/participation of Bidders and their eligibility to participate in the Bank’s procurements is subject to compliance with code of integrity and performance in contracts as per terms and conditions of contracts. Following grades of debarment from empanelment/participation in the Bank’s procurement process shall be considered against delinquent Vendors/Bidders:

(a) Holiday Listing (Temporary Debarment - suspension):

Whenever a Vendor is found lacking in performance, in case of less frequent and less serious misdemeanors, the vendors may be put on a holiday listing (temporary debarment) for a period up to 12 (twelve) months. When a Vendor is on the holiday listing, he is neither invited to bid nor are his bids considered for evaluation during the period of the holiday. The Vendor is, however, not removed from the list of empaneled vendors, if any. Performance issues which may justify holiday listing of the Vendor are:

- Vendors who have not responded to requests for quotation/tenders consecutively three times without furnishing valid reasons, if mandated in the empanelment contract (if applicable).
- Repeated non-performance or performance below specified standards (including after sales services and maintenance services etc.).

- Vendors undergoing process for removal from empanelment/participation in procurement process or banning/debarment may also be put on a holiday listing during such proceedings.

(b)Debarment from participation including removal from empanelled list

Debarment of a delinquent Vendor (including their related entities) for a period (one to two years) from the Bank's procurements including removal from empanelment, wherever such Vendor is empaneled, due to severe deficiencies in performance or other serious transgressions. Reasons which may justify debarment and/or removal of the Vendor from the list of empaneled vendors are:

- Without prejudice to the rights of the Bank under Clause 45(i) hereinabove, if a Bidder is found by the Bank to have directly or indirectly or through an agent, engaged or indulged in any corrupt/fraudulent/coercive/undesirable or restrictive practices during the bidding Process, such Bidder shall not be eligible to participate in any EOI/Tender Document issued by the Bank during a period of 2 (two) years from the date of debarment.
- The Vendor fails to abide by the terms and conditions or to maintain the required technical/operational staff/equipment or there is change in its production/service line affecting its performance adversely or fails to cooperate or qualify in the review for empanelment.
- If Vendor ceases to exist or ceases to operate in the category of requirements for which it is empaneled.
- Bankruptcy or insolvency on the part of the vendor as declared by a court of law; or
- Banning by Ministry/Department or any other Government agency.
- Other than in situations of force majeure, technically qualified Bidder withdraws from the procurement process or after being declared as successful bidder: (i) withdraws from the process; (ii) fails to enter into a Contract; or (iii) fails to provide performance guarantee or any other document or security required in terms of the Tender Document documents.
- If the Central Bureau of Investigation/CVC/C&AG or Vigilance Department of the Bank or any other investigating agency recommends such a course in respect of a case under investigation.
- Employs a government servant or the Bank's Officer within two years of his retirement, who has had business dealings with him in an official capacity before retirement; or
- Any other ground, based on which the Bank considers, that continuation of Contract is not in public interest.

- If there is strong justification for believing that the partners / directors / proprietor /agents of the firm/company have been guilty of violation of the code of integrity or Integrity Pact (wherever applicable), evasion or habitual default in payment of any tax levied by law; etc.

(c) Banning from Ministry/Country-wide procurements

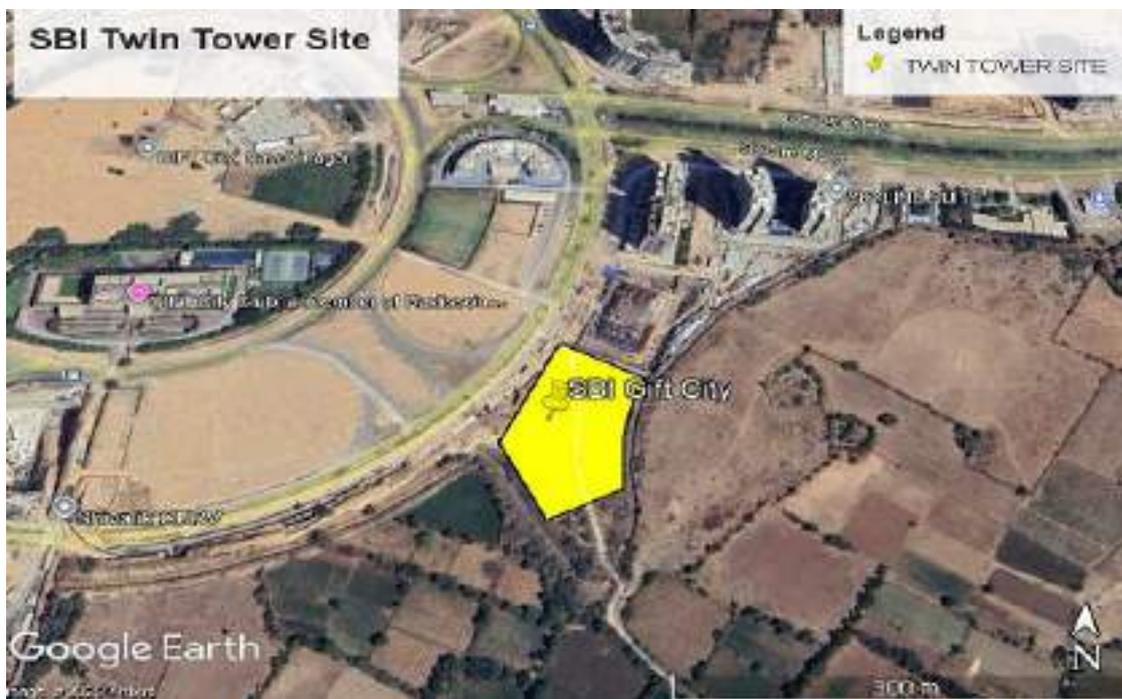
For serious transgression of code of integrity, a delinquent Vendor (including their related entities) may be banned/debarred from participation in a procurement process of the Bank including procurement process of any procuring entity of Government of India for a period not exceeding three years commencing from the date of debarment.

10.0 PART -B of INFORMATION & INSTRUCTIONS FOR BIDDERS FOR e-BIDDING:**10.1 Scope of work**

Sealed Tenders are invited by M/s. VK:a architecture for and behalf of State Bank of India for the Construction works of Civil, Plumbing, Sanitary, Electrical, Firefighting, HVAC, SECURITY- EQUIPMENT, LIFTS, IBMS, Landscaping, and Allied Services, etc. for the Proposed Construction of Residential Twin Towers at **Block No 41 A & B, Gift City, Gandhinagar, Gujarat**

10.1.1 Site and its location

The proposed work is to be carried out at **Block No 41 A & B, Gift City, Gandhinagar, Gujarat**.

**10.2 Tender Documents**

10.2.1 The work must be carried out strictly according to the conditions stipulated in the tender consisting of the following documents and the most workmen like manner.

- a. Instructions to Tenderers
- b. General Conditions of Contract
- c. Special Conditions of Contract
- d. Additional Conditions for Electrical Installation
- e. Technical Specifications
- f. Drawings
- g. Price bid

10.2.2 The above documents shall be taken as complementary and mutually explanatory of one another but in case of ambiguities or discrepancies, shall take precedence in the order given

below:

- a. Price Bid
- b. Drawings
- c. Technical specifications
- d. Additional Conditions for Electrical Installation
- e. Special conditions of contract
- f. General conditions of contract
- g. Instructions to Tenderers

Note: - Even though preference in the order above is given to the Price Bid, the higher-grade Detailed technical specifications mentioned in the Tender Documents and drawings shall always be followed during execution of the works.

10.2.3 The Tender Documents are not transferable.

10.3 Site Visit

10.3.1 The Bidder must obtain himself on his own responsibility and his own expenses all information and data which may be required for the purpose of filling this Tender Document and enter into contract for the satisfactory performance of the work. The Bidder is requested to satisfy himself regarding the availability of water, power, transport and communication facilities, the character quality and quantity of the materials, labour, the law-and-order situation, climatic conditions, local conditions, local authorities' requirements, traffic regulations etc.

The Bidder will be fully responsible for considering the financial effect of any or all the factors while submitting his tender.

10.3.2 The rates quoted by the Bidder in the tender will be adequate to complete such work according to the specifications and conditions attached thereto and he has taken into account all conditions and difficulties that may be encountered during its progress and to have quoted labour and material rates, which shall include cost of materials with taxes, octroi, levies, royalties, cess, and other duties, lead, lift, loading and unloading freight for materials, and all other charges including the furnishing of all plant, equipment, tools, scaffolding and other facilities and services necessary or proper for the completion and maintenance of the work, except such as may be otherwise expressly provided in the contract documents for the completion and maintenance of the work to the entire satisfaction of the APMCF/ Bank. The TDS amount on prevailing rate shall be deducted from Contractor's Running Account/ Final bills and paid to the Government. However, GST will be paid extra as actual.

10.3.3. The successful Bidder shall make his own arrangements for all materials except as specified in the contract if any.

10.3.4 The quantities indicated in the attached Schedule of Items are furnished solely for the purpose of providing a general guide to the scope of the work and are approximate in nature. Such quantities shall be subject to increase, decrease, or omission as may be required to meet the actual requirements of the Employer, and the Employer makes no representation or warranty,

express or implied, as to the accuracy or completeness of the said quantities. The Employer shall not be held liable for any discrepancy therein, nor shall the Contractor be entitled to any claim or compensation by reason of any variation, increase, decrease, or omission in respect of such quantities or in the event that no work is required under any particular item. Payment to the Contractor shall be limited strictly to the work executed, duly measured, and certified by the Employer or its authorised representative in accordance with the provisions of the Contract.

10.3.5 The Form of Agreement, Form of Tender, Invitation to Tender, Instruction to Tender, General Conditions of Contract, Special Conditions of Contract, Specifications, Drawings, Time Schedule and the rates and amounts accepted against the items of the Tender Schedule together with the Tender covering letter, and all correspondence entered into between the APMCF/Bank and the Bidder prior to the issue of the Letter of Intent and the Letter of Intent awarding the work and acceptance by Bidder shall form the contract.

10.3.6 The Security Protocol, Systems & Procedures of State Bank of India has to be meticulously followed & complied with during the currency of contract.

10.4 Earnest Money

10.4.1 The tenderers are requested to submit the Earnest Money the form of Demand Draft or Banker's Cheque drawn in favor of State Bank of India payable at Gift City, Gandhinagar as mentioned in the para number 4.0 of NIT from any Bank in India. EMD to be deposited before the last date of submission of the technical bid.

10.4.2 EMD in any other form other than as specified above will not be accepted. Tender not accompanied by the EMD in accordance with clause 4.1 above shall be rejected.

10.4.3 No interest will be paid on EMD.

10.4.4 EMD of unsuccessful Bidder will be refunded within 30 days of award of Contract.

10.4.5 EMD of successful Bidder will be retained as a part of security deposit.

10.5 Initial/ Security Deposit

The successful Bidder will have to submit a sum equivalent to 2% of contract value less EMD by means of DD drawn in favor of State Bank of India Payable at Gift City, Gandhinagar within a period of 15 days of acceptance of tender

10.6 Security Deposit / Retention amount:

10.6.1 Total security deposit shall be 5% of contract value. Out of this 2% of contract value is in the form of Initial Security Deposit (ISD) which includes the EMD. Balance 3% shall be deducted from the running account bill of the work at the rate of 10% of the respective running account bill i.e., deduction from each running bill account will be 10% till total Security Deposit (TSD) including ISD reaches to 5% of contract value. This Retention amount shall be released by the SBI in in 2 stages, 50% of the total security shall be paid to the contractors on the basis of architect's certification

of the virtual completion. The balance 50% would be paid to the contractors after the defect liability period as specified in the contract and provided no complaint is received or the defects has been rectified by replacing the same satisfactorily.

10.6.2 No interest shall be paid to the amount retained by the Bank as Security Deposit & Additional Security Deposit.

10.6.3 Additional Security deposit (ASD)/Additional performance Guarantee (APG) shall be applicable if the bid price is below 10.0% of the estimated cost put to tender and the quoted price. The amount of such ASD/ APG shall be the difference between 90.0 % of estimated cost put to tender and the quoted price. ASD in the format of DD / Banker's Cheque / Bank Guarantee shall be submitted within 15 days of intimation of award of work / work order, without which the contractor will not be allowed to start the work and failure of submission of ASD will result in forfeiture of EMD and cancellation of tender.

10.7 Signing of contract Documents

The successful Bidder shall be bound to implement the contract by signing an agreement and conditions of contract within **15** days from the receipt of intimation of acceptance of the tender by the SBI. However, the written acceptance of the tenders by the Bank will constitute a binding agreement between the Bank and successful Bidder whether such formal agreement is subsequently entered into or not.

10.8 Completion Period

Refer Clause No 27 of GCC.

10.9 Validity of Tender –

Refer Clause No. 9.5, Part A of Information, and Instruction to Bidders

10.10 Liquidated Damages

Please refer to Clause No 8 of GCC.

10.11 Rate and prices:

10.11.1 In case of item rate tender

10.11.1.1 The tenderers shall quote their rates for individual items both in words and figure. In case of discrepancy between the rate quoted in words and figures, the unit rate quantity in words will prevail. If no rate is quoted for particular one or more tender items, the contractor shall not be paid for that item when it is executed.

The amount of each item shall be calculated, and the requisite total is given. In case of discrepancy between the unit rate and the total amount calculated from multiplication of unit rate and the quantity the unit rate quoted will govern and the amount will be corrected.

10.11.1.2 The tenderers need not quote their rates for which no quantities have been given. In case the tenderers quote their rates for such items those rates will be ignored and will not be considered during execution.

10.11.1.3 The tenderers should not change the units as specified in the tender. If any unit is changed the tenders would be evaluated as per the original unit and the Contractor/ Vendor would be paid accordingly.

The Bidder should not change or modify or delete the description of the item. If any discrepancy is observed he should immediately bring to the knowledge of the SBI/APMCF.

10.11.1.4 Each page of the BOQ & all other documents on technical bid shall be signed by the authorized person and cutting or overwriting shall be duly attested by him.

10.11.1.5 Each page shall be totaled, and the grand total shall be given.

10.11.1.6 The quoted rate should be firm & inclusive of materials, labour, wages, fixtures, transportation, installation, wastages, Octroi, levies, all cess, royalties, all taxes (but excluding GST), machinery, temporary works such as scaffolding, cleaning, overheads, profit, statutory expenses, incidental charges and all related expenses to complete the work during the currency of contract including authorized extension, if any, but excluding GST, which shall be mentioned in the bills/invoices separately, as applicable. GST shall be as applicable on actuals.

10.11.1.7 The SBI reserve their rights to accept any tenders, either in whole or in part or may entrust the work in phases or may drop the part scope of work at any stage of the project within its sole discretion without assigning any reason(s) for doing so and no claim / correspondence shall be entertained in this regard.

10.11.1.8 In case, it is decided by the SBI to drop one or more Items from the scope of work at any stage of the project, the Contractor/ Vendor shall not be entitled to raise any claim /compensation for such deleted scope of work

10.12 Pre-bid conference held as per NIT point no. 8. Bidders should send all queries by email mail@vkarch.com, sdoshi@vkarch.com, agmpe.lhognr@sbi.co.in, agmcivil.lhognr@sbi.co.in, before pre-bid conference, latest 11.00 Hrs. before 2 days before of prebid conference Because of pre-bid conference, certain modifications may be issued to all eligible bidders by the APMCF /SBI by e-mail, if require. If further pre-bid conferences are required for complete and effective interactions, the date and time of same will be communicated at the end of 1st pre-bid meeting or later. All modifications/addendums/corrigendum issued regarding this bidding process, shall be uploaded on website only and shall not be published in any Newspaper.

10.13 The bid submitted shall become invalid if:

i. The bidder does not deposit EMD and Pre contract integrity pact with SBI office on given address within stipulated time.

ii. The bidder does not upload all the documents as listed in “List of Documents to be scanned & uploaded with duly signed & stamp and as well as in hard copy within the period of bid submission”.

Refer clause 7.2.1 of Instruction to Bidders List of Documents to be scanned, uploaded and submitted hard copy within the period of bid submission of Bid documents

**** Note:** - Bidder shall submit the original copy of duly executed Documented as mentioned above and seal it in an envelope and mark the envelope as "Technical Bid." The said envelope shall clearly bear the name of the NIT and name and address of the Bidder. In addition, the last date for bid submission should be indicated on the right and corner of the envelope. The hard copies as mentioned above should be submitted within the bid submission date and time for the NIT at the address mentioned in Sl No 10 of Notice Inviting Tender, failing which Bid will be treated as non-responsive.

10.14 Evaluation of Bids:

(i) At First Technical Bid evaluation will be done. Upon scrutiny of submitted documents, verification, Site visit, Bidders will get shortlisted and these bidders shall be treated as technically qualified bidders.

(ii) The bidders who submit the Bid and above documents without any conditions and in compliance of NIT shall be considered only for evaluation and The Financial/Price Bid of shall be opened of the Bidders, who will be technically qualified.

10.15 Award criteria and Award of contract:

i. Prospective Bidders shall submit Technical Bid and Price Bid as per the Schedule Described in the NIT.

ii. Applications received from prospective bidders regarding Technical Bid shall be first scrutinized and list of all eligible contractors based on prequalification criteria given in Technical Bid shall be finalized from various applicants.

iii. The eligible contractors shall be informed about the scheduled date of Opening of Price Bid.

iv. The Technical bid shall be opened as per schedule and evaluated as per clause no 10.14 as mentioned above.

v. . The Price bids of technically qualified venders will be opened, and the final Award of Contract shall be based on L1 Basis.

11.0 LETTER OF TRANSMITTAL AND UNDERTAKING (Annexure-V)

(The bidders are required to print this on their company's head and sign, stamp before emailing)

To,
 The Assistant General Manager (Premises & Estate),
 Premises & Estate Dept.,
 Local Head Office, GIFT City
 Gandhinagar, Gujarat-382355

Dear Sir,

Having examined the drawings, specification, design and schedule of quantities relating to the works specified in the memorandum hereinafter set out and having visited and examined the site of the works specified in the said memorandum and having acquired the requisite information relating thereto as affecting the tender, I/We hereby offer to execute the works specified in the said memorandum at the rates mentioned in the attached Schedule of Quantities and in accordance in all respects with the specifications, design, drawings and instructions in writing referred to in conditions of tender, the Articles of Agreement, Special Conditions, Schedule of Quantities and Conditions of Contract and with such materials as are provided for by, and in all other respects in accordance with such conditions so far as they may be applicable.

MEMORANDUM

(a)	Description of work	Composite Construction works of Civil, Plumbing, Sanitary, Electrical, Firefighting, HVAC, Security Equipment, IBMS, LIFTS, Landscaping, and Allied Services, etc. for the Proposed Construction Residential Twin Towers at Block No 41 A & B, Gift City, Gandhinagar, Gujarat”
(b)	Earnest Money	As per Clause 4 of the NIT
(c)	Time allowed for completion of the Works from fifteenth day after the date of written Order or date of handing over of the site (Whichever is later) to commence the work.	As per Clause No 27 of GCC.

1) Should this tender be accepted, I/we hereby agree to abide by and fulfill the terms and provisions of the said conditions of contract annexed hereto so far as may be applicable or in default thereof to forfeit and pay to SBI, the amount mentioned in the said contract.

2) I / We have deposited a sum of **₹. 2,53,33,000.00** (Rupees Two Crore Fifty-Three Lakhs Thirty-Three Thousand Only) of the total tender amount as Earnest Money with the SBI which amount is not to bear any interest. Should I / We fail to execute the Contract when called upon to do so I / We do hereby agree that this sum shall be forfeited by me/us to State Bank of India.

3) I/ We understand that as per terms of this tender, the SBI may consider accepting our tender in part or whole or may entrust the various work proposed in phases. We, therefore, undertake that we shall not raise any claim/ compensation in the eventuality of Bank deciding to drop any of the work from the scope of work of this tender at any stage during the contract period. Further, we also undertake to execute the work entrusted to us in phases on our approved rates and within stipulated time limit without any extra claim for price escalation unless otherwise separately mentioned as also provided for in the clauses of "Instructions to Tenderers" of this tender.

4) I/ We hereby also undertake that we will not raise any claim for any escalation in the prices of any of the material during the contract/execution/completion period including authorized extended contract period, if any.

5) Our Bankers are:

- i)
- ii)

The names of partners of our firm are:

- i)
- ii)

Name of the partner of the firm Authorised to sign

Or

(Name of person having Power of Attorney to sign the Contract.

(Certified true copy of the Power of Attorney should be attached)

Yours faithfully,

Signature of Contractors.

Signature and addresses of Witnesses

- i) ii)

12.0 GENERAL CONDITIONS OF CONTRACT (GCC)

“Contract” means the documents forming the tender and the acceptance thereof and the formal agreement executed between State Bank of India (Client) and the contractor, together with the documents referred therein including these conditions, the specifications, designs, drawings and instructions issued from time to time by the APMCF/Bank and all these documents taken together shall be deemed to form one contract and shall be complementary to one another. 1.1 In the contract the following expressions shall, unless the context otherwise requires, have the meaning hereby respectively assigned to them.

1.1.1 ‘SBI’ shall mean State Bank of India (client) a body Corporate created under State Bank of India Act 1955, having its Corporate Centre at State Bank Bhavan, Madame Cama Road, Mumbai 400021 and a LHO at GIFT City, Gandhinagar, Gujarat-382355 and includes the client’s representatives, successors, and assigns. ‘APMCF’ shall mean M/s. VK: a architecture

1.1.2 ‘Site Engineer’ shall mean an Engineer appointed by the Bank as their representative to give instructions to the contractors.

1.1.3 ‘The Contractor’ shall mean the individual or firm or company whether incorporated or not, undertaking the works and shall include legal personal representative of such individual or the composing the firm or company and the permitted assignees of such individual or firms of company. The expression ‘works or ‘work’ shall mean the permanent or temporary work described in the ‘Scope of Work” and/or to be executed in accordance with the contract and includes materials, apparatus, equipment, temporary supports, fittings and things of all kinds to be provided, the obligations of the contractor hereunder and work to be done by the contractor under the contract.

1.1.4 ‘Engineer’ shall mean the representative of the APMCF.

1.1.5 ‘Drawings’ shall mean the drawings prepared by the Architects and issued by the Engineer and referred to in the specifications and any modifications of such drawings as may be issued by the Engineer from time to time ‘Contract value shall mean the value of the entire work as stipulated in the letter of acceptance of tender subject to such additions thereto or deductions there from as may be made under the provision herein after contained.

1.1.6 ‘Specifications’ shall mean the specifications referred to in the tender and any modifications thereof as may time to time be furnished or approved by the APMCF.

1.1.6a “Month” means calendar month.

1.1.7 “Week” means seven consecutive days.

1.1.8 “Day” means a calendar day beginning and ending at 00 Hrs. and 24 hrs. respectively

1.1.9 The following shall constitute the Joint Project Committee (herein under referred to as JPC) for assessing and reviewing the progress of the work on the project and to issue instructions or

directions from time to time for being observed and followed by the APMCF's Site Engineer /APMCF and other consultants / contractors engaged in the execution of the project.

- I)** Assistant General Manager (Premises & Estate),
- II)** Assistant General Manager (Civil),
- III)** SBI Engineer (Civil, Electrical, Fire & Security) in-charge of the Project, as may be nominated by the Premises & Estate Department, State Bank of India, Gift City, Gandhinagar.
- IV)** Concerned partner / proprietor of the Architects or Their Project Architect
- V)** Resident Civil Engineer- in Charge of PMC.

VI) 1.1.10 "SITE" shall mean the land and/ or other places on, into or through which work is to be executed under the contract or any adjacent land, path or street through which work is to be executed under the contract or any adjacent land, path or street which may be allotted or used for the purpose of carrying out the contract.

VII) 1.1.11 "NOTICE" in writing or written notice means a notice in writing typed or printed characters sent (unless delivered personally or otherwise proved to have been received) by registered post to the last known private or business address or registered office of the Bidder/ contractor and or at the mail id mentioned by the contractor in the "form of tender" of these tender document and shall be deemed to have been received when in the ordinary course of post it would have been delivered. .

VIII) 1.1.12 "APPROVED" means approved in writing including subsequent written confirmation of previous verbal approval and "Approval" means approved in writing including as aforesaid.

IX) 1.1.13 "SCHEDULED BANK" means bank included in the second schedule to the Reserve Bank of India Act, 1934.

X) 1.1.14 "SUBCONTRACTOR" means any person, firm or corporation having a contract for the execution of a part or parts of the work included in the contract and a person, firm or corporation furnishing materials called for in the contract and worked to a special design according to the specifications.

1.1.16 "CONTRACT PERIOD" means the accepted period of consecutive days stated on the Form of Tender starting from the APMCF or Employer's order to commence the work.

1.1.17 "APMCF" shall mean M/s VK: a Architecture, Pune who are the Project Architect and Project Management Consultants, hereinafter abbreviated as APMCF and their personnel like Architects, Engineers, Associates, Site Engineers, Project Engineers, Consulting Engineers, PMC Personnels etc. appointed by the SBI at site as their representative for day-to-day supervision of work and to give instructions to the contractors.

1.1.18 "Complete Project Closure Report" by SBI and APMCF means following conditions are satisfied and all works related to it are complete & reports closed after due repairs, replacements, trials, test, etc.

The project shall be considered complete & closed only when:

- a. **Defect Liability Period (DLP)** for all items of work is over: DLP is for 18 months (Other than Specifically Mentioned in Tender Document) from the date of virtual completion (as per Para 23 of GCC) of work
- b. Acceptance & closure of all queries & works after due rectification/replacements/ tests as referred by Chief Technical Examiner, CVC and
- c. Acceptance and closure of all arbitration, court cases, etc. as decided by the Bank whichever is later.

2.0 Total Security Deposit

Total Security deposit comprises of

- a) Earnest Money Deposit
- b) Initial Security Deposit
- c) Retention Money
- d) Additional Security Deposit

a) Earnest Money Deposit -

The Bidder shall furnish EMD of ₹. **2,53,33,000.00** ((Rupees Two Crore Fifty-Three Lakhs Thirty-Three Thousand Only) in the form of Demand Draft or Banker's Cheque drawn in favor of State Bank of India Payable at Gift City, Gandhinagar of any schedule Bank. No tender shall be considered unless the EMD is so deposited in the required form. No interest shall be paid on this EMD. The EMD of the unsuccessful Bidder shall be refunded within 30 days after the decision to award the contract is taken without interest. The EMD shall stand absolutely forfeited if the Bidder revokes his tender at any time period when he is required to keep his tender open acceptance by the SBI or after it is accepted by the SBI the contractor fails to enter into a formal agreement or fails to pay the initial security deposit as stipulated. Or fails to commence the work within the stipulated time.

b) Initial Security Deposit (ISD)

The amount of ISD shall be 2% of accepted value of tender including EMD. Balance of ISD (i.e. excluding EMD) is to be submitted in the form of D/D drawn on any scheduled Bank and shall be deposited within 15 days from the date of letter of acceptance of tender.

c) Retention Money: -

Besides the ISD as deposited by the contractor in the above-mentioned manner the retention money shall be deducted from the running account bill at the rate of 10% of the gross value of work done by the contractor and claimed in each bill provided the total security deposit i.e. the ISD plus Retention Money shall both together not exceed 5% of the contract value. 50% of the total security deposit shall be refunded to the contractor without any interest, on issue of Virtual Completion certificate by the APMCF. The balance of 50% of the total security

deposit shall be refunded to the contractors without interest within fifteen days after the end of defects liability period provided the contractor has satisfactorily attended to all defects in accordance with the conditions of contract including site clearance.

d) Additional Security Deposit: -

Additional Security deposit (ASD)/Additional performance Guarantee (APG) shall be applicable if the bid price is below 10% of the estimated cost put to tender. The amount of such ASD/ APG shall be the difference between 90% of estimated cost put to tender and the quoted price. ASD in the format of DD / Banker's Cheque / Bank Guarantee shall be submitted within 15 days of intimation of award of work / work order, without which the contractor will not be allowed to start the work and failure of submission of ASD will result in forfeiture of EMD and cancellation of tender. or eg, if a contractor is quoting 15% below the estimated cost put to tender (i.e. 85% of the estimate), then ASD of 5% of estimated cost is required to be obtained from the contractor (90%-85%). The ASD will be returned / released after virtual completion of the project within 30 days after issue of Virtual completion certificate.

3.0 Language Errors, Omissions and Discrepancies

In case of errors, omissions and/or disagreement between written and scaled dimensions on the drawings or between the drawings and specifications etc., the following order shall apply.

- i) Between scaled and written dimensions (or description) on a drawing, the latter shall be adopted.
- ii) Between the written or shown description or dimensions in the drawings and the corresponding one in the specification the former shall be taken as correct.
- iii) Between written description of the item in the specifications and descriptions in bills of quantities of the same item, the latter shall be adopted.
- iv) In case of difference between rates written in figures and words, the rate in words prevails.
- v) Between the duplicate/subsequent copies of the tender, the original tender shall be taken as correct.

4.0 Scope of Work:

The contractor shall carry out complete and maintain the said work in every respect strictly accordance with this contract and with the directions of and to the satisfaction of the Bank to be communicated through the APMCF. The APMCF at the directions of the SBI from time-to-time issue further drawings and / or written instructions, details directions and explanations which are here after collectively referred to as APMCF 's/SBI's instructions. In regard to the variation or modification of the design, quality or quantity of any work or the

addition or omission or substitution of any work, any discrepancy in the drawings or between BOQ and / or drawings and / or specifications, the removal from the site of any material brought thereon by the Contractor and any substitution of any other materials thereof, the demolition removal and / or re-execution of any work executed by him, the dismissal from the work of any person employed/engaged thereupon.

5.0 i) Letter of Acceptance:

Within the validity period of the tender the SBI shall issue a letter of acceptance either directly or through the APMCF by registered post or otherwise depositing at the address of the contractor as given in the tender to enter into a Contract for the execution of the work as per the terms of the tender. The letter of acceptance shall constitute a binding contract between the SBI and the contractor.

ii) Contract Agreement:

On receipt of intimation of the acceptance of tender from the SBI/APMCF the successful Bidder shall be bound to implement the contract and within fifteen days thereof he shall sign an agreement in a non-judicial stamp paper of appropriate value.

6.0 Ownership of drawings:

All drawings, specifications and copies thereof furnished by the SBI through its APMCF are the properties of the SBI. They are not to be used on other work.

7.0 Detailed drawings and instructions:

The SBI, through its APMCF, shall furnish with reasonable promptness additional instructions by means of drawings or otherwise necessary for the proper execution of the work. All such drawings and instructions shall be consistent with the contract documents, true developments thereof and reasonably inferable there from.

The work shall be executed in conformity therewith and the contractor shall prepare a detailed programme schedule (i.e. BAR/PERT Chart) indicating therein the date of start and completion of various activities on receipt of the work order and submit the same to the SBI through the APMCF

3 Sets of hard Copies of working drawings will be issued to Contractor by the APMCF, Contractor shall make necessary laminations, waterproof paper covering & filing so that these drawings will be available in good condition at site throughout the period of works.

7.1 Copies of agreement

Two copies of agreement/tender document duly signed by both the parties in a non-judicial stamp paper of Rs 500/- with the drawings shall be handed over to the contractors.

8.0 Liquidated damages:

If the contractor fails to maintain the required progress in terms of clause 27, 29 & 30 of GCC or to complete the work and clear the site including vacating their office on or before the contracted or extended date or completion without justification in support of the cause of delay, he may be called upon without prejudice to any other right of remedy available under the law to the SBI on account of such breach to pay a liquidated damages at the rate of 0.5% of the contract value per week subject to a maximum of 5% of the contract value.

9.0 Materials, Appliances and Employees

Unless or otherwise specified the contractor shall provide and pay for all materials, labour, water, power, tools, equipment, transportation and any other facilities that are required for the satisfactory execution and completion of the work. Unless or otherwise specified all materials shall be new and both workmanship and materials shall be best quality. The contractor shall at all times enforce strict discipline and good order among his employees and shall not employ any unfit person or anyone not skilled in the work assigned to him. Workman whose work or behavior is found to be unsatisfactory by the SBI/APMCF he shall be removed from the site immediately.

10.0 Permits, Laws and Regulations:

All the Permits and licenses required for the execution of the work shall be obtained by the contractor at his own expense.

The contractor shall give notices and comply with the regulations, laws, and ordinances rules, applicable to the contractor. If the contractor observes any discrepancy between the drawings and specifications, he shall promptly notify the SBI in writing under intimation of the APMCF. If the contractor performs any act which is against the law, rules and regulations he shall meet all the costs arising there from and shall indemnify the SBI of any legal actions arising there from.

11.0 Setting out Work:

The contractor shall set out the work and shall be responsible for the true and perfect setting out of the same and for the correctness of the positions, levels, dimensions, and alignment of all parts thereof and get it approved by the APMCF before proceeding with the work. If at any time any error in this respect shall appear during the progress of the works, irrespective of the fact that the layout has been approved by the APMCF the contractor shall be responsible for the same and shall at his own expenses rectify such error, if so, required to satisfaction of the APMCF/SBI.

12.0 Protection of works and property:

The contractor shall continuously maintain adequate protection of all his work from damage and shall protect the SBI's properties from injury or loss arising in connection with contract. He shall make good any such damage, injury, loss due to his fault or negligence except which are due to causes beyond his control.

He shall take adequate care and steps for protection of the adjacent properties. The contractor shall take all precautions for safety and protection of his employees on the work and shall comply with all applicable provisions of Government and local bodies' safety laws

and building codes to prevent accidents or injuries to persons or property of about or adjacent to his place of work. The contractor shall take insurance covers as per clause 24.0 and 25.0 at his own cost. The policy may be taken in joint names of the contractors and the SBI and the original policy may be lodged with the SBI.

13.0 Inspection of work:

The SBI / APMCF or their representatives shall at all reasonable times have free access to the work site and/or to the workshop, factories or other places where materials are lying or from where they are obtained and the contractor shall give every facility to the SBI, APMCF and their representatives necessary for inspection and examination and test of the materials and workmanship. No person unless authorized by the SBI/APMCF except the representative of public authorities shall be allowed on the work at any time. The proposed work either during its construction stage or its completion can also be inspected by the Chief Technical Examiner's organization, a wing of Central Vigilance Commission.

14.0 Assignment and subletting

The whole of work included in the contract shall be executed by the contractor and he shall not directly entrust and engage or indirectly transfer assign or underlet the contract or any part or share thereof or interest therein without the written consent of the SBI through the architect and no undertaken shall relieve the contractor from the responsibility of the contractor from active superintendence of the work during its progress.

15.0 Quality of materials, workmanship & Test

(i) All materials and workmanship shall be best of the respective kinds described in the contract and in accordance with APMCF instructions and shall be subject from time to time to such tests as the APMCF may direct at the place of manufacture or fabrication or on the site or an approved testing laboratory. The contractor shall provide such assistance, instruments, machinery, labour and materials

(ii) Samples: All samples of adequate numbers, size, shades & pattern as per specifications shall be supplied by the contractor without any extra charges. If certain items proposed to be used are of such nature that samples cannot be presented or prepared at the site detailed literature/test certificate of the same shall be provided to the satisfaction of the Architect/consultant. Before submitting the sample/literature the contractor shall satisfy himself that the material/equipment for which he is submitting the samples/literature meets the requirement of tender specification. Only when the samples are approved in writing by the APMCF, the contractor shall proceed with the procurement and installation of the particular material/equipment. The approved samples shall be signed by the APMCF for identification and shall be kept on record at site office until the completion of the work for inspection/comparison at any time. The APMCF shall take reasonable time to approve the sample. Any delay that might occur in approving the samples for reasons of its not meeting the specifications or other discrepancies inadequacy in furnishing samples of best qualities from various manufacturers and such other aspects causing delays on the approval of the materials / equipment etc shall be to the account of the contractor.

(iii) Cost of tests

The cost of making any test shall be borne by the contractor if such test is intended by or provided for in the specifications or BOQ.

iv) Costs of tests not provided for

If any test is ordered by the APMCF which is either

If so intended by or provided for or (in the cases above mentioned) is not so particularized, or though so intended or provided for but ordered by the APMCF to be carried out by an independent person at any place other than the site or the place of manufacture or fabrication of the materials tested or any Government / approved laboratory, then the cost of such test shall be borne by the contractor.

16.0 Obtaining information related to execution of work

No claim by the contractor for additional payment shall be entertained which is consequent upon failure on his part obtaining correct information as to any matter affecting the execution of the work nor any misunderstanding or the obtaining incorrect information or the failure to obtain correct information relieves him from any risks or from the entire responsibility for the fulfillment of contract.

17.0 Contractor's Superintendence

The contractor shall give necessary personal superintendence during the execution of the works and as long, thereafter, as the APMCF may consider necessary until the expiry of the defect liability period, stated here to.

18.0 Quantities

i) The bill of quantities (BOQ) unless or otherwise stated shall be deemed to have been prepared in accordance with the Indian Standard Method of Measurements.

The rate quoted shall remain valid for variation of quantity against individual item to any extent subject to maximum variation of the contract value by 25%. The entire amount paid under Clause 20 hereof as well as amounts of prime cost and provisional sums, if any, shall be excluded.

ii) Variation exceeding 25%: The items of work executed in relation to variation exceeding 25% shall be paid on the basis of provisions of clause 19 to 21 hereof.

19.0 Works to be measured

The APMCF may from time to time intimate to the contractor that he required the work to be measured, and the contractor shall forthwith attend or send a qualified representative to assist the Architect in taking such measurements and calculation and to furnish all particulars or to give all assistance required by any of them. Such measurements shall be taken in accordance with the Mode of measurements detailed in the specifications. The representative of the APMCF shall take joint measurements with the contractor's representative and the measurements shall be entered in the measurement book. The

contractor or his authorized representative shall sign all the pages of the measurement book in which the measurements have been recorded in token of his acceptance. All the corrections shall be duly attested by both representatives. No over writings shall be made in the M book. Should the contractor not attend or neglect or omit to depute his representative to take measurements then the measurements recorded by the representative of the APMCF shall be final. All authorized extra work, omissions and all variations made shall be included in such measurements.

20.0 Variations

No alteration, omission or variation ordered in writing by the APMCF shall vitiate the contract.

In case the SBI / APMCF thinks proper at any during the progress of works to make any alteration in, or additions to or omission from the works or any alteration in the kind or quality of the materials to be used therein, the APMCF shall give notice thereof in writing to the contractor or shall confirm in writing within seven days of giving such oral instructions the contract shall alter to, add to, or omit from as the case may be in accordance with such but the contractor shall not do any work extra to or make any alterations or additions to or omissions from the works or any deviation from any of the provisions of the contract, stipulations, specifications or contract drawings without previous consent in writing of the APMCF and the value of such extras, alterations, additions or omissions shall in all cases be determined by the APMCF and the same shall be added to or deducted from the contract value, as the case may be.

21.0 Valuation of Variations

No claim for an extra charge shall be allowed unless it shall have been executed under the authority of the APMCF with the concurrence of the SBI as herein mentioned. Any such extra is herein referred to as authorized extra and shall be made in accordance with the following provisions.

i) The net rates or prices in the contract shall determine the valuation of the extra work where such extra work is of similar character and executed under similar conditions as the work priced herein.

Rates for all items, wherever possible, should be derived from the rates given in the priced BOQ.

ii) The net prices of the original tender shall determine the value of the items omitted, provided if omissions do not vary the conditions under which any remaining items of Works are carried out, otherwise the prices for the same shall be valued under sub-Clause 'iii' hereunder.

iii) Where the extra works are not of similar character and/or executed under similar conditions as aforesaid or where the omissions vary the conditions under which any remaining items or works are carried out, then the contractor shall within 7 days of the receipt of the letter of acceptance inform the APMCF of the rate which he intends to charge for such items of work, duly supported by analysis of the rate or rates claimed and the APMCF shall fix

such rate or prices as in the circumstances in his opinion are reasonable and proper, based on the market rate.

iv) Where extra work cannot be properly measured or valued the contractor shall be allowed day work prices at the net rates stated in the tender, of the BOQ or, if not, so stated then in accordance with the local day work rates and wages for the district; provided that in either case, vouchers specifying the daily time (and if required by the APMCF) the workman's name and materials employed be delivered for verification to the ~~Architect/consultant~~ APMCF at or before the end of the week following that in which the work has been executed.

E)v) It is further clarified that for all such authorized extra items where rates cannot be derived from the tender, the Contractor shall submit rates duly supported by rate analysis worked on the 'market rate basis for material, labour hire / running charges of equipment and wastage etc. plus 15% towards establishment charges, contractor's overheads, and profit. Such items shall, not be eligible for escalation.

22.0 Final measurement

The measurement and valuation in respect of the contract shall be completed within Six months of the virtual completion of the work.

23.0 Virtual Completion Certificate (VCC)

On successful completion of entire works covered by the contract to the full satisfaction of the APMCF/SBI, the contractor shall ensure that the following works have been completed the satisfaction of the SBI:

- i) Clear the site of all scaffolding, wiring, pipes, surplus materials, contractor's labour equipment and machinery.
- ii) Demolish, dismantle, and remove the contractor's site office, temporary works, structure including labour sheds/camps and constructions and other items and things whatsoever brought upon or erected at the site or any land allotted to the contractor by the SBI not incorporated in the permanent works.
- iii) Remove all rubbish, debris etc. from the site and the land allotted to the contractor by the APMCF/SBI and shall clear, level and dress, compact the site as required by the APMCF/SBI
- iv) Shall put the SBI in undisputed custody and possession of the site and all land allot by the SBI
- v) Shall hand over the completed Project/works in a peaceful manner to the APMCF/SBI
- vi) All defects / imperfections have been attended and rectified as pointed out by the Architects to the full satisfaction of SBI

Upon satisfactory fulfillment by the contractor as stated above, the contractor shall be entitled to apply to the APMCF for the certificate. If the APMCF is satisfied with the completion of the work, relative to which the completion certificate has been sought, the APMCF shall within fourteen (14) days of the receipt of the application for virtual completion certificate, issue a VCC in respect of the work for which the VCC has been applied.

This issuance of a VCC shall be without prejudice to the SBI's rights and contractor's liabilities under the contract including the contractor's liability for defects liability period nor shall the issuance of VCC in respect of the works or work at any site be construed as a waiver of any right or claim of the SBI against the contractor in respect of works or work at the site and in respect of which the VCC has been issued.

24.0 Work by other agencies

The SBI / APMCF reserves the rights to use premises and any portion of the site for execution of any work not included in the scope of this contract which it may desire to have carried out by other persons simultaneously and the contractor shall not only allow but also extend reasonable facilities for the execution of such work. The contractor, however, shall not be required to provide any plant or material for the execution of such work except by special arrangement with the SBI. Such work shall be carried out in such manner as not to impede the progress of the work included in the contract.

25.0 Insurance of work

25.1 Without limiting his obligations and responsibilities under the contract the contractor shall insure in the joint names of the SBI and the contractor against all loss of damages from whatever cause arising other than the excepted risks, for which he is responsible under the terms of contract and in such a manner that the SBI and contractor are covered for the contract period stipulated including vide clause 28 of GCC and are also covered during the period of maintenance for loss or damage arising from a cause, occurring prior to the commencement of the period of maintenance and for any loss or damage occasioned by the contractor in the course of any operations carried out by him for the purpose of complying with his obligations under clause.

- i) The Works for the time being executed to the estimated current Contract value thereof, or such additional sum as may be specified together with the materials for incorporation in the works at their replacement value.
- ii) The constructional plant and other things brought on to the site by the contractor to the replacement value of such constructional plant and other things.
- iii) Such insurance shall be affected with an insurer and in terms approved by the SBI which approval shall not be unreasonably withheld, and the contractor shall whenever require produce to the APMCF the policy of insurance and the receipts for payment of the current premiums.

25.2 Damage to persons and property

The contractor shall, except if and so far as the contract provides otherwise indemnify the SBI against all losses and claims in respect of injuries or damages to any person or material or physical damage to any property whatsoever which may arise out of or in consequence of the execution and maintenance of the works and against all claims proceedings, damages, costs, charges and expenses whatsoever in respect of or in relation thereto except any compensation of damages for or with respect to:

- i) The permanent use or occupation of land by or any part thereof.
- ii) The right of SBI to execute the works or any part thereof on, over, under, in or through any lands.
- iii) Injuries or damage to persons or properties which are unavoidable result of the execution or maintenance of the works in accordance with the contract
- iv) Injuries or damage to persons or property resulting from any act or neglect of the SBI their agents, employees or other contractors not being employed by the contractor or for or in respect of any claims, proceedings, damages, costs, charges and expenses in respect thereof or in relation thereto or where the injury or damage was contributed to by the contractor, his servants or agents such part of the compensation as may be just and equitable having regard to the extent of the responsibility of the SBI, their employees, or agents or other employees, or agents or other contractors for the damage or injury.

25.3 Contractor to indemnify SBI

The contractor shall indemnify SBI against all claims, proceedings, damages, costs, charges and expenses in respect of the matters referred to in the provision sub-clause 25.2 of this clause.

25.4 Contractor's superintendence

The contractor shall fully indemnify and keep indemnified the SBI 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 article or part thereof included in the contract. In the event of any claim made under or action brought against SBI in respect of such matters as aforesaid the contractor shall be immediately notified thereof and the contractor shall be at liberty, at his own expenses 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 SBI if the infringement of the patent or design or any alleged patent or design right is the direct result of an order passed by the APMCF in this behalf.

25.5 Third Party Insurance

25.5.1 Before commencing the execution of the work the contractor but without limiting his obligations and responsibilities under clause 24.0 & 25.0 of GCC shall insure against his liability for any material or physical damage, loss, or injury which may occur to any property

including that of SBI, or to any person, including any employee of the SBI, by or arising out of the execution of the works or in the carrying out of the contract, otherwise than due to the matters referred to in the provision to clause 24.0 & 25.0 thereof.

25.5.2 Minimum amount of Third-Party Insurance

Such insurance shall be effected with an insurer and in terms approved by the SBI which approval shall not be reasonably withheld and for at least the amount stated below. The contractor shall, whenever required, produce to the APMCF the policy or policies of insurance cover and receipts for payment of the current premiums.

25.6 The minimum insurance cover for physical property, injury, and death is Rs.5.0 Lacs per occurrence with the number of occurrences limited to four. After each occurrence contractor will pay additional premium necessary to make insurance valid for four occurrences always.

25.7 Accident or Injury to workman:

25.7.1 The SBI shall not be liable for or in respect of any damages or compensation payable at law in respect or in consequence of any accident or injury to any workmen or other person in the employment of the contractor or any sub-contractor, save and except an accident or injury resulting from any act or default of the SBI or their agents, or employees. The contractor shall indemnify and keep indemnified SBI against all such damages and compensation, save and except as aforesaid, and against all claims, proceedings, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

25.7.2 Insurance against accidents etc. to workmen

The contractor shall insure against such liability with an insurer approved by the SBI during the whole of the time that any persons are employed by him on the works and shall, when required, produce to the APMCF such policy of insurance and receipt for payment of the current premium. Provided always that, in respect of any persons employed by any sub-contractor the contractor's obligation to insured as aforesaid under this sub-clause shall be satisfied if the sub-contractor shall have insured against the liability in respect of such persons in such manner that SBI is indemnified under the policy but the contractor shall require such sub-contractor to produce to the Architect /consultant when such policy of insurance and the receipt for the payment of the current premium.

25.7.3 Remedy on contractor's failure to insure

If the contractor fails to effect and keep in force the insurance referred to above or any other insurance which he may be required to effect under the terms of contract, then and in any such case the SBI may effect and keep in force any such insurance and pay such premium or premiums as may be necessary for that purpose and from time to time deduct the amount so paid by the SBI as aforesaid and also deduct 15% of contract value from any

amount due or which may become due to the contractor, or recover the same as debt from the contractor.

25.7.4 Without prejudice to the other rights of the SBI against contractors. In respect of such default, the employer shall be entitled to deduct from any sums payable to the contractor the amount of any damage costs, charges, and other expenses paid by the SBI and which are payable by the contractors under this clause. The contractor shall, upon settlement by the Insurer of any claim made against the insurer pursuant to a policy taken under this clause, proceed with due diligence to rebuild or repair the works destroyed or damaged. In this event all the monies received from the Insurer in respect of such damage shall be paid to the contractor and the Contractor shall not be entitled to any further payment in respect of the expenditure incurred for rebuilding or repairing of the materials or goods destroyed or damaged.

The policy may be taken in joint names of the contractors and the SBI and the original policy may be lodged with the SBI.

26.0 Commencement of Works:

The date of commencement of the work will be reckoned as the recorded date of handing over site by the SBI or 15 days from the date of issue of Letter of Acceptance of Bank, whichever is later.

27.0 Time for completion

Time is essence of the contract and shall be strictly observed by the contractor. The entire work shall be completed within a period of **42 (Forty-Two) Months including Monsoon & Holidays** from the date of commencement. If required in the contract or as directed by the APMCF. The contractor shall complete certain portions of work before completion of the entire work. However, the completion date shall be reckoned as the date by which the whole work is completed as per the terms of the contract.

28.0 Extension of time

If, in the opinion of the APMCF, the work be delayed for reasons beyond the control of the contractor, the APMCF may submit a recommendation to the SBI to grant a fair and reasonable extension of time for completion of work as per the terms of contract. If the contractor needs an extension of time for the completion of work or if the completion of work is likely to be delayed for any reasons beyond the due date of completion as stipulated in the contract, the contractor shall apply to the SBI through the Architect' Consultant in writing at least 30 Days before the expiry of the scheduled time and while applying for extension of time he shall furnish the reason in detail and his justification if any', for the delays. The APMCF shall submit their recommendations to the SBI in the prescribed format for granting extension of time. While granting extension of time the contractor shall be informed of the extended period which will qualify for levy of liquidated damages. For the balance period in excess of original stipulated period and duly sanctioned extension of time by the SBI by provision of liquidated damages as stated under clause 8.0 shall become applicable. Further the contract shall

remain in force even for the period beyond the due date of completion irrespective of whether the extension is granted or not.

29.0 Rate of progress

Whole of the materials, plant and labour to be provided by the contractor and the mode, manner and speed of execution and maintenance of the works are to be of a kind and conducted in a manner to the satisfaction of the APMCF. Should the rate of progress of the work or any part thereof be at any time be in the opinion the APMCF too slow to ensure the completion of the whole of the work the prescribed time or extended time for completion the APMCF shall thereupon take such steps as considered necessary by the APMCF to expedite progress so as to complete the works by the prescribed time or extended time. Such communications from the APMCF neither shall relieve the contractor from fulfilling obligations under the contract nor will he be entitled to raise any claims arising out of such directions.

30.0 Work during nights and holidays

Subject to any provision to the contrary contained in the contract no permanent work shall save as herein provided be carried on during the night or on holidays without the permission in writing of the SBI/APMCF, save when the work is unavoidable or necessary for the saving of life or property or for the safety of the work in which case the contractor shall immediately advise the SBI/APMCF. However, the provisions of the clause shall not be applicable in the case of any work which becomes essential to carry by rotary or double shifts in order to achieve the progress and quality of the part of the work being technically required / continued with the prior approval of the APMCF at no extra cost to the SBI.

All work at night after obtaining approval from APMCF competent authorities shall be carried out without unreasonable noise and disturbance. Sufficient arrangement of light and Protection for work and manpower should be done by contractor.

31.0 No compensation or restrictions of work

If at any time after acceptance of the tender SBI decide to abandon or reduce the scope of work for any reason whatsoever and hence not required, the whole or any part of the work to be carried out, the APMCF/SBI shall give notice in writing that effect to the contractor and the contractor shall act accordingly in the matter. The contractor shall have no claim to any payment of compensation or whatsoever on account of any profit or advantage which he might have derived from the execution of the Work fully but which he did not derive in consequence of the foreclosure of the whole or part of the work.

Provided that the contractor shall be paid the charges on the cartage only of materials actually and bona-fide brought to the site of the work by the contractor and rendered surplus as a result of the abandonment, curtailment of the work or any portion thereof and then taken back by the contractor, provided however that the APMCF shall have in such cases the option of taking over all or any such materials at their purchase price or a local current rate whichever is less.

“In case of such stores having been issued from SBI stores and returned by the contractor to stores, credit shall be given to him at the rates not exceeding those at which were originally issued to the contractor after taking into consideration and deduction for claims on account of any deterioration or damage while in the custody of the contractor and in this respect the decision of APMCF shall be final.

32.0 Suspension of work

The contractor shall, on receipt of the order in writing of the APMCF/SBI (whose decision shall be final and binding on the contractor) suspend the progress of works or any part thereof for such time and in such manner as APMCF may consider necessary so as not to cause any damage or injury to the work already done or endanger the safety thereof for any of following reasons:

- i) On account of any default on the part of the contractor, or
- ii) For proper execution of the works or part thereof for reasons other than the default of the contractor, or
- iii) For safety of the works or part thereof.

The contractor shall, during such suspension, properly protect and secure the work to the extent necessary and carry out the instructions given in that behalf by the APMCF.

If the suspension is ordered for reasons (ii) and (iii) in sub-para (i) above:

The contractor shall be entitled to an extension of time equal to the period of every such suspension. No compensation whatsoever shall be paid on this account.

33.0 Action when the whole security deposit is forfeited

In any case in which under any clause or clauses of this contract, the Contractor shall have rendered himself liable to pay compensation amounting to the whole of his security deposit the APMCF shall have the power to adopt any of the following course as they may deem best suited to the interest of the SBI:

- i) To rescind the contract (of which rescission notice in writing to the contractor by – APMCF shall be conclusive evidence) and in which case the security, deposit of the contractor shall be forfeited and be absolutely at the disposal of SBI
- ii) To employ labour paid by the SBI and to supply materials to carry out the work, or part of the work, debiting the contractor with the cost of the labour and materials cost of such labour and materials as worked out by the APMCF shall 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 manner and at the same rates as if it had been carried out by the contractor under the terms of this contract certificate of Architect /consultant as to the value of work done shall be final conclusive against the contractor.

iii) To measure up the work of the contractor, and to take such part thereof as shall 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 (The amount of which excess the certificates in writing of the Architects / consultant shall final and conclusive) shall be borne by original contractor and may be deducted from any money due to him by SBI under the contract or otherwise, or from his security deposit or the proceeds of sale thereof, or sufficient part thereof.

In the event of any of above courses being adopted by the SBI the contractor shall have no claim to compensation for any loss sustained by him by reasons of his having purchased or procured any material or entered into any engagements or make any advances on account of, or with a view to the execution of the work or the performance of the contract and in case the contract shall be rescind under the provision aforesaid, the contractor shall not be entitled to recover or to be paid any sum or any work thereto for actually performed under this contract, unless, and until the APMCF will have 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.

34.0 SBI's right to terminate the contract

If the contractor being an individual or a firm commit any 'Act of insolvency' or shall be adjusted an insolvent or being an incorporated company shall have an order for compulsory winding up voluntarily or subject to the supervision of Govt. and of the Official Assignee of the liquidator in such acts of insolvency or winding up shall be unable within seven days after notice to him to do so, to show to the reasonable satisfaction of the APMCF that he is able to carry out and fulfill the contract, and to dye security therefore if so required by the APMCF.

Or if the contractor (whether an individual firm or incorporated Company) shall suffer execution to be issued or shall suffer any payment under this contract to be attached by or on behalf of any of the creditors of the contractor.

Or shall assign or sublet this contract without the consent in writing of the SBI through the APMCF or shall charge or encumber this contract or any payment due to which may become due to the contractor there under:

i) Has abandoned the contract; or

ii) has failed to commence the work, or has without any lawful excuse under these conditions suspended the progress of the works for 14 days after receiving from the SBI through the APMCF written notice to proceed, or

iii) has failed to proceed with the works with such diligence and failed to make such due progress as would enable the works to be completed within the time agreed upon, or has failed to remove the materials from the site or to pull down and replace work within seven days after written notice from the SBI through the APMCF that the said materials were condemned and rejected by the APMCF under these conditions; or has neglected or failed

persistently to observe and perform all or any of the acts matters or things by this contract to be observed and performed by the contractor for seven days after written notice shall have been given to the contractor to observe or perform the same or has to the detriment of good workmanship or in defiance of the SBI or Architect's / consultant's instructions to the contrary subject any part of the contract. Then and in any of said cases the SBI and or the Architect / consultant, may not withstanding any previous waiver, after giving seven days' notice in writing to the contractor, determine the contract, but without thereby affecting the powers of the SBI or the APMCF or the obligation and liabilities of the contractor the whole of which shall continue in force as fully as if the contract had not been determined and as if the works subsequently had been executed by or on behalf of the contractor. And, further the SBI through the APMCF their agents or employees may enter upon and take possession of the work and all plants, took scaffolding, materials, sheds, machineries lying upon the premises or on the adjoining lands or roads use the same by means of their own employees or workmen in carrying on and completing the work or by engaging any other contractors or persons to the work and the contractor shall not in any way interrupt or do any act, matter or thing to prevent or hinder such other contractor or other persons employed for complement and finishing or using the materials and plant for the works.

When the works shall be completed or as soon thereafter as convenient the SBI or APMCF shall give a notice in writing to the contractor to remove his surplus materials and plants and should the contractor fail to do so within 14 days after receiving thereof by him the SBI sell the same by publication, and after due publication, and shall, adjust the amount realized by such auction. The contractor shall have no right to question any of the act of the SBI incidental to the sale of the materials etc.

35.0 Certificate of payment

The Contractor shall be entitled to receive the certificates issued by the APMCF within 10 working days from the date of submission, provided that the submission is complete in all respects, including all required documents, test reports, material consumption statements vis-à-vis receipts, and proper recording in the Measurement Book (MB).

The State Bank of India (SBI) shall recover statutory deductions and other dues, including the retention amount, from the certificate of payment.

Only submission of Bills to the SBI/APMCF not relieve the contractor's responsibility. Contractor shall help/assist APMCF/SBI during checking/verification of Bills with all required documents, details, test certificate, insurances etc. and presence of Billing Engineer is necessary while scrutiny of Bills.

Provided always that the issue of any certificate by the APMCF during progress of work or completion shall not have effect as certificate of satisfaction relieve the contractor from his liability under clause.

The APMCF shall have power to withhold the certificate if the work or in part thereof is not carried out to their satisfaction.

The APMCF may by any certificate make any corrections required previous certificate.

The SBI shall modify the certificate of payment as issued by the APMCF from time to time while making the payment

The contractor shall submit interim bills only after taking actual measurements and properly recorded in the Measurement Book (M. B.)

The Contractor shall not submit interim bills when the value of work done by him is less than the limit as prescribed in NIT, **Clause No. 17** and the minimum interval between two such bill shall be one month.

The final bill may be submitted by contractor within a period of one month from the date of virtual completion and APMCF/SBI shall issue the certificate of payment within a period of two months. The SBI shall pay the amount within a period of three months from the date of issue of certificate provided there is no dispute in respect of rates and quantities.

The contractor shall submit the interim bills in the prescribed format with all details.

36.0 A. Settlement of Disputes and Arbitration

Dispute Resolution and Arbitration Clause

Amicable Settlement

Any dispute, controversy, or claim arising out of or in connection with this Agreement or the interpretation, validity, performance, breach, or termination thereof (“Dispute”) shall, to the extent possible, be resolved amicably between the Parties through good faith negotiations.

Notice of Dispute

In the event the Parties are unable to resolve the Dispute amicably, either Party may issue a written notice to the other Party specifying the nature of the Dispute (“Notice of Dispute”). Upon receipt of such notice, the senior representatives of both Parties shall meet at the State Bank of India, Local Head Office, Gandhinagar, within ten (10) days from the date of receipt of the Notice of Dispute to attempt resolution through mutual discussions and deliberations.

Negotiation Period

The senior representatives shall endeavor to resolve the Dispute within thirty (30) days from the date of the first meeting. If the Dispute remains unresolved after the expiry of the said period, the same shall be referred to arbitration in accordance with the provisions below.

Arbitration

(a) The Dispute shall be referred to and finally resolved by arbitration in accordance with the provisions of the Arbitration and Conciliation Act, 1996, and any statutory modification or re-

enactment thereof for the time being in force.

(b) The arbitral tribunal shall consist of a sole arbitrator appointed by mutual consent of the Parties.

(c) In the event the Parties fail to agree upon the appointment of the sole arbitrator within thirty (30) days from the date one Party requests the other to so agree, the arbitrator shall be appointed in accordance with the provisions of the said Act.

(d) The seat and venue of arbitration shall be Gandhinagar, Gujarat, or such other place within Gujarat as may be mutually agreed by the Parties.

(e) The arbitration proceedings shall be conducted in the English language.

(f) The award rendered by the arbitrator shall be final and binding on the Parties.

Jurisdiction

Subject to the provisions of arbitration contained herein, the courts at Gandhinagar, Gujarat, shall have exclusive jurisdiction in all matters arising out of or in connection with this Agreement.

37.0 Power Supply

The contractor shall make his own arrangements for power and supply/distribution system for driving plants or machinery for the work and for lighting purpose at his own cost. The cost of running and maintenance of the plants are to be included in his tender prices. He shall pay all fees and charges required for the power supply and include the same in his tendered rates and hold the owner free from all such costs. He has to obtain necessary approval from the appropriate authorities, if required.

38.0 Water Supply

The contractor shall make his own arrangements for water required for the work and nothing extra will be paid for the same. This will be subject to the following conditions.

i) That the water used by the contractor shall be fit for construction purposes to the satisfaction of the Architect / consultants.

ii) The contractor shall make alternative arrangements for the supply of water if the arrangement made by the contractor for procurement of water in the opinion of the APMCF is unsatisfactory.

38.1 The contractor shall construct temporary well / tube well in SBI land for taking water for construction purposes only after obtaining permission in writing from the SBI. The contractor has to make his own arrangements for drawing and distributing the water at his own cost. He has to make necessary arrangements and comply with Environmental Clearance guidelines/NOC. To avoid any accidents or damage caused due to construction and subsequent maintenance of the wells. He has to obtain necessary approvals from local authorities, if required, at his own cost. He shall restore the ground to its original condition

after wells are dismantled on completion of work or hand over the well to the SBI without any compensation as directed by the Architect / consultant.

39.0 Treasure Trove etc. Any treasure trove, coin or object antique which may be found on the site shall be the property of SBI and shall be handed over to the bank immediately.

40.0 Method of Measurement

Unless otherwise mentioned in the schedule of quantities or in mode of measurement, the measurement will be on the net quantities or work produced in accordance with up-to-date rules laid down by the Bureau of Indian Standards. In the event of any dispute / disagreement the decision of the APMCF/SBI shall be final and binding on the contractor.

Precedence to be followed for measurements is mentioned below.

- a) As mentioned in Price Bid
- b) As mentioned in Technical Bid
- c) As Per IS 1200 updated till date
- d) As per SP 27 updated till date
- e) As per CPWD up to date manuals/ guidelines
- f) As per sound Engineering Practices or any other relevant standards available

41.0 Maintenance of Registers

The contractor shall maintain the following registers as per the enclosed formats at site of work and should produce the same for inspection of SBI /APMCF whenever desired by them. The contractor shall also maintain the records / registers as required by the local authorities / Govt. from time to time.

- i) Register for secured advance
- ii) Register for hindrance to work
- iii) Register for running account bill
- iv) Register for labour

42.0 PRICE VARIATION ADJUSTMENT (PVA) FOR ALL MATERIALS (INCLUDING CEMENT & STEEL) & LABOUR

In partial modification of the provisions made elsewhere in this contract regarding rate quoted being not subject to any variations, price adjustments to the value of work payable to the Contractor at tendered rates shall be made towards variations in the prices of materials and labour in the manner specified hereunder: -

If, after written order to commence the work and during the operative period of this contract including any authorized extensions of the original stipulated completion period: -

(a) There be any variation in the Consumer Price Index- General Index- for industrial workers (Base 1982=100) (source – data published from time-to-time Indian Labour Journal by the Labour Bureau, Government of India), OR

(b) There be any variation in the All-India Wholesale Price Index for all commodities (Base 1993- 94=100) (as published from time to time in the RBI Bulletin based on the date issued by the Office of the Economic Advisor to the Government of India).

Price Variation Adjustment (PVA) towards (1) Labour Component and (2) Material Component shall be calculated in accordance with formula A and B respectively, given below, subject to stipulations herein under mentioned: -

FORMULA (A) FOR LABOUR:

$$VL = \frac{0.85P \times K1 \times (C1 - C0)}{100 \quad C0}$$

FORMULA (B) FOR MATERIALS:

$$VM = \frac{0.85X (P-Y) \times K2 \times (I1 - I0)}{100 \quad I0}$$

Where: -

VL = Amount of Price Variation Adjustment Increase or decrease in rupees due to labour component

VM = Amount of Price Variation Adjustment Increase or decrease in rupees on account of materials component

NOTE: Bill period (noted hereunder) signifies the period of actual execution and not date of measurement or preparation of bill.

P = Cost of work done during the period under consideration (bill period) excluding advances on materials and/or adjustments thereof

Y = Cost of any other materials supplied/ arranged by the Bank at fixed price during the period under consideration (bill period)

K1 = Percentage of labour component calculated as indicated in Note (1) below

K2 = Percentage of materials component as indicated in Note (2) below.

C0 = Consumer Price Index – General Index Number for industrial workers (Base 1982 = 100) referred to at (a) above, ruling on the last due date of receipt of tenders, and

as applicable to the center, nearest to the place of work, for which the index is published)

C1 = Average of above-mentioned Consumer Price Index number during the period under consideration (bill period)

I0 = All India Wholesale Price Index number for all commodities referred to at (b) above, ruling on the last date for receipt of tenders and as applicable to the Centre, nearest to the place of work for which the index is published.

I1 = Average of above mentioned monthly all India Wholesale Price Index numbers during the period under consideration (bill period)

NOTE (1) : K1 shall be taken as under: -

Component of work	K 1
a) Civil work including ancillary works and external works and RCC / tanks, septic tanks, etc. if any of sanitary and plumbing work	30
b) Sanitary and plumbing work including fittings and fixtures (internal work only)	20
c) Electrical installations work including fittings and fixtures (external and internal works)	20

NOTE (2): K2 shall be taken as under: -

Component of work	K2
a) Civil work including ancillary works as detailed under Note (1) (a) above	70
b) Sanitary and plumbing works including fittings and fixtures as detailed under Note (1) (b) above	80
Electrical installations work including fittings and fixtures as detailed under Note (1) (c) above	80

Stipulations:

(i) PVA Clause is operative either way i.e. if the variations in above referred price indices are on the plus side. PVA shall be payable to the contractor and if they are on the negative side PVA shall be recoverable from the contractor for the respective bill period of occurrence of fluctuations.

(ii) The rates quoted by the Contractor shall be treated as firm for the value of work required to be done in the first 12 months of the contract period from the date of written order to commence work and no PVA is admissible on the same on any grounds whatsoever. The value of work required to be done during the first 12 months of the contract period shall be taken as 80% of the value of work to be done on pro-rata basis in 12 months as compared to the total stipulated completion period. No PVA is admissible on the value of work required to be done in first 12 months as worked out above, even if this value of work is actually done in a period longer than 12 months. However, in case of any delay in the first 12 months due to genuine reasons which are not attributable to the contractor and which are beyond his control, such period of delay will be deducted from 12 months, and the value of work to be done will be 80% of the pro-rata value of work to be done in such reduced period on pro-rata basis.

(iii) (a) For works where the original stipulated period of completion is not more than 12 months, no PVA whatsoever is permissible under this clause. However, if the period of completion is delayed beyond 12 months on account of genuine reasons which are not attributable to the contractor and which are beyond his control, PVA will be admissible on the value of work done only in excess of value of work required to be done on a pro-rata basis in the first 12 months minus the period of such genuine delay.

(b) For purpose of admissibility of PVA all the cumulative period of extensions granted for reasons which are solely attributable to the contractor is excluded from the total extended period of the contracts and PVA shall not be admissible on the value of work done during such period of extensions, which are granted for keeping the contract current, but only due to reasons for which the contractor was solely responsible. Periods of extensions granted on account of genuine reasons which are not attributable to the contractor, and which are beyond his control will, however, be included in the period for which PVA is admissible.

(c) Notwithstanding anything to the contrary mentioned in any other clause/ clauses of the contract, extensions of the contract period shall be granted by the Architect only with prior approval of the Bank. Extensions granted by the Architect without Bank's prior approval shall not bind the Bank for payment of PVA for work done in the concerned period of extensions.

(iv) (a) Where the total cost of work done beyond the value of work required to be done in the first 12 months (vide note (ii) and (iii) above does not exceed Rs.50 lacs the total amount of PVA worked out on the basis of provisions of foregoing stipulations will be limited to an upper ceiling of 10% of such value of work done in excess of value of work required to be done in the first 12 months, minus the cost of any materials issued/arranged by the Bank at fixed prices i.e. $P - Y$ (these terms being as per definitions given formulae A and B above).

(b) Where the total value of work done beyond the value of work required to be done in the first 12 months exceeds Rs.50 lacs, the PVA on the first Rs.50 lacs will be calculated as provided for in the foregoing para and for the balance value of work done for which PVA is admissible subject to foregoing conditions, the PVA will have the upper ceiling of **10%** but

it will be worked out at a lower rate i.e. 80% of the amount worked out as per the formulae A and B referred to earlier.

(v) In working out the amount of PVA as per all the foregoing stipulations, value of such extra items or such portions of extra items the rates of which are derived from the prevailing market rates of materials and labour will not be included in the value of work done. Value of only such extra items or such portions of extra items, rates of which are derived entirely from tendered rates will be included in the value of work on which PVA is calculated.

(vi) For claiming the payment for PVA the contractor shall keep such books of accounts and other documents, vouchers receipts etc. as may be required by the Bank/Architect, for verification of the increased claims or reduction to be made as the case may be and he shall also allow Engineers and/or other duly authorized representatives of the Bank/Architects and furnish such information as may be required or called for to enable verification of the claim within a week of such request.

(vii) The contractor is required to submit to the Bank, through the Architect, his claims for PVA separately for each running Bill for the individual bill periods for the work paid to him by the Bank. He will also be required to submit detailed calculations in support of the claims.

(viii) No claim will be entertained from the contractor for interest or any other grounds for nonpayment or for any delay in payment of PVA due to late publication or non-availability of the necessary price indices or due to delay in preparation of the Running or Final Bills.

(ix) In view of adjustments for variations in process of materials and labor which have been covered in this clause no other adjustments for any reason whatsoever, like statutory measures, taxes, levies, etc. will be allowed.

42.a Materials Having Basic Price

If the basic rate of any material used for the work is more or less than the basic rate given in schedule of quantities, in that case differential rate will be 1.15 times of actual rate without GST minus Basic rate in the tender. The actual rate without GST shall be taken from the GST invoice produced by the contractor subject to be found in order as per the prevailing market rates by the Architect & the Bank. The differential rate shall be applicable for the actual quantity executed & measured for that item of work. The differential amount thus calculated shall be either plus or minus and shall be paid or recovered from the contractor. GST shall be paid on this amount.

It shall be mandatory to obtain approval of quantity / rate for the PMC / Bank before purchase of any material.

In the above case for calculating price variation as per clause 42 of GCC, amount of above material/s shall be deducted as per basic rate from the total work done amount.

43.0 Force Majeure

43.1 Neither contractor nor SBI shall be considered in default in performance of the obligations if such performance is prevented or delayed by events such as ~~but not~~ war, hostilities revolution, riots, civil commotion, strikes, lockout, conflagrations, epidemics, pandemic, accidents, fire, storms, floods, droughts, earthquakes or ordinances or any act of or for any other cause beyond the reasonable control of the party affected or prevents or delayed. However, a notice is required to be given within 30 days from the happening of the event with complete details, to the other party to the contract, if it is not possible to serve a notice, within the shortest possible period without delay.

43.2 As soon as the cause of force majeure has been removed the party whose ability to perform its obligations has been affected, shall notify the other of such cessation and the actual delay incurred in such affected activity adducing necessary evidence in support thereof.

43.3 From the date of occurrence of a case of force majeure obligations of the party affected shall be suspended during the continuance of any inability so caused. With the cause itself and inability resulting there from having been removed, the agreed time completion of the respective obligations under this agreement shall stand extended a period equal to the period of delay occasioned by such events.

43.4 Should one or both parties be prevented from fulfilling the contractual obligations by state of force majeure lasting to a period of 6 months or more the two parties shall mutually decide regarding the future execution of this agreement.

44.0 Local laws, Acts Regulations:

The contractor shall strictly adhere to all prevailing labour laws inclusive at contract labour (regulation and abolition act of 1970) and other safety regulations. The contractors should comply with the provision of all labour legislation including the latest requirements of the Acts, laws, any other regulations that are applicable to the execution of the project.

- i) Minimum wages Act 1948 (Amended)
- ii) Payment of wages Act 1936 (Amended)
- iii) Workmen's compensation Act 1923 (Amended)
- iv) Contract labour regulation and abolition act 1970 and central rules 1971 (Amended)
- v) Apprentice act 1961 (amended)
- vi) Industrial employment (standing order) Act 1946 (Amended)
- vii) Personal injuries (Compensation insurance) act 1963 and any other modifications
- viii) Employees' provident fund and miscellaneous provisions Act 1952 and amendment thereof
- ix) Shop and establishment act
- x) Any other act or enactment relating thereto and rules framed there under from time to time.

xi) Prevailing Indian Electricity rules & act.

45.0 SAFETY CODE:

Safety code to be followed as per para 82 of SCC (Special Conditions of Contract)

46.0 Accidents

The contractor shall immediately consider the occurrence of any accident at or about the site or in connection with the execution of the work report such accident to the Architect / consultant. The contractor shall also make such report immediately to the competent authority whenever such report is required to be lodged by the law and take appropriate action thereof.

47.0 The contractors shall be bound to comply the following provision in terms of “Restrictions imposed by the Government of India, Ministry of Finance Department of Expenditure under Rule 144 (XI) of General Financial Rules 2017 vide their order no. F. No 6/18/2019/PPD dated 23rd July 2020” as under.

I. Any bidder from a country which shares a land border with India will be eligible to bid in this tender ONLY if the bidder is registered with the Competent Authority (registration committee constituted by the Department for Promotion of Industry and Internal Trade).

II. Bidder’ (including the term ‘Bidder’, ‘consultant’ or ‘service provider’ in certain contexts) means any person or firm or company, including any member of a consortium or joint venture (that is an association of several persons, or firms or companies), every artificial judicial person not falling in any of the descriptions of bidders stated herein before, including any agency branch or Office controlled by such person, participating in a procurement process.

III. ‘Bidder from a country which shares a land border with India (such a country)’ for this purpose means:

- a. An entity incorporated, established, or registered in such a country; or
- b. A subsidiary of an entity incorporated, established, or registered in such a country; or
- c. An entity substantially controlled through entities incorporated, established or registered in such a country; or
- d. An entity whose beneficial owner is situated in such a country; or
- e. An Indian (or other) agent of such an entity; or
- f. A natural person who is a citizen of such a country; or
- g. A consortium or joint venture where any member of the consortium or joint venture falls under any of the above IV. The beneficial owner for the purpose of (iii) above will be as below:

1. In case of A Company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more

judicial person, has a controlling interest or who exercises control through other means. Explanation

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

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

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

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

4. Where no natural person is identified under (1) or (2) or (3) above, the beneficial owner is the relevant natural person who holds the position of senior managing official.

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

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

V. The successful bidder shall not be allowed to sub-contract works to any contractor from country which shares a land border with India unless such contractor is registered with the Competent Authority.

VI. All bidders need to submit a declaration-cum-certificate (along with evidence) in this regard as per "Annexure VI". Failure to submit such valid declaration-cum-Certificate will make the bid liable for rejection."

48.0 Extension of time:

The time allowed for carrying out the work as entered into in the agreement shall be strictly observed by the contractor and shall be reckoned from the date of commencement of work. The work shall throughout the stipulated period of contract be proceeded with care and

due diligence (time being the essence of the contract) on the part of the contractor. To ensure good progress of the work during the execution, the contractor shall be bound in all cases, by the time schedule submitted by him.

i) If the contractor desire an extension of time for completion of work on the grounds that there having been unavoidable hindrances in execution or on any other ground, he shall apply in writing in format enclosed at Annexure VII to the architect within 30 days of the hindrance on account of which he desires such extension.

ii) The Site Engineer/APMCF shall consider the application with reference to the reasonableness of the grounds cited therein and the recordings in the Hindrance register maintained at site (Proforma enclosed at Annexure VIII). They shall thereafter forward their comments/recommendations to the architects. The architects shall refer the case to the /Premises & Estate Department of the Bank along with their recommendations.

iii) The Premises & Estate Department, on being satisfied about the reasonableness of the request of the contractors, in terms of the relevant contract conditions, may recommend a fair and reasonable extension of time as per Bank Guidelines for granting extension of time as per Bank Guidelines for granting extension of time.

iv) Extension of time shall be granted before expiry of the contract period so that the contract is in force at the time of granting extension of time. Even if the contractor fails to apply for extension of time, the Site Engineer/APMCF and architects shall bring the fact to the notice of the Premises & Estate Department.

v) While granting extension of time, it shall be clearly stipulated that the extension of time is being given without prejudice to the Bank's right to recover liquidated damages under relevant contract clause.

vi) The letter granting extension of time (**if approved by Bank**) is to be issued by the architects as per Bank's standard format

vii) If the contractors fail to complete the work within the stipulated period, the extended time as above or if the delay in completion of the work is attributable to the contractor in any way whatsoever, liquidated damages shall be recovered from the contractor's dues as stipulated in the contract. The authority to decide as to whether liquidated damages are to be levied or not are as per Bank guidelines.

49.0 Substandard works and materials:

The contractors are required to execute all works satisfactorily and according to the specifications.

i) If any material or work is found to be unsound, imperfect, or inferior, from what is specified in the contract, the contractor should be advised to rectify or re-execute the work or remove the material as the case may be within a reasonable time depending upon the nature of work. If the contractor fails to do so, the work shall be got redone or rectified or the material replaced through any other agency at the contractor's risk and cost as per the provisions of the contract. The form of letter to be

given to the contractor in regard to rectification of defective work and removal of substandard material is to be issued as per Bank's Standard Format.

ii) Under certain exceptional circumstances, when the substandard work done cannot be rectified or redone because of structural or other constraints, the matter shall be reported to the architects and Premises & Estate Department and if it is subsequently decided to accept the said work, payment for such work shall be allowed at a reduced rate arrived at keeping in view the nature and extent of deviation from the specifications or drawings.

50.0 DELINQUENCIES

The under noted delinquencies / defaults / misconduct / misdemeanors on the part of Bidder or enlisted contractor will attract disqualification action.

- Incorrect information about credentials, about his performance, equipment, resources, technical staff etc.
- Non-submission of the fresh / latest income tax clearance certificate
- Irregular tendering practice.
- Submission of tender containing far too many arithmetical errors and freak rates.
- Revoking a tender without any valid reasons.
- Tardiness in commencing work
- Poor organization at site and lack of personal supervision
- Ignoring Bank's notices for replacement / rectification of rejected materials, workmanship etc.
- Violating any of the important conditions of contract i.e. site facilities, insurance, labour laws, banning on subletting etc.
- Lack of promptitude and co-operation in measurement of work and settlement of final account.
- Non-submission of vouchers and proof of purchases etc.
- Tendency towards putting up false and untenable claims.
- Tendency towards suspension of work for frivolous reasons.
- Treatment of labour
- Bad treatment of sub-contractors (piece workers) and unbusiness like dealings with suppliers of material.
- Lack of co-operation with nominated contractors of Bank
- Contractors becoming Bankrupt or insolvent.
- Contractor's conviction by a Court of Law.
- Failure to satisfactorily rectify defects during Defects Liability Period (DLP) and discovery of latent defects in contractor's work after the expiry of DLP of his contract.

50.1 DISQUALIFICATION ACTION AGAINST (DELINQUENCIES OF) CONTRACTOR

The award of the under-noted disciplinary action shall be considered.

- a) Placing embargo on issue of tenders or temporary suspension from the Bank's approved list.
- b) Permanent ban on issue of tenders and removal from the Bank's approved list.

50.2 PROCEDURE

The Contractor will debar as per standard guidelines of Bank and Govt. of India.

51.0 Observance of Contract Labour Act 1970

Various provisions of the Contract labour Act 1970 and the rules made there under cast certain obligations on the Bank in respect of Bank's Projects under construction at various centers. Under the Act, the Assistant General Manager of Premises & Estate Department would be considered as the "Principal Employer", even though the labourers are employed by the building contractor. The Act applies to every establishment in which twenty or more workmen are employed or were employed on any day of the preceding 12 months as contract labour. A workman shall be deemed to be employed as contract labour in connection with the work of an establishment when she/he is hired in connection with such work through a contractor with or without the knowledge of the principal employer.

However, in the cases of package deal agreements, it would not apply until the builder/vendor is deemed to be a contractor after execution of Deed of Conveyance, if so, provided in the agreement. The Act also does not apply to the work of gardening, maintenance of residential colonies and services therein. Such arrangements need not be included in the records to be maintained under the Act and rules made thereunder. During the construction of a project the "Principal Employer" shall comply with certain provisions of the Act in so far as they are applicable to the particular case. These provisions relate to-

(i) Registration of Establishment (Section 7).

The principal employer shall make an application to the registering officer in the prescribed manner for registration of establishment. The application for registration shall be made in triplicate in Form No.1 (Ref. Annexure XII) to the registering officer of the area in which the establishment sought to be registered is located. The application shall be accompanied by the Treasury rec

eipt showing payment of fees for the registration of the establishment. The application shall be either personally delivered to the registering officer or sent to him by registered post. The employer cannot employ the contract labour in his establishment unless he registers under Section 7 of the Act.

(ii) Maintenance of registers and other records (Section 29).

The following registers and records are required to be maintained by the Principal Employer:

a) Register of contractors in Form XII of the Contract Labour (Regulation & Abolition) Control Rules 1971 (Refer Annexure-XIII).

b) Notice showing the rates of wages, hours of work, wage period, dates of payment of wages, names and address of the Inspectors having jurisdiction and date of payment of unpaid wages, shall be displayed in English and in Hindi and in local language, in conspicuous places at the work site.

c) Return intimating the actual date of the commencement or completion of each contract work, under each contractor, shall be submitted to the Inspector within 15 days from the commencement or completion of the work as the case may be. The return shall be filed in Form No.VI B (Refer Annexure XIV)

d) The annual return in duplicate in Form No. XXV (Annexure XV) shall be submitted to the Registering Officer concerned so as to reach him not later than the 15th of February following the end of the year to which it relates.

All the registers, records and notices shall be produced on demand before the Inspector or any other authority under the Act.

(iii) Responsibility of payment of wages of workmen (Section 21).

Every principal employer shall nominate a representative duly authorized by him to be present at the time of disbursement of wages by the contractor and it shall be the duty of such representative to certify the amounts paid as wages in the prescribed manner. The authorized representative shall record under his signature a certificate at the end of the entries in the Register of wages or in the Register of wage and Muster Roll, in the following form.

"Certified that the amount shown in Column No. ____ has been paid to the workmen concerned in my presence on _____ at _____."

The Contractor shall be advised to disburse the wages in the presence of the authorized representative. If the contractor fails to make payment of wages within the prescribed period or makes short payment, the principal employer shall be liable to make payment of wages in full or the unpaid balance due to the contract labour employed by the contractor and recover the amount so paid from amounts payable to the contractors.

(iv) Welfare measures (Sections 16 to 19)

The welfare measures like canteen, restrooms and other facilities to the contract labour are required to be provided by the contractor himself, but if any of the facilities is not provided by the contractor, then it shall be provided by the employer within 7 days of the commencement of the employment of contract labour. However, all expenses incurred by the Bank in providing the amenity shall be recovered from the Contractor either by deductions from any amount payable to the contractor or as a debt payable by the contractor.

(v) Penalty for contravention (Section 22 to 27).

a) Whoever obstructs an Inspector in the discharge of his duties under the Act or refuses or willfully neglects to afford the Inspector any reasonable facility for making any inspection, examination, enquiry or investigation authorised by or under the Act in relation to an establishment, shall be punishable with imprisonment for a term which may extend to 3 months or with fine which may extend to Rs.500/- or with both.

b)The contravention of any provision of the Act or of the rules made thereunder or contravention of any condition of a license granted under the Act is punishable with imprisonment which may extend to 3 months or with fine which may extend up to Rs.1000/- or with both.

The Site Engineer/APMCF shall ensure that all the obligations under the relevant provisions of the Act including obtaining licenses by the contractor under Section 12 of the Act are complied with. Before releasing the contractor's final payment, they shall also ensure that the contractors have paid all dues to their contract labour. Note: The contractor has to meticulously comply with para 50 & Annexures (XII to XV) about the Observance of Contract Labour Act 1970 and its updated version/ amendments time to time.

52.0 Execution of Contract Agreement

- i) Contract documents shall be executed within 15 days from the date of issuance of work order or the date of handing over the site, whichever is later.
- ii) The original agreement of the successful Bidder shall be kept in safe custody of the Premises/ Estate Department at Bank. The site office shall keep record of all contracts executed in respect of works undertaken at the respective centers and a register for such executed agreements shall be maintained.

53.0 Execution of Project Work

53.1. Office Accommodation at Project Site The contractor shall provide and maintain adequate temporary fully furnished and air-conditioned site office accommodation minimum 750 sft for SBI and APMCF staff approx. 10 no's seating including top executive staff, which includes pantry area, exclusive Toilet area, 12-15- seater conference / meeting room with audio visual system. Office shall be equipped with all necessary facilities to run efficiently. For more details refer to clause no 57 of SCC.

53.2 Substandard works and materials:

The contractors are required to execute all work satisfactorily and according to the specifications.

- i) If any material or work is found to be unsound, imperfect, or inferior, from what is specified in the contract, the contractor shall be advised to rectify or re-execute the work or remove the material within a reasonable time depending upon the nature of work. If the contractor fails to do so, the work shall be redone or rectified or the material replaced through any other agency at the contractor's risk and cost as per the provisions of the contract.
- ii) Under certain exceptional circumstances, when the substandard work done cannot be rectified or redone because of structural or other constraints, the matter shall be reported to the APMCFs and Premises Department and if it is subsequently decided to accept the said work, payment for such work shall be allowed at a reduced rate arrived at keeping in view the nature and extent of deviation from the specifications or drawings.

53.3 Performance guarantees/manufacturers test certificates

NA

53.4 Completion drawings:

On completion of the project, in consultation with APMCF, CONTRACTOR shall prepare and

submit 'as-built drawings' in respect of layout, floor plans, sections, elevations showing all external services on cloth tracing/polyester film and soft copies in *.dwg (AutoCAD) and PDF format. The APMCF shall also obtain relevant operating instructions, manuals wherever applicable and forward the same to the Bank. The final bill of the contractor shall be released after all the completion drawings as required are furnished by them.

53.5. Programme charts and Progress Report:

i) As soon as the contract is awarded, a suitable program of work, preferably in the form of a bar / PERT chart shall be drawn up for completion of the different stages of the work, so as to ensure its completion within the allotted period of time. This program shall be submitted by the contractor in consultation with APMCF. Refer clause 7 of GCC and Clause 31 of SCC

ii) The monthly progress chart as given in Annexure- X indicating there in the programme and progress achieved both physical and financial with reasons for shortfall, if any, shall be sent by the APMCF to the concerned Department of the Bank.

iii) In addition to the above a weekly/fortnightly progress chart/report as given in Annexure X has to be submitted to the Bank.

iv) Further a daily progress report for all the works of the project has to be maintained in tabulated form at site and shared with APMCF and Bank as required.

53.6 Co-ordination and Monitoring:

i) It is the prime responsibility of the Contractor to ensure that execution of the work progresses smoothly in accordance with the programme and in proper co-ordination among different agencies.

ii) The APMCF shall keep a close watch on the progress of work, the resources position etc. and take suitable timely remedial measures to sort out the bottlenecks in consultation with the Department of the Bank concerned.

iii) Site meetings shall be held at periodical intervals at least once in a month or at closer intervals where APMCF/Bank's Engineer and the representatives of Contractor and various agencies who are involved in the project shall attend and review the progress of work and sort out hindrances, if any.

iv) Concerned Project Engineers/A.G.M. shall attend site meetings as often as possible in the interest of expeditious progress of the work. Minutes of the site meetings shall be prepared by the APMCFs and furnished to the department concerned and others concerned immediately after holding such meeting.

v) In terms of the contract provisions, the contractors are required to prepare and submit progress photographs (in triplicate) and videos at the beginning of each month. The photographs shall be taken in such a manner to give a fair idea of the progress of construction and the date on the photographs and video taken shall be written.

vi) As a faster means of coordination and monitoring, the use of advanced technology may be used

53.7 Testing of materials and approval:

i) To ensure use of quality materials and to exercise proper quality control on the work, certain tests are to be undertaken regularly by the contractor during the progress of the work as per the provisions of the contract. Some of the important tests that are to be carried out on the construction materials are such as water, steel, bricks, cement, tiles, timber, particle boards, aggregates, pipes, fittings, concrete, wires/cables, M.S. sheets, conduits, earth pits and these shall be conducted as per the relevant BIS specifications/agreement at the Government approved Technical Institutes/Laboratories. Report on these tests shall be forwarded to the APMCFs who shall duly certify the results thereof are in order and the materials may be used in the work. If the results do not conform to the relative BIS, the APMCFs shall take immediate appropriate action as per terms of contract.

ii) Results of all concrete cube tests shall be recorded in a Register of Cube Tests as per Annexure XI maintained at site in a register and signature of the contractors and APMCFs be obtained.

In case to ascertain quality of executed work on site SBI/APMCF may ask Contractor to carry out specialized third In -party tests, then the contractor to carry out those tests without any extra cost to SBI/APMCF.

iii) Under the terms of contract, the contractors are required to submit samples of various materials, items, fittings, etc. for the approval of the Bank and APMCF. For this purpose, special site meetings shall be arranged at the initial stage of project execution. As far as possible, the materials of brand names, if any, given in the contract shall only be selected. - The materials of brand names, if any, given in the contract shall only be selected. In exceptional cases only like outdate of product technology, closure of company etc., equivalent material usage other than mentioned in approved materials list shall be allowed after duly approval from the SBI/APMCF. SBI reserves the right to reject the materials without assigning any reason, whatever it may be. As far as possible, the materials of brand names, if any, given in the contract shall only be selected.

iv) All tests to be carried out and recorded as mentioned under various sections of Technical Bid by contractor at his own cost.

53.9 Measurement Books and Recording of measurements.

i) The Measurement Book (called MB hereinafter) is the initial record of works accounts and is the basis of all accounts of quantities of work done by the contractors or by labourers employed departmentally or materials received. The payment for all works done and for all materials received through a contract shall be made based on detailed measurements recorded in MB.

The digitized form of measurements, calculation and thus digitized MB's, its printout as hard copy, duly signed by contractor and APMCF should be maintained for the project.

The MB's to be hard bound, printed in A4 size paper, of minimum 80 GSM, with indelible inks

(Color as required).

- a) MBs shall be maintained very carefully and accurately as these may have to be produced as evidence in a Court of Law as and when required. These shall be printed books with the proforma referred to Annexure-XX. The number of pages for measurement alone shall be 100 per book in triplicate. The pages shall be serially machine numbered. The book shall be in custody of the APMCF.
- b) In addition to pages of measurements, pages shall be provided for index, instructions and record of handing and taking over.
- c) Each book shall bear an identifying number.
- ii) The Contractor shall take joint measurements of the work along with the Engineer of the APMCF as it progresses and records them directly in the digitalized MBs.
- iii) It shall be ensured that the method of measurements is in accordance with the mode of measurement given in the contract. Any point of disagreement/dispute with the contractor pertaining to mode of measurements shall be promptly referred to the AGM of the Department Concerned for final decision.
- v) Extra/deviated items, as claimed by the contractor, shall not be recorded in MB until they are approved by the Bank.
- v) The MB/digitalized record shall not be left under the custody of the contractor at any time. The contractor or his representative may be permitted by the Site Engineer/PMC to see it in his presence or make a copy of his own.
- vi) The measurement shall be authenticated / signed at the end of each session of measurement of the day's work, as the case may be, by both the parties i.e. site engineer/PMC and the contractor's authorized representative.
- vii) The contractor shall give due notice to the Bank whenever any work is to be buried in the earth, concrete or in the bodies of walls or otherwise, becoming inaccessible later on, in order that the work may be inspected and correct dimension taken before such burial, in default whereof, the same at the opinion of the Bank, be either opened up for measurement at the contractor's expenses or no payment may be made for such material, should any dispute or difference arise after the execution of any work as to measurements etc. or other matters which cannot be conveniently tested or checked. The notes of the Bank shall be accepted as correct and binding on the contractor.
- viii) The work shall be measured in the same sequence as constructed.
- ix) Before the start of excavation measurements, the measurer should be in possession of the reduced levels (RLs), of the bottom of excavation, of the natural ground floor level i.e. plinth level. Any discrepancy with measured sites shall be set right.
- x) Work at different levels/stages/floors shall be kept scrupulously separate. Location notes should be made opposite the respective dimensions' entries on M.B. pages.

- xi) Abbreviations commonly used by quantity surveyors should be freely used to convey maximum information about entries.
- xii) Measurements should start at the left-hand rear corner of the building. The record of measurement of work should be so methodical that after the perusal of a few pages only, anyone should be able to follow the measurement procedure of recording entries.
- xiii) Checking of measurements shall be as under. It should not be perfunctory and should reveal errors, accidental or deliberate, by the staff. It should also serve as a process of instructions to junior staff.
 - a) The initial record of measurements will be done by the Site Engineer/APMCF along with contractor's authorized representative as mentioned in Para ii under this clause.
 - b) The Site Engineer should also certify along with the APMCF wherever applicable, particularly where there is no separate supervision agency in the MB that
 - (i) the work has been executed as per specification and approved drawings,
 - (ii) no labour complaint is received so far against the contractor,
 - (iii) no water and electricity is drawn from the Bank by the contractor for his use,
 - (iv) the amount withheld against part rate payment is sufficient.

All measurements should be recorded neatly and directly in the M.B. at the site of work. The recording of measurements elsewhere and copying them into a 'M.B.' is forbidden.

The entries should be made with ball pen/ink pen. No entry should be erased/over written. If a mistake is made, it should be corrected by crossing at the incorrect words or figures and inserting the correction. The correction thus made shall be properly attested. The persons recording the measurements should be signed in all pages. Any page or space left blank inadvertently should be cancelled by diagonal lines; the cancellation should be attested and dated. When any measurements are cancelled or disallowed, they must be endorsed by the dated initials of the officer ordering the cancellation or by a reference to his written order initialed by the APMCF/Engineer who recorded the measurements. The reasons for cancellation are also recorded.

The details of major works along with its details in case of electrical works like Make, Sr. No, details of length of cables measured etc and same in case of civil like Grid, Column/Beam number etc. also should be recorded for future references. MB should be sent only by registered post or by special messenger. The following items of work which, owing to their situation, cannot subsequently be checked are known as hidden items.

- 1) All works below ground level such as concrete, masonry, steel work etc. in foundation.
- 2) Fabricated steel work in columns, beams etc. which are encased either in masonry or concrete.
- 3) Framework of false ceiling, partition, wall paneling.

4) Bitumen painting of roofs under mud-pushka and tiles paving or under terrace concrete.

5) Waterproofing treatment.

6) Lines of pipes buried in floor or wall or ceiling in internal sanitary, water supply or drainage installation. The levels of the plot shall be recorded in the field book. The Site Engineer/PMC are responsible for safe custody of the MB and he shall maintain a register showing the movement of MBs.

7) In case a MB is lost, the fact should be reported to the Bank and the APMCF and the measurements in the lost MB should be recorded at the earliest.

53.10 Certification of Bills and Payment:

Normally the agreement stipulates the value of works for interim bills. When the gross payment due to the contractor against work done & materials collected at site exceeds the interim amount of bill specified in the tender, the contractor is entitled to submit a bill as explained below:

- i) The contractor shall prepare the bill (Refer Table XIII) in triplicate on the basis of the item wise abstract of the total measured quantities as recorded in the MBs. The tender items shall be serially reproduced in the bill. The extra or variation items which have been approved shall only be included in the bill. Such extra items shall be shown in the bill in separate sub-heads along with references for approvals. The bills in triplicate shall be submitted to the Bank's Site Engineer/PMC.
- ii) The APMCF on receipt of the bill in triplicate from the contractors shall verify the following:
 - a) The bill of quantities is as per the measurements recorded in the MBs.
 - b) The rates for different items are as per accepted tender/quotation and/or the approved rates for variation.
 - c) The part rates are commensurate with the actual stage of work done, and reasons for allowing part rates are briefly mentioned-
 - d) Deductions/rebate on account of retention money, mobilization advance, or any item of work have correctly been shown in the bill.
 - e) Proper insurance cover as provided for in the contract and for proper value has been taken by the contractor.
 - f) Test certificates for the materials used concrete etc. required as per the contract have been enclosed.
- iii) The bill after due verification as above and after incorporating necessary corrections shall be certified by the APMCF. The bill in triplicate shall then be sent to the APMCF for certification.
- iv) The bill shall be thoroughly scrutinized and checked by the APMCF and sent to the Premises/ Estate Department along with a certificate of payment in duplicate as per Table-XX
- v) While passing a bill for payment, if the gross amount of the bill exceeds the sanctioned cost

including the contingencies, the payment shall be restricted to the sanctioned amount and after obtaining the additional sanction from the earlier sanctioned authority the balance amount may be released.

75% of net payment to be released within 15 working days from date of receipt of Architect's certificate. Balance 25% to be released within 30 working days from the date of receipt of Architect's Certificate subject to satisfaction of client.

vii) In terms of the relevant provision of the Income Tax Act 1961, all payments made against the bills shall be subject to the recovery of income Tax and surcharge as specified by the I.T. Department. The amount deducted shall be credited to the Government account and a certificate of deductions shall be given to the contractor. All statutory recoveries including labour cess, etc. are affected from the gross values of the bill.

viii) The APMCF shall ensure that the final bills are obtained from the contractors as early as possible after the virtual completion certificate with a view to settling the bill within the stipulated period of three months or contractual conditions.

ix) While scrutinizing the final bill, the following checks shall be exercised:

- a) That the APMCFs have issued the virtual completion certificate for the work.
- b) That extension of time, if any, beyond scheduled date of completion has been granted by the competent authority.
- c) That where the invocation of Liquidity damages clause has been decided upon, the recovery of liquidated damages has been affected.
- d) That the contractors have submitted the necessary guarantees/undertakings/test certificates as required in terms of contract.
- e) That all advances including mobilization advance are recovered in full. The interest component as applicable shall also be recovered.
- f) That there are no outstanding recoveries against the contractors on account of water, electricity, telephone charges or damages to fittings/fixtures or any other account as specifically provided for in the agreement.
- g) That all receipts for refundable deposits, if any, paid by the contractors on behalf of the Bank, have been submitted by the contractor to the Bank, so that the Bank may pursue with the concerned authorities, for obtaining refund of the same.
- h) That the required check measurements have been carried out in the MBs and the fact recorded in MB.
- i) That the contractors have been given a certificate to the effect that "Accepted in full and final settlement of all claims".

- j) Income Tax, Sales tax on works contract, Labour cess or any other tax as per terms of contract are recovered as per statutory regulations.
- k) That the total cost of work is within the sanction, If not, revised sanction has to be obtained before releasing the payment to the contractor.
- l) Two sets of executed plans with soft copy.

53.11 Variations/Extra Items of Work:

- i) Deviations in the agreement would normally comprise of
 - a) new items of work i.e. items completely new and in addition to the items of contract. These are known as extra or additional items.
 - b) Substituted items i.e. items which substitute for the existing one or are taken up in lieu of those already provided in the contract. There can be slight modifications or partially omitting items of work in the contract
 - c) Deviation in quantities of items, i.e. where there is an increase or decrease in the quantities of work in the agreement. In other words, the nomenclature of work remains the same, but the quantities vary with those provided in the agreement.
- ii) As regards substitution or extra item of work, it should be ensured, while doing so, that the quantity of low rates items is not substituted by high rated items either by way of substitution or by allowing extra items.
- iii) The rates of substitution or extra items shall be approved by the competent authorities, and these rates are to be derived in the manner as specified in the tender document.
- iv) As regards variation in quantities of the tender items, the same may be permitted by the competent authority for certifying the contractor's running bills and making payment.

Measurements for inadmissible items:

In case of items which are claimed by the contractor but are not admissible, measurements should be taken for record purposes only and without prejudice so that in case it is subsequently decided to advise the contractor, there should be no difficulty in determining the quantities of such items. A suitable reason should however be made in red ink against such measurements, to guard against payments in the ordinary way.

53.12 Site Order Book:

- i) For issuing instructions to contractors in the course of day-to-day supervision of works, site order book shall be maintained by the Site Engineer/APMCF in a prescribed form (Refer Table XVI (Annexure- XVI). Instructions should be prepared in triplicate and serially numbered. A copy of these instructions can be given to the contractor and APMCF for necessary action.

While issuing such instructions, the contractor/his authorized representatives' signature shall be obtained from the office.

ii) Instructions in the site order book shall be recorded under the signature of the Site Engineer/APMCF. The Bank's Engineer during his periodical inspection/visit shall peruse and record his instructions, if any, in this book.

iii) All instructions to the contractors which are at variance with tender provisions also pointing out lapses on the part of the contractors to adhere to the tender specifications shall be issued in writing through site order book by the Site Engineer as well as APMCF and Bank's officials visiting the site.

iv) The site order book shall be kept in custody of the Site Engineer/APMCF at site. This fact should be made clear to the contractors at the beginning of the work. The site order book shall be referred to at the time of making final payments to the contractors.

v) The site order book shall be preserved for a period of 5 years or up to the time of all disputes/arbitration cases of the work are finally settled, whichever is later, after completion of work in the same manner as a M.B.

vi) The site order book shall be referred to at the time of making final payments to the contractors

53.13 Hindrance Register:

In order to have a record of hindrance in the progress of work which may result in delays and consequent claims from the contractors for extension of time a Hindrance Register shall be maintained at the construction site. The details of hindrances with time period shall be recorded by the Site Engineer/PMC therein when these occur and all recordings shall be signed jointly by the Site Engineer/PMC and the contractor's representative. While considering the contractor's request for an extension of time for completion of work, this register shall be referred to.

53.13 Site Register:

The following registers are to be maintained by contractor at site office:

- i) Daily Progress record
- ii) Site order book
- iii) Cement and steel register (Receipts, consumption, balances).
- iv) Concrete cube test register/slump cone test register.
- v) Register of drawings and working details.
- vi) Logbook of defects.
- vii) Test reports of building materials.
- viii) Sand bulkage register/silt content register.
- ix) Lead register.
- x) Daily labour register.
- xi) Variation order register.
- xii) Hindrance register

- xiii) Electrical wiring system testing register.
- xiv) Equipment test certificate register.

These registers and a set of latest drawings shall be kept in the safe custody of the Site Engineer/PMC.

Other than above registers, more may be required to be maintained at site as per project requirements.

54.0 – MAINTENANCE OF RECORDS TO BE DONE BY CONTRACTOR

S. No.	Registers at the site office of APMCF
1	Measurement Books.
2	Cement Register (Daily Record).
3	Steel Register.
4	Steel Consumption Register – Bill wise.
5	Drawings register
6	Materials at site register.
7	Hindrance Register.
8	Concrete cube Test Register.
9	File and register for extra / variation items.
10	Materials test Register and File.
11	Site Order Book (in triplicate).
12	Lead caulking Register.
13	Labour Reports and progress Reports Register.
14	Site Visit & Instructions Register.
15	Certified true copies of the contracts.

55.0 Writing error: If any flaw, omission, commission in writing or otherwise is observed in the RFP, then following Precedence shall be followed in resolving it :

- i) Premises Manual 2025 of the Bank and its circulars..
- ii) Manual for Procurement of Works, 2022 or latest edition from DoE, GOI.

ANNEXURE-XII: FORM I: FORMAT OF APPLICATION FOR REGISTRATION OF ESTABLISHMENT EMPLOYING CONTRACT LABOUR

1	Name and location of the Establishment.	
2	Postal address of the Establishment.	
3	Full name and address of the Principal Employer. (furnish father’s name in the case of individuals)	
4	Full name and address of the Manager or the person responsible for the supervision and control of the	

	Establishment.	
5	Nature of work carried on in the Establishment.	
6	Particulars of Contractors and Contract Labour:	
(a)	Names and address of the Contractors	
(b)	Nature of work in which contract labour is employed or is to be employed.	
(c)	Maximum number of contract labour to be employed any day through each Contractor.	
(d)	Estimated date of commencement of each contract work under each Contractor.	
(e)	Estimated date of termination of employment of contract labour under each Contractor.	
7	Particulars of Treasury Receipt enclosed. (Name of the Treasury, Amount and Date)	

I hereby declare that the particulars given above are true to the best of my knowledge and belief.

Principal Employer

Seal and Stamp

ANNEXURE- XIII: FORM XII: FORMAT OF REGISTER OF CONTRACTORS

1 Name and addresses of the Principal Employer _____

2 Name and address of the Establishment _____

Sr. No	Name and address of the contractor	Nature of work on contract	Location of contract work	Period of contract from to	Maximum number of workmen employed by the contractor

ANNEXURE- XV: FORM XXV: FORMAT OF ANNUAL RETURN OF THE PRINCIPAL EMPLOYER TO BE SENT TO THE REGISTERING OFFICER

Sr. No	Item	Year ending 31st December
1	Full name and address of the Principal employer	
2	Name of the Establishment. (a) District (b) Postal Address (c) Nature of operation/industry/work carried on	
3	Full name of the Manager or person responsible for supervision control of the Establishment.	
4	Number of Contractors who worked in the Establishment during the year (Given details as per proforma below).	
5	Nature of work/operations on which contract labour was employed.	
6	Total number of days during the year on which contract labour was employed.	
7	Total number of man days worked by contract labour during the year.	
8	Maximum number of workmen employed directly on any day during the year.	
9	Total number of days during the year on which direct labour was employed.	
10	Total number of man days worked by directly employed workmen.	
11	Changes, if any, in the management of the establishment, its location or any other particulars furnished to the Registering Officer in the application for Registration indicating also the dates.	

Place _____ Date _____ Principal Employer Name

13.0 ARTICLES OF AGREEMENT

This agreement made theday of between Assistant General Manager/ DGM (),State Bank of India, -----(hereinafter called the Bank or SBI) which expression shall include the successors and assigns) of the one part and M/s. company / partnership for registered under the Indian Companies Act / Partnership Act having its office registered ----- (hereinafter called 'the Contractors' which expression shall include the present directors / partners and also the directors / partners from time to time as also their respective heirs, legal representatives, administrators and assigns) of the other part

WHEREAS the employer is desirous of execution of _____ **(Name of Work)** _____ and has caused drawings and specifications describing the works to be done prepared by Project **Architects M/s** _____ having their offices at _____ (hereinafter called "the Architect")

AND WHEREAS THE SAID Drawings numbered as mentioned in the tender documents hereinafter mentioned and to be issued from time to time, the specifications and the Schedule of items and quantities have been signed by or on behalf of the parties hereto. AND whereas the contractors have agreed to execute upon and subject to the condition set forth herein and Schedule of items and quantities, General & special Conditions of Contract, specification etc. contained in the tendered documents including all correspondences exchanged by or between the parties from the submission of tender till the award of work, both letters inclusive, (all of which are collectively hereinafter referred to as "the said conditions"). The works shown upon the said drawing and /or described in the said specification and included in the schedule of Items and Quantities at the respective rates therein set forth amounting to the sum of **___Rs_____** (Rupees _____ in words _____) as there in arrived at or such other sum as shall become payable there under (hereinafter referred to as " the said Contract Amount".

NOW IT IS HEREBY AGREED AS FOLLOWS:

1. In consideration of the said Contract amount to be paid at the times and the manner set forth in the said Conditions, the Contractors shall upon and subject to the said conditions execute and complete the work shown upon the said drawings and described in the said

specifications and the schedule of items and quantities.

2. The employer shall pay the Contractors the amount or such other sum as shall become payable, at the times and in the manner specified in the said conditions.

3. The term "the Architect" in the said condition shall mean the said "M/s _____" or in the event of their ceasing to be the Architect for the purpose of this contract for whatever reason, such other person or persons as shall be nominated for that purpose by the Employer, not being a person to whom the Contractor shall object for reasons considered to be sufficient by the Employer provided always that no person or persons subsequently appointed to be Architect under this contract shall be entitled to disregard or over rule any previous decisions or approval or direction given or expressed in writing by the architect for the time being.

4. The said conditions and appendix thereto shall be read and construed as forming part of this agreement, and the parties hereto shall respectively abide by/ submit themselves to the said conditions and perform the agreements on their part respectively in the said conditions contained.

5. The plans, agreement and documents mentioned herein shall form the basis of this contract. 6. This contract is neither a fixed Lump sum contract nor a piece work contract but is a contract to carry out the work in respect of the entire project on item rate basis to be paid for according to actual measured quantities at the rates contained in the schedule of quantities and rates or as provided in the said conditions.

7. The Bank / Employer reserves to itself the rights to alter the specifications and nature of work by adding to or omitting any item of work or having portions of the same carried out without prejudice to the contract.

8. Time shall be considered as the essence of this contract and the contractor here by agrees to commence the work soon after the site is handed over to him or from the 14th day after date of issue of formal work order as provided for in the said conditions of contractor whichever is later and to complete the entire work within ____ (period of contract) months subject never the less to the provisions for extension of time.

9. All payments by the Employer under this contract will be made only at _____.

10. Any dispute arising under this Agreement shall be referred to arbitration in accordance with the stipulations laid down in the tender.

11. That all the parts of this contract have been read by the contractor and fully understood

by the contractor. They further agree to complete the said work to fullest satisfaction of architect / Employer.

12. IN WITNESS WHEREOF the Employer and the contractors have set their respective hands to these presents through their duly authorized official and the said two duplicates hereof to be executed on its behalf of the day and year first herein above written.

**Signed on Behalf of
State Bank of India**

**Signed on Behalf of the
Contractor**

In Presence of

In Presence of

1. Signature_____

1. Signature _____

Name_____

Name_____

Address_____

Address _____

In Presence of

In Presence of

2. Signature_____

2. Signature _____

Name_____

Name_____

Address_____

Address _____

14.0 APPENDIX HEREIN BEFORE REFERRED TO

1	Name of the organization Offering Contract:	Assistant General Manager, Premises & Estate Dept., Local Head Office, GIFT City Gandhinagar, Gujarat-382355
2	Architect Consultants /APMCF	M/s. VK:a architecture, SB Road, Pune
3	Site Address	<i>Block No 41 A & B, Gift City, Gandhinagar, Gujarat”</i>
4	Scope of Works	Composite Construction works of Civil, Plumbing, Sanitary, Electrical, Firefighting, HVAC, SECURITY EQUIPMENTS, IBMS, LIFTS, Landscaping, and Allied Services, etc. for the Proposed Construction of Residential Twin Towers.
5	Name of the Contractor	
6	Address of the Contractor	
7	Period of Completion	As per clause 3 of NIT.
8	Earnest Money Deposit	₹. 2,53,33,000.00 (Rupees Two Crore Fifty-Three Lakhs Thirty-Three Thousand Only) in the form of Demand Draft or Banker’s Cheque drawn in favor of State Bank of India Payable at Gift City, Gandhinagar. (Valid for a period of 90 Days from the last date of submission of the tender) + GST EMD to be deposited on or before the time and last date of submission of the technical bid.
9	Security Deposit (SD) / Retention Money	As per Part B - Point 10.6 of Information and Instruction to Bidders
10	Defects Liability Period	As per Clause No. 1.1.18 (a) of GCC.
11	Insurance to be undertaken by the :	As per Clause 25 of GCC.
12	Liquidated damages:	As per Clause No 8 of GCC.
13	Value of Interim Bill (Min.) :	As per Clause no. 17 of NIT.
14	Date of Commencement	As per Clause 26 of GCC.
15	Period of Final measurement	As per Clause 22 of GCC.
16	Initial Security Deposit:	As per clause no. 2 (b) of GCC.

17	Total Security Deposit: As per clause No.	2 of GCC
18	Refund of Total Security Deposit Comprising of EMD and ISD	This Retention amount shall be released by the SBI in Two stages ie. 50% of Security Deposit be released after issuing of VCC and remaining 50% shall be released after completion of Defect Liability Period and Completion of Project Closure report from SBI and APMCF whichever is later and provided no complaint is received or the defects has been rectified by replacing the same satisfactorily.
19	Period for Honoring Certificate	<p>1. One Month for R.A. Bills</p> <p>2. The final bill will be submitted by the Contractor within one month of the date fixed for completion work and the Bill shall be Certified as per Clause 22 of GCC provided the bills are submitted with all pre-requisite documents, compliance of Statutory Authorities, test reports, etc. prescribed in the tender.</p>

Signature of Bidder.

Date:

15.0 SPECIAL CONDITIONS OF CONTRACT (SCC)**GENERAL**

1) Unless otherwise specified, IS Codes, NBC Guidelines, CPWD Specifications 2019 volume I - II with correction slips up to 31.10.2025 or latest edition shall be followed. Any additional item of work, if taken up subsequently, shall also conform to the relevant IS Code, CPWD specifications mentioned above. Should there be any difference or discrepancy between the description of items as given in the schedule of quantities, particular specifications for individual items of work and I.S. Codes etc., the following order of preference shall be observed.

- i) Specification and standards, Tender Drawings, Schedule of Quantities
- ii) Particular Specifications, Special Conditions
- iii) CPWD Specifications.
- iv) Indian Standard Specifications of BIS
- v) National Building Code 2016 with up-to-date amendments
- vi) Standard engineering practices as per directions of the APMCF/SBI

2) The work shall be carried out in accordance with the Architectural drawings, structural drawings & MEPF drawings, relevant codes, specifications etc. Before commencement of any item of work, the contractor shall correlate all the relevant architectural and structural drawings issued for the work and satisfy himself that the information available therein is complete, suitable and unambiguous. The discrepancy, if any, shall be brought to the notice of the APMCF/SBI before execution of the work. The contractor shall be solely responsible for any loss or damage occurring by the commencement of work on the basis of any erroneous and or incomplete information. The APMCF /SBI, in no case, shall be held responsible for the accuracy thereof and/or interpretations or conclusions drawn there from by the Contractor and all consequences shall be borne by the Contractor. It is presumed that the Contractor shall satisfy himself for all possible contingencies, incidental charges, wastage, bottlenecks etc. likely during execution of work and acts of coordination which may be required. Nothing extra shall be payable on this account.

“The work shall be carried out strictly in accordance with the true intent and meaning of the specifications and the drawings taken together, whether or not every detail is specifically shown or described, provided that such requirement can be reasonably inferred for proper completion of the works.

3) All incidental works—including ancillary labour, materials, accessories, temporary arrangements, protections, cutting/chasing, patching, making good, etc.—that are not expressly listed in the Bill of Quantities / drawings / specifications but are essential for completing each quoted item in all respects shall be deemed to be included in the respective item-rate quoted by

the Contractor. No extra payment shall be admissible for any such incidental requirements, irrespective of their quantity or variation due to actual site conditions or instructions of the Employer / APMCF / SBI. However, where during execution new or substantially different items of work—not reasonably inferable from the tender drawings/specifications and not covered by any of the quoted BOQ items—are found necessary for satisfactory completion of the project, such items shall be treated as Extra Items and shall be paid at the applicable rates determined in accordance with the conditions of contract for extra/deviated items. Except as provided above for extra items, no adjustment of quoted rates shall be made on account of variation in the quantum or nature of incidental works that remain integral to the originally tendered items.”

4) Should the Contractor require any further details, elaborations, clarifications, or miscellaneous drawings in addition to those issued with the tender for the proper execution of the works, such requests shall be made at least one (1) month in advance of the intended requirement at site. This will enable the Consultant / Engineer-in-Charge to review the request and furnish the required information in due time, ordinarily within one (1) month of receipt of such request. The Contractor shall not claim any delay, hindrance, or extension of time on this account, provided the required information is furnished within the stipulated period. Any such additional detailing, elaboration, or miscellaneous drawings supplied by the Consultant / Department shall be deemed supplementary or explanatory to the original drawings and specifications and shall not be construed as a change in the Scope of Work. No extra payment shall be payable to the Contractor for complying with such supplementary details or drawings.

5) In the event of any variation, inconsistency, or discrepancy between the drawings, specifications, and other parts of the tender/contract documents, the Contractor shall promptly notify the APMCF / SBI in writing at the earliest opportunity and, in any case, before proceeding with the affected work. The APMCF / SBI, after consultation with the Consultant / Engineer-in-Charge where necessary, shall issue a written clarification or instruction, and such decision shall be final and binding on both parties for the purpose of execution of the work. Any work carried out by the Contractor without seeking such prior clarification shall be at the Contractor’s own risk and cost, and no claim for extra payment or extension of time shall be admissible on that account. The Contractor shall not take advantage of any clerical, typographical, or grammatical error that may appear in the drawings, specifications, or other standard clauses used in the agreement. Any such error, if found, shall be reported immediately to the APMCF / SBI for correction or clarification, which shall then prevail.

6) Existing drains, pipes, cables, over-head wires, sewer lines, water lines and similar services encountered in the course of the execution of work shall be protected against the damage by the contractor, in case any damages to such existing services take place the same shall be rectified by the contractor at his own expense to the satisfaction of the APMCF / SBI. The contractor shall not store materials or otherwise occupy any part of the site in a manner likely to hinder the operation

of such services.

7) Existing Storm water drains around periphery of site shall be maintained by the Contractor free of cost by regular cleaning, repairing, protecting, Debris removing, making smooth path for the flow of storm water.

8) The contractor shall be responsible for the watch and ward / guard of the buildings, safety of all fittings and fixtures including sanitary and water supply fittings and fixtures provided by him against theft/ pilferage and breakage during the period of installations and thereafter till the building is physically handed over to the department.

9) The entire work up to the plinth level, if required for obtaining approval up to the plinth (Further commencement certificate after plinth level) from the local authority, shall be completed by the Contractor simultaneously.

10) The rates quoted by the Contractor are deemed to be inclusive of site clearance, setting out work, profile, establishment of reference benchmark(s), taking spot levels, construction of all safety and protection devices, barriers, preparatory works, working during monsoon, working at all depths, height, lead, lift and location and any other incidental works required to complete this work.

11) For work below ground level the contractor shall keep that area free from water. If dewatering or bailing out of water is required, the same shall be responsibility of contractor. Nothing extra shall be paid on this account.

12) Any legal or financial implications resulting out of disposal of earth shall be carried out by the contractor at his own cost. Nothing extra shall be payable on these accounts

13) The Contractor shall keep himself fully informed of all acts and laws of the Central & State Governments, all orders, decrees of statutory bodies, tribunals having any jurisdiction or authority, which in any manner may affect those engaged or employed and anything related to carrying out the work. All the rules & regulations and byelaws laid down by local body and any other statutory bodies shall be adhered to by the contractor, during the execution of work. The Contractor shall also adhere to all traffic restrictions notified by the local authorities.

14) The cost of water for construction and labours (for municipal water connection/any other statutory body as well as tanker water) shall be borne by the contractor. Also, if the contractor obtains water connection for drinking purposes from the municipal authorities or any other statutory body, the consequent charges shall be borne by the contractor. All statutory taxes, levies, charges (including water and sewerage charges, charges for temporary service connections and / or any other charges) payable to such authorities for carrying out the work, shall be borne by the Contractor.

15) The Contractor shall arrange to give all notices as required by any statutory / regulatory

authority for labour licenses, registration with EPFO, ESIC and BOCW Welfare Board etc. and shall pay to such authority all the fees, cess, labour cess, etc. that is required to be paid for the execution of work. He shall protect and indemnify the Department and its officials & employees against any claim and /or liability arising out of violation of any such laws, ordinances, orders, decrees, by himself or by his employees or his authorized representatives. Nothing extra shall be payable on these accounts.

16) All payments or fees related to all works shall be payable to Government/ Local Body including statutory payments demanded either in the name of Customs Department Contractor for obtaining the various applicable permissions/ all required and applicable Approvals/licenses like CFO approvals, excavation approval, Certificate and making and getting all permanent civil and E & M service connections, Payments payable to electrical supply company etc. for the scope of this work shall be borne by the Contractor. No extra payment shall be done to Contractor on this account.

17) Royalty at the prevailing rates shall be paid by the Contractor on all materials such as boulders, metals, sand and bajri etc. collected by him for the execution of the work, directly to the revenue authority of the state government concerned.

18) No foreign exchange shall be made available by the SBI for importing (purchase) equipment, plants, machinery, materials of any kind or any other items required to be carried out during execution of the work. No delay and no claim of any kind shall be entertained.

19) The Contractor shall carry out his work so as not to interfere with or hinder the progress of the work being carried out by any other agency. As far as possible, he shall arrange his work and place, so as not to interfere with the operations of other Contractors or shall arrange his work with that of the others, in an acceptable and coordinated manner and shall perform it in proper sequence

20) If the work is carried out in more than one shift or during night, no claim on this account shall be entertained. The agency must take permission from the statutory authorities etc. if required for work during night hours, no claim / hindrance on this account shall be considered if work is not allowed during nighttime.

21) The Contractor shall assume all liability, financial or otherwise in connection with this contract and shall protect and indemnify the SBI from any and all damages and claims that may arise on any account. The Contractor shall indemnify the SBI against all claims in respect of patent rights, royalties, design, trademarks of name or other protected rights, damages to adjacent buildings, roads or members of public, residents, visitors, other agencies/ vendor's workers, etc *Block No 41 A & B, Gift City, Gandhinagar, Gujarat* & their vehicles in course of execution of work or any other reasons whatsoever, and shall himself defend all actions arising from such claims and shall indemnify the SBI in all respect from such actions, costs and expenses. Nothing extra shall be payable on this account.

22) The Contractor shall make all necessary arrangements for protection from rains, the work already executed and for carrying out the further work, during monsoon including providing and fixing temporary shelters, protections etc. Without any extra payment.

23) In case of flooding of site on account of rain or any other cause and any consequent damage, whatsoever, no financial claim will be entertained. Also, the Contractor shall make good at his own cost, the damages caused, if any.

24) The Contractor shall take all necessary precautions to prevent any nuisance or inconvenience to SBI, tenants or occupants of the adjacent properties and to the public in general. The Contractor shall take all care, as not to damage any other adjacent property or other services running adjacent to the plot. If any damage is done, the same shall be made good by the Contractor at his own cost and to the entire satisfaction of the APMCF /SBI. The Contractor shall use such methodology and equipment for execution of the work, to cause minimum environmental pollution of any kind during construction, to have minimum construction time (applicable as per tender item) and minimum inconvenience to road users and to the occupants of the buildings on the adjacent plot and public in general, etc. He shall make good at his own cost and to the entire satisfaction of the APMCF /SBI any damage to roads, paths, cross drainage works, or public or private property whatsoever caused, due to the execution of the work or by traffic brought thereon, by the Contractor. Further, the Contractor shall take all precautions to prevent any pollution of streams and waterways. All waste or superfluous materials shall be carted away by the Contractor, entirely to the satisfaction of APMCF /SBI. Utmost care shall be taken to keep the noise level to the barest minimum so that no disturbance as far as possible is caused to the occupants / users of adjoining buildings. No claim whatsoever on account of site constraints mentioned above or any other site constraints not specifically stated here, shall be entertained from the Contractor. Therefore, the Contractors are advised to visit site and get first-hand information of site constraints. They should quote their rates accordingly.

25) The quoted rates shall also be inclusive of all ancillary/enabling and incidental works required for execution of work like labour camp, stores, fabrication yard, offices, watch and ward, temporary structure for plants and machineries, scaffolds, H frames, Props, Spans, Cup lock system, Safety Platforms, Covering external scaffold with green shade nets, polypropylene sheets to avoid direct fall of any materials from higher side, Safety equipment, watch and ward security, vehicles, labs, water storage tanks, arrangement for temporary connection for electricity, telephone, water etc. including their consumption charges, protection works, barricading, providing testing facilities / laboratory at site of work for various field and laboratory tests or any other activity which is necessary for execution of work and as directed by APMCF /SBI. Before starting the work, the Contractor shall obtain approval of the APMCF /SBI, before locating various temporary structures/ site office, positioning of machinery, material yard, cement and other storage, steel fabrication yard, site laboratory, water tank, etc.

In Addition to the above Contractor to take into considerations of Preamble mentioned in Tender BOQ

26) The Contractor shall display all permissions, licenses, registration certificates, bar charts, other statements etc. under various labour laws and other regulations applicable, at his site office.

27) The Contractor shall cooperate with and provide facilities to the other agencies if any appointed by the SBI for working at site for smooth execution of the work. The Contractor shall

i) Properly co-ordinate his work with the work of other agencies if any are appointed by the SBI.

ii) Provide control lines and benchmarks to the other Contractors if any are appointed by the SBI.

iii) Provide electricity at mutually agreed rates.

iv) Co-ordinate with other Contractors for leaving inserts, making chases, alignment of services etc. at site.

v) Adjust his work schedule and site activities in consultation with the APMCF /SBI and other Contractors to suit the overall completion schedule.

vi) Resolve the disputes with another Contractor amicably. The contractor shall indemnify the SBI against any claim(s) arising out of such disputes.

Vii) In case of variation / conflicting provisions is observed in any condition of bid document forming part of contract, the decision of tender accepting authority shall be final and binding on the contractor

28) AS BUILT DRAWINGS

i) For the drawings issued to the contractor by the APMCF. The APMCF will issue two sets of drawings (and soft copies if required) to the Contractor for the items because some changes have been made. From the approved drawings as instructed by the SBI / APMCF. The contractor will make the changes made to these copies and return these copies to the APMCF for their approval. In cases revision is required or the corrections are not properly marked the APMCF will point out the discrepancies to the contractor. The contractor will have to incorporate these corrections and / or attend to discrepancies either on copies as directed by the APMCF and submit them to APMCF for approval. The APMCF will return one copy duly approved by him.

ii) For the drawings prepared by the contractor

The contractor will modify the drawing prepared by him wherever the changes are made by the SBI / APMCF and submit two copies of such modified drawings to the APMCF for approval. The APMCF will return one copy of the approved drawing to the contractor.

29) SUFFICIENCY OF TENDER

The Bidder shall be entirely responsible for sufficiency of rates quoted by him in his tender.

Sufficiency of tender prices: Subject to any provisions laid down in the tender document, the Contractor shall be deemed to have satisfied himself before submitting his tender as to the correctness and sufficiency of the tender and to have taken account of all that is required for the full and proper execution of the contract and to have included in his rates and prices all costs related to item the completion of work.

30) PROGRAM /SCHEDULE

The Contractor shall prepare an integrated programme chart within fifteen days of issue of award letter including Civil as well as E & M (Electrical and Mechanical) activities for the execution of work, showing clearly all activities from the start of work to completion, with details of manpower, equipment and machinery required for the fulfillment of the program within the stipulated period and submit the same for approval of the APMCF /SBI. These shall be submitted by the contractor through electronic media besides forwarding hard copies of the same. The integrated programme chart so submitted should not have any discrepancy with the physical milestones attached in the contract agreement. The programme chart should include the following:

- i) Descriptive note explaining sequence of various activities.
- ii) Construction Programme prepared on M.S. Project Software, which will indicate resources in financial terms, manpower and specialized equipment for every important stage. One planning engineer should be engaged in projects who is familiar with MS Project software. No extra payment shall be made in this regard to the contractor. Hard copy of the construction programme with sign & stamp of Authorized signatory shall be submitted to SBI/APMCF
- lii) Programme for procurement of materials by the contractor.
- iv) Programme for arranging and deployment of manpower both skilled and unskilled so as to achieve targeted progress.
- v) Programme of procurement of machinery/equipment having adequate capacity, commensurate with the quantum of work to be done within the stipulated period, by the contractor.
- vi) Programme for achieving fortnightly micro milestones and periodic milestones.

31) The time allowed for carrying out the work as entered in the tender shall be strictly observed by the Contractor. This shall be reckoned from the date on which the order to commence work is given to the Contractor.

32) If at any time, it appears to the APMCF /SBI that the actual progress of work does not conform to the approved programme referred to above, the contractor shall produce a revised program within 7 days showing the modifications to the approved program by additional inputs to ensure completion of the work within the stipulated time. A recovery of amount/Penalty as specified shall be made in case of delay as per Tender Clause of liquidated damages.

33) The submission for approval by the APMCF / SBI of such programme or the furnishing of such particulars shall not relieve the contractor of any of his duties or responsibilities under the contract. This is without prejudice to the right of APMCF /SBI to act against the contractor as per terms and conditions of the agreement.

QUALITY ASSURANCE & MATERIALS TESTING

34) The contractor shall establish field laboratory at site including all necessary equipment for field tests as given in tender document. All the relevant and applicable standards and specifications shall be made available by the contractor at his cost in the field laboratory.

Contractor shall be responsible for carrying out all mandatory field/ laboratory tests. The contractor should provide adequate support of staff at his cost for carrying out field tests, packaging & forwarding samples for outside laboratory tests and for maintaining test records. All the registers of tests carried out at site or in outside laboratories shall be maintained by the contractor. The test register shall be prepared and maintained by the Contractor as directed and approved of the APMCF /SBI. All the entries in the test register will be made by the designated engineer of the contractor and same shall be regularly reviewed by the APMCF /SBI or his authorized representatives at site.

35) The Contractor shall procure and provide all the materials from the manufacturers / suppliers as per the list attached with the tender documents, as per the conditions and specifications for the work. The equivalent brand for any item shall be permitted to be used in the work, when any of the preferred make is not available. This is, however, subject to documentary evidence produced by the contractor regarding non availability of the preferred brand and subject to independent verification by the APMCF /SBI. In exceptional cases, where such approval is required, the decision of APMCF /SBI as regards equivalent make of the material shall be final and binding on the Contractor. No claim, whatsoever, of any kind shall be entertained from the Contractor on this account. Also, the sample work/ material shall be procured only after obtaining written approval of the APMCF /SBI.

36) All materials shall be checked by the APMCF or his authorized supervisory staff on receipt of the same at site before use.

37) The Contractor or his authorized representative shall associate in collection, preparation, forwarding and testing of such samples. In case he or his authorized representative is not present or does not associate him, the result of such tests and consequences thereon shall be binding on the Contractor. The Contractor or his authorized representative shall remain in contact with the APMCF/SBI, or his authorized representative associated for all such operations. No claim of payment or claim of any other kind, whatsoever, shall be entertained from the Contractor.

38) All the hidden/Buried/ Concealed items such as water supply lines, drainage pipes, conduits, sewers etc. are to be properly tested as per the design conditions before covering.

39) Water tanks, taps, sanitary, water supply and drainage pipes, fittings and accessories should be confirmed to Green Building norms, bylaws and municipal body/corporation where Specifications are not available.

40) BIS marked materials except otherwise specified shall be subjected to quality test at the discretion of the APMCF /SBI besides testing of other materials as per the specifications described for the item/material. Wherever BIS marked materials are brought to the site of work, the agency shall, if required, by the APMCF /SBI, furnish manufacturer's test certificate or test certificate from approved testing laboratory to establish that the material / procured by the agency for incorporation in the work satisfies the provisions of specifications / BIS codes relevant to the material and / or the work done.

41) The contractor shall procure the required materials in advance so that there is sufficient time to test the materials and clearance of the same before use in the work.

42) The contractor shall supply free of charge the materials required for testing including packing and transportation to testing laboratory. The testing of materials shall be conducted in Govt. Laboratory/ Govt. colleges/ IITs/NITs or from the laboratory approved by APMCF/SBI. The charges for testing of materials shall be borne by the Contractor.

The tests shall be carried out under the supervision of the Engineer-in-charge. 80% of the total tests to be done are to be carried out on site laboratory if the facilities are available as per tender terms and remaining 20% tests are to be carried out at Govt. recognized/NABL accredited laboratory.

43) All expenditure to be incurred for testing samples e.g., packaging, sealing, transportation, loading, unloading etc. including testing charges shall be borne by the contractor in all cases irrespective of testing results.

44) Contractor shall submit minimum "Quality Assurance" plan within 45 days after award of work which shall be consisting of:

45) Lot size, number of required tests and frequency of testing.

46) While deciding these criteria Tender Specifications & Provisions of BIS Codes and Standard Practices may be referred. Volume of work, Practical Difficulties and Site Conditions etc. may also be kept in view. The lot size, number of tests and frequencies of testing can be increased as per requirement by the APMCF /SBI from the prescribed limits.

47) It should clearly indicate the Machinery and other Tool & Plants required to be deployed at site by the agency. Entire Machinery and T&P may not be required at the start of work, therefore, a proper time schedule by which each Machinery & T&P is to be brought at site should also be indicated.

48) The Contractor shall allow access to Third Party Quality Assurance (TPQA) Agency if any

appointed by APMCF/SBI or any other Committee related to APMCF/SBI which required to visit the site to have a control on quality and methodology of execution. Samples of materials including Cement Concrete Cubes shall be taken jointly by Contractor and APMCF /SBI or his authorized representative. All arrangements for transporting and getting them tested shall be made by the Contractor.

49) All material received at site shall be entered in MAS (Material at site Register) Register and copy of Supply order, Manufacturer's Test Certificate & Bill-invoice shall be maintained in order.

50) The MAS Registers, Cement Register, Steel Register, Paint and Chemical Register, Bitumen Register, Test Register etc. shall be maintained by a qualified staff of Contractor which may be inspected by APMCF /SBI or his/her representative at any time. The daily report of receipt of material shall be sent to Project Manager / Project Architect of APMCF or his/her representative.

51) The safe custody of all registers shall be the responsibility of Contractor. Submission of copy of all test registers and Material at Site Register along with each Running Account Bill and Final Bill shall be mandatory.

52) As and when any important item is taken up for execution, the Contractor shall submit the working methodology and develop a checklist and Pour card. This sample checklist should be got approved from the APMCF /SBI and should be used at site. This check list should be shown to the APMCF /SBI or his/her representative during inspection. This procedure is to be followed for all hidden items, CC/RCC work, Steel-reinforcement, shuttering, flooring, doors & windows, plumbing, including water supply pipelines, roof treatment, earth filling etc.

53) In addition, the contractor shall submit theoretical consumption statements for the items involving use of cement, steel reinforcement, chemical, paints, ready mix concrete, bitumen etc. as directed by the APMCF /SBI along with every running account bill for record and reconciliation of material issued, consumed and balance.

54) These measurements shall then be 100% checked & verified by the authorized representatives of the APMCF. The contractor shall incorporate all such changes or corrections, as may be done during these checks, to his draft computerized measurements and submit the corrected computerized measurement Books with its page's machine numbered to the APMCF /SBI.

55) The Computerized Measurement Book shall be prepared by the Contractor as per given format in consultation with APMCF. The approved measurement book shall be bind properly by the contractor at his own cost and shall be submitted for the further process of payment.

56) PREPARATION OF SAMPLE FLATS

The contractor shall prepare one sample flat in actual position for each Type of flat comprising of all finishes and fittings included in the scope of this contract for approval of committee consisting of members from each discipline, of APMCF and SBI. The work executed in approved sample flat in

actual position will form part of the work. However, any sample not approved will not form part of the main work and the contractor shall have to dismantle and remove the same from the site of work at his cost and shall prepare new sample for approval as per direction of the APMCF /SBI. Nothing extra shall be paid on account of this.

Contractor can prepare 4 to 5 /suitable nos. of mockups of tiles, Toilets, CP Sanitary fittings and all other materials separately and get the samples approved before sample flat construction also. No payment for preparation of any mockups will be paid.

57) FACILITIES AT SITE FOR SBI & APMCF

i) The Contractor shall construct site office (Permanent/semi-permanent structure for SBI & APMCF staff, equipped with all necessary equipment required for functioning of the office. The area of the office shall accommodate pantry, conference room, office rooms, toilets and other requisite facilities. In case of shifting CLIENT/APMCF site office should be carried out without any cost as per site requirement. Also refer of GCCC point no. 53

ii) For APMCF - The Contractor shall provide 3 number of computers (with minimum specification i5, 8GB RAM, 1 TB hard disc, 256 SSD, integrated graphic card), 1 laptops (with minimum specification i5, 8GB RAM, 1 TB harddisc, 256 SSD, 2GB dedicated graphic card) and along with one-multi-function colour laser printer with A3 size print and one black and white laser printers etc. all new and in working condition with necessary peripherals. It's O&M too is to be arranged by contractor by own cost. For SBI -The Contractor shall provide 2 number of computers of above specification with One Color printer.

iv) The Contractor shall provide one land line with broadband connection. Printing pages should also be provided by contractor.

v) The Contractor shall provide brand new, BEE certified Air Conditioners of necessary tonnage capacity as per space, lighting and fixtures i/c fans, RO purified drinking water etc. during the whole agreement period. AMC charges, Electricity bill, water supply bills, RO/drinking water bills, telephone charges, internet charges etc. shall be borne by the contractor.

vi) The contractor shall provide the minimum required file/ Document storage and required infrastructure for a site office

vii) Security and watch and ward

viii) The contractor shall be responsible for security and watch and ward of the office, records, furniture and fixtures.

ix) The contractor shall maintain the site office and its surroundings in a neat and clean condition for the entire duration of the construction. The toilet effluent shall be discharged into sewer lines or soak pits without causing unsanitary conditions in the surroundings. After completion of the work, site office shall be dismantled by the contractor, and all the dismantled materials furniture fixtures shall be taken away at his cost.

X) Nothing extra shall be paid on account of this. The quoted rate by the contractor is inclusive of these facilities.

58.0 WATER / ELECTRICITY / TELEPHONE CONNECTION

i) The contractor shall make his own arrangement for water, electricity & telephone etc. for his use at his cost. The Contractor shall abide by the rules/ bye laws applicable in this regard and he shall be solely responsible for any penalty on account of violation of any of the rules /bye laws in this regard. The Contractor shall indemnify the Department against any claim arising out of pilferage, theft, damage, penalty, non-settlement of bills etc. whatsoever on this account.

ii) The Department shall in no way be responsible for any delay in getting electric and water and telephone connections for execution of the work or not getting connections at all. No claim of any kind, whatsoever, on this account shall be entertained from the Contractor. The Contractor shall arrange electricity and water etc. at his own cost required for testing of the various electrical installations, testing of water supply, sanitary and drainage lines, water proofing of underground and overhead tanks.

All above with no extra payment.

59.0 WATERPROOFING WORKS

The Contractor has to submit 10 Yr Guarantee bond for all Water proofing works executed on site.

60.0 CLEANLINESS OF SITE

The Contractor shall not stack building material / malba / muck on the land or road of the local development authority or on the land owned by the others. The site of work shall be always kept clean. The Contractor shall take all care to prevent any water- logging at site. The wastewater, slush etc. shall not be allowed to be collected at site. It may be directly pumped out to public drainage system with prior approval of the concerned authorities at his cost. The work shall be carried out in such a way that the entire area is kept clean and tidy throughout the completion of the project. No extra payment shall be made to the contractor in this regard.

61.0 SECURITY & TRAFFIC ARRANGEMENTS

i) In event of any restriction being imposed by the Department, traffic or any other statutory authority having control over the project, on the working or movement of Labour, materials, etc., the Contractor shall strictly follow all such restrictions or instructions issued regarding the same and nothing extra shall be payable to the Contractor on account of such restrictions or instructions. No delay or claims of any kind shall be entertained from the Contractor on this account.

ii) The Contractor shall be wholly responsible for security of site and works. The Contractor shall not permit entry of any unauthorized persons in the Site; and entry shall be limited to the Employees of the Contractor, Sub Contractor or persons authorized by the APMCF/SBI. CCTV at Site

should be provided by contractor which covers all site locations with 90 days back up and also provide access and recording to APMCF/SBI without any extra cost. Also provide recording for same when it will required by APMCF/SBI

iv) Lighting: The contractor shall provide sufficient lighting at project site, during periods of insufficient natural light, if required.

62.0 PHOTOGRAPHY & VIDEOGRAPHY DOCUMENTATION (TO BE DONE BY PROFESSIONAL AGENCY ONLY):

The Contractor shall undertake and carry out documenting the total sequences of this project by way of photography, slides, video recording (including drone recording after due approval from Local Authorities if required) etc. at his cost. The original photographs & videos shall be the property of the SBI. No copy shall be prepared by the contractor without prior approval of the APMCF/SBI. The RCC & RMC works for sub-structure & super-structure has to be photographed & video graphed for every slab level as well as foundation work, for each important activities like Concreting, Reinforcement laying, Cube Casting etc. In other cases, the photography shall be taken at minimum of 2 weeks interval and videography at a minimum of 4 weeks interval. The said soft copies shall be shared by pen drive and also be stored in Hard disc of requisite capacity at site. The positive of photographs in 4" x 6" size should be sequentially documented in album. All should be kept securely at site/ SBI office.

63.0 CONDITIONS FOR USE OF REINFORCEMENT STEEL AT SITE

- i) The agency shall procure steel reinforcement as per the approved list of makes given in this document and directions given by APMCF/SBI from time to time.
- ii) The contractor shall have to obtain and furnish test certificates to the APMCF /SBI in respect of all supplies of steel brought by him to the site of work.
- iv) If required, samples shall also be taken and tested by the APMCF /SBI as per the provisions in this regard in relevant BIS codes. In case the test results indicate that the steel arranged by the contractor does not conform to the specifications, the same shall stand rejected, and it shall be removed from the site of work by the contractor at his cost within a week's time or written orders from the Engineer- in-Charge/SBI to do so.
- v) The steel reinforcement bars shall be brought to the site in bulk supply of 10 tons or more, or as decided by the APMCF /SBI.
- vi) The steel reinforcement brought on site shall be of straight bars only and no bent bars are allowed on site and nothing extra shall be paid to Contractor on account of this.
- Vii) The steel reinforcement bars shall be stored by the contractor at site of work in such a way as to prevent their distortion and corrosion, and nothing extra shall be paid on this account. Bars of different sizes and lengths shall be stored separately to facilitate easy counting and checking.
- Viii) For checking nominal mass, tensile strength, bend test & re-bend test etc. specimen of sufficient length shall be cut from each size of the bar at random at frequency not less than as specified in latest version of IS 1786.

vii) The contractor shall supply the required steel bars free of charge for including its transportation to testing laboratories. **The cost of tests shall be borne by the contractor.**

viii) The actual issue and consumption of steel on work shall be regulated the theoretical consumption of steel shall be worked out as per procedure prescribed in Tender document, General Conditions of the contract shall be governed by conditions laid therein. In case the consumption is less than theoretical consumption including permissible variations leading to under designing of the structure, the work shall be summarily rejected, otherwise recovery at rate so prescribed shall be made after ensuring structural soundness and stability. In case of excess consumption, no adjustment needs to be made.

ix) Steel brought to site and remaining unused shall not be removed from site without the written permission of APMCF /SBI.

X) The standard sectional weights referred to shall be as given in Table 5.4 in para 5.3.4 in CPWD Specification 2019 Vol.-I and will be considered for conversion of length of various sizes of TMT Bars into standard weight. Records of actual sectional weights shall also be kept dia and lot wise. The average sectional weight for each diameter and shall be arrived at from samples from each lot of steel received at site. The decision of the APMCF /SBI shall be final for the procedure to be followed for determining the average sectional weight of each lot. Quantity of each diameter of steel received at site of work each day will constitute one single lot for the purpose. The weight of steel by conversion of length of various sizes of bars based on the actual weighted average sectional weight shall be terms as Derived Actual Weight.

Xi) Measurement of steel is strictly as per I.S. Code. Weights shall be calculated by taking Average weight of 3 no. samples of steel rods and if derived actual weight is less than theoretical weight but within a limit of IS : 1786-2008 or latest then payment will be done as per theoretical weight only. If derived weight is less than limit of IS 1786:2008 then that lot will be rejected and contractor should immediately remove this lot from site without any extra cost.

Xii) If the derived actual weight is found more than the standard weight, then nothing shall be paid extra for the difference in derived actual weight and standard weight.

xiii) The contractor shall submit original vouchers from the manufacturer/Supplier /Dealer for the total quantity of steel supplied under each consignment to be used in the work. All consignments received at the work site shall be inspected by the Site staff along with the relevant documents before acceptance. The contractor shall obtain Original Vouchers and Test Certificates and furnish the same to the Engineer- in-Charge of APMCF /SBI in respect of all the steel brought by him from approved supplier to the site of work. The original vouchers and test certificates shall be checked/countersigned by the Site staff appointed by APMCF/SBI and kept on record in the site office.

64.0 CONDITIONS FOR USE OF CEMENT AT SITE

- i) Cement required for the work shall be procured by the contractor.
- ii) The contractor shall procure PPC conforming to IS: 1489(Part-I) / OPC (grade 43/53) conforming to IS:8112 as per list of Preferred Makes for Civil Works. All concrete work shall be carried out as per approved design mix by SBI /APMCF. For Plastering and Waterproofing works Contractor can use PPC cement as given approved list of makes.
- iii) The Supply of cement shall be taken in 50 kg bags/Bulkers bearing manufacturer's name, or his registered trademarks if any and grade and type of cement as well as ISI marking. The packing of the cementbags shall be as per CPWD Specifications 2019 with correction slipsup to last date of submission of bid. Samples of cement arranged by the contractor shall be taken by the APMCF /SBI and got tested in accordance with provisions of relevant BIS codes. In case the testresults indicate that the cement arranged by the contractor does not conform to the relevant BIS codes, the same shall stand rejected, andit shall be removed from the site by the contractor at his own cost within a week's time of written order from the APMCF /SBI to do so.
- iv) The cement shall be brought to the site in bulk supply of approximately 20 tons or more as decided by the APMCF /SBI.
- v) At least 1 no. cement godown of the capacity to store a minimum of 500 bags of cement shall be constructed by the contractor at site forwhich no extra payment shall be made
- vi) The contractor shall be responsible for the watch and ward and safetyof the cement godown. The contractor shall facilitate the inspection ofthe cement godown by the APMCF /SBI at any time.
- Vii) The cement shall be got tested by the Contractor as per Relevant IS Code and Contractor will be allowed to use the Cement on site only after submitting Company Test Certificate as per Batch. The contractor shall supply the cement required for testing free of cost, including its transportation cost to testing laboratories. The cost of tests shall be borne by the contractor.
- Viii) The actual issue and consumption of cement at work shall beregulated and proper accounts maintained. The theoretical consumption of cement shall be worked out as per standard consumption mentioned in Tender /CPWD manual and shall be governed by conditions laid there in. In case the cement consumption is less than theoretical consumption including permissible variation, work shall be liable to be rejected. In case of excess consumption, no adjustment needs to be made.
- ix) The cement brought to the site and the cement remaining unused after completion of the work shall not be removed from site without the written permission of the APMCF /SBI.
- x) The damaged cement shall be removed from the site immediately by ~~te~~ contractor on receipt of a notice in writing from the Engineer-in- Charge of APMCF. If he does not do so within 3 days of receipt of such notice, the Engineer- in-Charge of APMCF shall get it removed at the cost of the

contractor.

65.0 CONDITIONS SPECIFIC TO GREEN BUILDING PRACTICE/ENVIRONMENTAL CLEARANCE

It is envisaged to fulfill Environmental Clearance conditions for various buildings to be constructed under this contract. The contractor shall strictly adhere to the following conditions as part of his contractual obligation.

i) The Contractor should follow the construction plan as proposed by the Architect /APMCF /SBI to minimize the site disturbance such as soil pollution due to spilling. Use staging and spill prevention and control plan to restrict the spilling of the contaminating materials at site. Protect topsoil from erosion by collection storage and reapplication of topsoil, constructing sediment basin, contour trenching, mulching etc.

ii) No excavated earth shall be removed from the campus unless suggested otherwise by APMCF /SBI. All subsoils shall be reused in backfilling/landscape, etc. as per the instructions of the APMCF /SBI. The surplus excavated earth shall be disposed of by the contractor for reuse. A certificate of reuse as required by the APMCF /SBI shall be submitted by the contractor.

iii) The contractor shall not change the natural gradient of the ground unless specifically instructed by the APMCF /SBI. This shall cover all-natural features like water bodies, drainage gullies, slopes, mounds, depressions, etc. Existing drainage patterns through or into any preservation area shall not be modified unless specifically directed by the APMCF /SBI.

iv) The contractor shall not carry out any work which results in the blockage of natural drainage.

v) The contractor shall ensure that existing grades of soil shall be maintained around existing vegetation and lowering or raising the levels around the vegetation is not allowed unless specifically directed by the APMCF /SBI.

vi) Contractor shall reduce pollution and land development impacts from automobiles used during construction.

vii) Overloading trucks is unlawful and creates erosion and sedimentation problems, especially when loose materials like stone dust, excavated earth, sand etc. are moved. Proper covering must take place. No overloading shall be permitted.

viii) Preserve and Protect Landscape during Construction

ix) The contractor shall ensure that no trees existing or otherwise, shall be harmed and damage to roots should be prevented during trenching, placing backfill, driving or parking heavy equipment, dumping of trash, oil, paint, and other materials detrimental to plant health. These activities should be restricted to the areas outside of the canopy of the tree, or, from a safe distance from the tree/plant by means of barricading. Trees will not be used for support; their trunk shall not be damaged by cutting and carving or by nailing posters, advertisements or other material.

Lighting of fires or carrying out heater gas emitting construction activity within the ground, covered by canopy of the tree is not to be permitted.

x) The contractor shall take steps to protect trees or saplings identified for preservation within the construction.

xi) Contractor should limit all construction activity within the specified area as per the Construction Management Plan (CMP) approved by APMCF /SBI.

Xii) The contractor shall avoid cutting and filling in the root zones, through delineating and fencing the dripline (the spread limit of a canopy projected on the ground) of all the trees or group of trees. Separate the zones of movement of heavy equipment, parking, or excessive foot traffic from the fenced plant protection zones.

Xiii) The contractor shall ensure that maintenance activities during construction period shall be performed as needed to ensure that the vegetation remains healthy.

Xiv) The permission for cutting of trees and / or Transplanting of the trees shall be obtained by the Contractor from GIFT Authority/Local Authorities or any other authority of the State Government, and execution of cutting and transplanting the trees or any other action in this regard will be taken by the contractor for which provision is already available in amount quoted by the contractor. No extra payment will be made on this ground.

xv) Contractor shall collect all construction waste generated on site. Segregate these wastes based on their utility and examine means of sending such waste to manufacturing units which use them as raw material or other site which require it for specific purposes. Typical construction debris could be broken bricks, steel bars, broken tiles, spilled concrete and mortar etc.

xvi) The contractor shall provide potable water for all workers.

xvii) The contractor shall provide the minimum level of sanitation and safety facilities for the workers at site. The contractor shall ensure cleanliness of workplace regarding the disposal of waste and effluent; provide clean drinking water and latrines and urinals as per applicable standard. Adequate toilet facilities shall be provided for the workman within easy access of their place of work. The total no. to be provided shall not be less than 1 per 30 employees in any one shift. Toilet facilities shall be provided from the start of building operations, and connections to a sewer shall be made as soon as practicable. Every toilet shall be so constructed that the occupant is sheltered from view and protected from the weather and falling objects. Toilet facilities shall be maintained in a sanitary condition. Enough disinfectants shall be provided. Natural or artificial illumination shall be provided.

Xviii) The contractor shall ensure that air pollution due to dust/generators is kept to a minimum, preventing any adverse effects on the workers and other people in and around the site. The contractor shall ensure proper screening, covering stockpiles, covering brick and loads of dusty

materials, wheel-washing facility, gravel pit, and water spraying. Contractor shall ensure the following activities to prevent air pollution during construction:

xix) Clear vegetation only from areas where work will start right away.

xx) Vegetate / mulch areas where vehicles do not ply.

Xxi) Apply gravel / landscaping rock to the areas where mulching / paving is impractical.

Xxii) Identify roads on-site that would be used for vehicular traffic. Upgrade vehicular roads (if these are unpaved) by increasing the surface strength by improving particle size, shape and mineral types that make up the surface & base. Add surface gravel to reduce source of dust emission. Limit amount of fine particles (smaller than 0.075mm) to 10 - 20%

xxiii) Water spray, through a simple hose for small projects, to keep dust under control. Fine mists should be used to control fine particulate. However, this should be done with care so as not to waste water. Heavy watering can also create mud, which when tracked onto paved public roadways, must be promptly removed. Also, there must be an adequate supply of clean water nearby to ensure that spray nozzles don't get plugged.

Xxiv) Water spraying shall be done on:

Any dusty materials before transferring, loading and unloading

Area where demolition work is being carried out Any un-paved main haul road

xxv) Areas where excavation or earth moving activities are to be carried out the contractor shall ensure that the speed of vehicles within the site is limited to 10 km/hr.

Xxvi) All material storage should be adequately covered and contained so that they are not exposed to situations where winds on site could lead to dust / particulate emissions.

Xxvii) Spills of dirt or dusty materials will be cleaned up promptly so the spilled material does not become a source of fugitive dust and also to prevent seepage of pollutant laden water into the ground aquifers. When cleaning up the spill, ensure that the clean-up process does not generate additional dust. Similarly, spilled concrete slurries or liquid waste should be contained / cleaned up immediately before they can infiltrate into the soil / ground or runoff in nearby areas

xxviii) Provide hoardings of not less than 3m high along the site boundary, next to a road or other public area

xxix) Provide dust screens, sheeting or netting to scaffold along the perimeter of the building

xxx) Cover stockpiles of dusty material with impervious sheeting

xxxi) Cover dusty load on vehicles by impervious sheeting before they leave the site

xxxii) The contractor shall ensure that no construction leachate (e.g., cement slurry etc.), is allowed to percolate into the ground. Adequate precautions are to be taken to safeguard against

this including, reduction of wasteful curing processes, collection, basic filtering and reuse. The contractor shall follow requisite measures for collecting drainage water run-off from construction areas and material storage sites and diverting water flow away from such polluted areas. Temporary drainage channels, perimeter dike/swale, etc. shall be constructed to carry the pollutant-laden water directly to the treatment device or facility (municipal sewer line).

Xxxiii) The storage of material shall be as per standard good practices as specified in Storage, Stacking and Handling practices, NBC latest edition shall be to the satisfaction of the APMCF /SBI to ensure minimum wastage and to prevent any misuse, damage, inconvenience, or accident. Watch and ward of the Contractor is materials shall be his own responsibility. There should be proper planning of the layout for stacking and storage of different materials, components and equipment with proper access and proper maneuverability of the vehicles carrying the materials. While planning the layout, the requirements of various materials, components and equipment at different stages of construction shall be considered.

Xxxiv) The contractor shall ensure the following activities for construction workers' safety, among other measures:

Guarding all parts of dangerous machinery.

Precautionary signs for working on machinery

Maintaining hoists and lifts, lifting machines, chains, ropes, and other lifting tackles in good condition.

Durable and reusable form work systems to replace timber form work and ensure that form work where used is properly maintained.

Ensuring that walking surfaces or boards and/or working platforms, etc. at height are of sound construction and are provided with safety rails or belts.

Provide protective equipment, helmets etc. -

Provide measures to prevent fires, Fire extinguishers and buckets of sand to be provided in the fire-prone area and elsewhere.

Provide sufficient and suitable light for working during nighttime

The contractor shall provide for adequate number of garbage bins around the construction site and the workers' facilities and will be responsible for the proper utilization of these bins for any solid waste generated during the construction. The contractor shall ensure that the site and the workers' facilities are kept litter free. Separate bins should be provided for plastic, glass, metal, biological and paper waste and labeled in both Hindi and English with suitable symbols.

The contractor shall prepare and submit spill prevention and control plans before the start of construction, clearly stating measures to stop the source of the spill, to contain the spill, to

dispose of the contaminated material and hazardous wastes, and stating designation of personnel trained to prevent and control spills. Hazardous waste includes pesticides, paints, cleaners, and petroleum products.

The Contractor shall collect & submit the relevant material certificates for materials with high recycled (both post-industrial and post-consumer) content, including materials like RMC mix with fly-ash, glass with recycled content, calcium silicate boards etc.

The contractor shall ensure that a flush out of all internal spaces is conducted prior to handover. This shall comprise the opening of all doors and windows for 14 days to vent out any toxic fumes due to paints, varnishes, Polishes, etc.

The providing & fixing Safety nets at various levels of Buildings as per instruction from APMCF /SBI. Safety Net shall be of Garware nylon Ropes made of three layers of (100 mm X 100 mm square with 8 mm thick nylon rope.), net with 2.5 mm nylon rope with 25mm x 25 mm square and mono filament net on top having width of 5.0 mts. horizontal to the periphery of the Building with supporting structure of 50 mm dia MS hollow (40 nb) pipe duly anchored on slab/beam with 10 mm thick base plate and anchor fastener (hilti) 4 Nos. at all corners, and free end of pipe to be tied up with upper floor column with the help of nylon rope 16 mm dia. same supporting system is to be followed for every 4.5 Mtr. in such a way to have a proper slope during Construction and removing and re fixing part of the same as and when required/ necessary for smooth progress of the work. Contractor has to replace unuseable safety net immediately from site with providing new safety net as per certification as and when directed by the APMCF/SBI.

Contractor shall collect the relevant material certificates for rapidly renewable materials such as bamboo, wool, cotton insulation, Agri fiber, linoleum, wheat board, strawboard and cork etc.

Contractor should adopt an IAQ (Indoor Air Quality) management plan to protect the HVAC system during construction, control pollutant sources, and interrupt pathways for contamination. He shall sequence installation of materials to avoid contamination of absorptive materials such as insulation, carpeting, ceiling tile, and gypsum wallboard. He shall also protect stored on-site or installed absorptive materials from moisture damage.

The contractor shall ensure that a flush out of all internal spaces is conducted prior to handover. This shall comprise an opening of all doors and windows for 14 days to vent out any toxic fumes due to paints, varnishes, Polishes, etc.

The Contractor shall make efforts to reduce the quantity of indoor air contaminants that are odorous or potentially irritating harmful to the comfort and well-being of installer and building occupants. Contractor shall ensure that the VOC (Volatile Organic Compounds) content of paints, coatings and primers used must not exceed the VOC content limits mentioned below: Paints: Non-flat - 150 g/L Flat (Mat) - 50 g/L Anti-corrosive/ anti rust - 250 g/L Coatings / Clear wood finishes:

Varnish - 350 g/L Lacquer - 550 g/L Floor coatings - 100 g/L Stains - 250 g/L Sealers: Waterproofing sealer - 250 g/L Sanding sealer - 275 g/L Other sealers - 200 g/L The VOC (Volatile Organic Compounds) content of adhesives and sealants used must be less than VOC content limits mentioned : Architectural Applications VOC Limit (g/l less water) Indoor Carpet adhesives - 50 g/L Carpet Pad Adhesives - 50 g/L Wood Flooring Adhesive - 100 g/L Rubber Floor Adhesives - 60 g/L Sub Floor Adhesives - 50 g/L Ceramic Tile Adhesives - 65 g/L VCT and Asphalt Tile adhesives - 50 g/L Dry Wall and Panel Adhesives - 50 g/L Structural Glazing Adhesives - 100 g/L Multipurpose Construction Adhesives - 70 g/L Substrate Specific Application VOC Limit (g/l less water) Metal to Metal - 30 g/L Plastic Foams - 50 g/L Porous material (except wood) - 50 g/L Wood - 30 g/L Fiber Glass - 80 g/L

Wherever required, Contractor shall meet and carry out documentation of all activities on site, supplementation of information, and submittals in accordance with IGBC LEED India New Construction v3.0 (or latest amendment) or GRIHA program standards and guidelines. Towards meeting the building environmental rating standard(s) expert assistance shall be provided to him up on request

No extra payment shall be made against all such safety measures.

66.0) WATER USE DURING CONSTRUCTION

i) Contractor should spray curing water on concrete structure and shall not allow free flow of water. Concrete structures should be kept covered with thick cloth/gunny bags and water should be sprayed on them. The Contractor shall do water poundings on all sunken slabs using cement and sand mortar.

67.0) RESOURCES CONSUMED DURING CONSTRUCTION

i) The contractor shall ensure that the water and electricity is not wasted during construction. The APMCF /SBI can bring to the attention any such wastage and the contractor will have to ensure that such bad practices are corrected.

ii) The contractor shall install necessary meters and measuring devices to record the consumption of water, electricity and diesel on a monthly basis for the entire tenure of the project.

iii) The contractor shall use treated recycled water of appropriate quality standards for construction, if available.

iv) The contractor shall minimize the use of electricity.

68.0) CONSTRUCTION AND DEMOLITION WASTE

i) Contractor shall minimize the generation of construction waste as per the requirement for Environmental Clearance Perspective.

ii) All construction debris generated during construction shall be carefully segregated and stored

in a demarcated waste yard. Clear, identifiable areas shall be provided for each waste type. Employ measures to segregate the waste on site into inert, chemical, or hazardous waste.

iii) No construction debris shall be taken away from the site, without the prior approval of the APMCF /SBI.

iv) The contractor shall recycle the unused chemical/hazardous waste such as oil, paint, batteries, and asbestos.

v) If and when construction debris is taken out of the site, after prior permissions from the APMCF /SBI, then the contractor shall ensure the safe disposal of all wastes and will only dispose of any such construction waste in approved dumping sites.

69) DOCUMENTATION

I) The contractor shall, during the entire period of the construction, submit the following records to the APMCF /SBI monthly basis:

ii) Water consumption in liters

iii) Electricity consumption in 'kwh' units

iv) Diesel consumption in liters

v) Quantum of waste (volumetric/weight basis) generated at site and thesegregated waste. Types divided into inert, chemical and hazardous wastes

vi) Digital photo documentation to demonstrate compliance with safety guidelines as specified in the tender, the contractor shall, during the entire tenure of the construction phase, submit the following records to the APMCF /SBI on a fortnightly basis:

vii) Quantities of material brought into the site, including the material issued to the contractor by the APMCF /SBI.

viii) Quantities of construction debris (if at all) taken out of the site

ix) Digital photographs of the works at site, the workers' facilities, the waste and other material storage yards, pre-fabrication and block making works, etc. as guided by the APMCF /SBI

x) The contractor shall submit a document after construction of the buildings, a brief description along with photographic records to show that other areas have not been disturbed during construction. The document should also include brief explanation and photographic records to show erosion and sedimentation control measures adopted. (Document CAD drawing showing site plan details of existing vegetation, existing buildings, existing slopes and site drainage pattern, staging and spill prevention measures, erosion and sedimentation control measures and measures adopted for top-soil preservation during construction.

xi) The contractor shall submit to the APMCF /SBI after construction of the buildings, a detailed

as built quantification of the following:

- 1) Materials used,
- 2) Total topsoil stacked and total reused
- 3) Total earth excavated
- 4) Total waste generated,
- 5) Total waste reused,
- 6) Total water used,
- 7) Total electricity, and
- 8) Total diesel consumed.

Xii) The contractor shall submit to the APMCF /SBI, before the startof construction, a site plan along with a narrative to demarcate areas on site from which topsoil has to be gathered, designate area where itwill be stored, measures adopted for topsoil preservation and indicate areas where it will be reapplied after construction is complete.

Xiii) The contractor shall submit to the APMCF /SBI, a detailed narrative (not more than 250 words) on provision for safe drinking water and sanitation facility for construction workers and site personnel.

Xiv) Provide supporting document from the manufacturer of the Batch mix/ Ready Mix concrete specifying the use of Fly Ash.

xv) Provide supporting document from the manufacturer of the pre-cast building blocks specifying the fly ash content of the blocks used in aninfill wall system.

Xvi) Provide total support to APMCF /SBII and Environmental Consultants appointed by the APMCF /SBI in completing all Environmental clearance related formalities, including signing of forms, providing signed letters in the contractor's letterhead whenever required.

70.0 Warning / Caution Boards/Signage

i) All temporary warning / caution boards / glow signage display such as"Construction Work in Progress", "Keep Away", "No Parking", Diversions etc. shall be provided and displayed by the Contractor, wherever required and as directed by the APMCF /SBI. All signage shall be suitably illuminated during night also. The Contractorshall be solely responsible for damage and accident caused, if any, due to negligence on his part. Also, he shall ensure that no hindrance,as far as possible, is caused to general traffic during execution of thework.

ii) In addition, the Contractor shall also provide a sign board of approvedsize, design & pattern at an approved location giving the details of theproject, client / SBI, architects, structural consultants, Department etc. besides providing space for names of Contractor/Sub- Contractors.

lii) All signage shall be dismantled & taken away by the Contractor after completion of the work with the approval of the Engineer – in – Charge of APMCF.

71.0 CONDITIONS OF NATIONAL GREEN TRIBUNAL

- i) The contractor shall not store/ dump construction material or debris on the metaled road.
- ii) The contractor shall get prior approval from APMCF /SBI for the area where the construction material or debris can be stored beyond the metaled road. This area shall not cause any obstruction to the freeflow of traffic /inconvenience to the pedestrians/public in general. It should be ensured by the contractor that no accidents occur because of such permissible storage.
- lii) The contractor shall take appropriate protection measures like raising wind breakers of appropriate height on all sides of the plot/area to ensure that no construction material dust fly outside the plot area.
- iv) The contractor shall ensure that all the trucks or vehicles of any kind which are used for construction purposes/or are carrying construction material like cement, sand, earth and other allied material are fully covered. The contractor shall take every necessary precaution that the vehicles are properly cleaned and dust free to ensure that they enroute their destination, the dust, sand or any other particles are not released in air/contaminate air.
- v) The contractor shall provide masks to every worker on the construction site and involved in loading, unloading and carriage of construction material and construction debris to prevent inhalation of dust particles.
- vi) The contractor shall provide all medical help, investigation and treatment to the workers involved in the construction of building and carry off construction material and debris relating to dust emission.
- Vii) The contractor shall ensure that C&D waste is transported to the C&D waste site only and due records shall be maintained by the contractor
- viii) The contractor shall compulsorily use wet jets in grinding and stone cutting.
- ix) The contractor shall comply with all the preventive and protective environmental steps as stated in the MoEF guidelines, 2010 or latest.
- x) The contractor shall carry out on-Road-Inspection for black smoke generating machinery. The contractor shall use cleaner fuel.
- xi) The contractor shall ensure that all DG set comply emission norms notified by MoEF/Respective Department.
- Xii) The contractor shall use vehicles having pollution under control certificate. The emissions can be reduced by a large extent by reducing the speed of a vehicle to 20 Kmph. Speed bumps shall be used to ensure speed reduction. In cases where reductions in speed cannot effectively reduce

fugitive dust, the contractor shall divert traffic to nearby paved areas.

Xii) The contractor shall ensure that the construction material is covered by tarpaulin. The contractor shall take all other precautions to ensure that no dust particles are permitted to pollute air quality because of such storage.

Xiii) The paving of the path for playing vehicles carrying construction material is more permanent solution to dust control and suitable for longer duration projects.

Xiv) Any violation of orders of MoEF including guidelines of State Government, SPCB or any officer of any department shall lead to stoppage of work for which Contractor shall be responsible, and no hindrance shall be accounted for in this regard.

xv) The contractor shall take appropriate protection measures like raising wind breakers of appropriate height on all sides of the plot/area using CGI sheets or plastic and/or other similar material to ensure that no construction material dust flies outside plot area.

72.0 Make in India Policy

i) The main contractor as well as associate contractor of each disciplines shall comply to Government of India Public Procurement (Preference to Make in India), Order-2017 amended up to last date of submission of bid.

73.0 Training and Awareness:

I) Training:

The training shall be in two phases – first induction training and then periodic training / refresher workshop.

Induction Training: All the workers shall have to undergo a training program of 16 hrs (8 hrs for 2 days) and to be declared satisfactorily trained by the Safety Manager before they are allowed to work on site.

ii) Orientation Program:

An orientation program shall be arranged for all people (other than workers) who normally work at or visit the site.

iii) Workshops: Refresher workshops shall be arranged every three months for all the workers on site.

iv) Advance Training:

For workers involved in high-risk activities (to be identified by the APMCF) an intensive training shall be held once a month. The training modules shall be designed by the Safety Manager and approved by the APMCF Methodology: The training methodology shall include both classroom and practical demonstration with audio visual techniques. For greater impact, demonstrations with dummies will be done to highlight hazards of not following safe practices.

The training shall be imparted in vernacular language and may include means such as songs, theatre, puppetry etc. for better appreciation and assimilation by workers.

v) Implementation:

The basic responsibility of implementation of safe practices shall be that of the safety manager and safety supervisors of the contractor at the first level and project team APMCF on second level. The basic approach of implementation should be towards voluntary acceptability of safe practices by all stakeholders.

The safety arrangement made by the contractor shall be open to inspection by the safety officer or any other representative appointed by the APMCF and the observation made by him shall be complied with by the contractor.

All workmen are checked for their suitability before development by the respective Safety Manager and each Safety Supervisor. Workers' physical fitness knowledge about the activity and his previous experience are checked before deployed. Workmen involved in physical activity (such as driver, operators, Height workers, Food handlers at Canteen and Pantries, welders) shall be subjected to pre-employment medical check-up, those who do not clear the medical examination shall not be employed. Adequate number of safety equipment and personal protective equipment (PPE) as per Indian Standards will be planned and procured.

Recommendations as per following table/Matrix should be followed:

ACTIVITY	WORKMEN CATEGORY	PPE- RECOMMENDED
General – Entry into work premises	All Employees	Safety Helmet, Safety Shoes & Reflective Jacket
Signaling	Security/marshal	Reflective Jacket
Working at Height – More than 1.8 meters	All	Full body harness Double lanyard
Involved with cement & Concrete Handling	All	Gum Boots & Rubber Hand Gloves
Breaking of ceramics & Agglomerate Materials	Chippers	Eye Protection–Clear Goggles
Welding & Gas Cutting	Welders & Cutters	Leather gloves, Safety shoe, Welding Shield with proper number
Working with slush	Unskilled & Excavation gang	Gumboots
Forming and Making shuttering materials	Carpenters and Woodworkers	Face shield & Nose Mask

Rebar's handling & Working	Bar benders	Cotton hand Gloves
Scaffolding	Scaffolders	Cotton hand gloves
Painting	Painters	Clear, Goggles, Nose mask
DG Operators & Other Noise prone areas	Operators	Ear Muff, Rubber HandGloves (Electrical Grade)
Electrical Maintenance & Repairs	Electricians	HV Rubber hand gloves
Concrete Batching Plant	Operators & Loaders	Nose Mask

vi) Color Coding of Helmets:

Grey	All Staff of Contractor/other Respective Person
Green	Safety Inspectors
Red	Electricians & Signal men
Blue	Supervisors
Yellow	Workmen
Orange	New Workmen (for one month)
Purple	Visitor
White	SBI/client

Vii) Enforcement:

The safety team of the contractor and project team of APMCF are entrusted with enforcement of safe practices. If safety program is not followed (as assessed by either APMCF) then recovery as below shall be made:

If the contractor does not employ and / or submit the names of Safety Manager and Safety Supervisors of specified numbers with appropriate qualification and or experience, then a recovery of Rs. 2000 per day and Rs. 1000 per day shall be affected by the Safety Manager and Safety Supervisor respectively.

Contractor will ensure that no person shall be allowed to enter the demarcated area without adequate safety gadgets (as per occupation / purpose of visit).

Inside the work area it is the responsibility of the contractor to make sure all person will follow the safety instructions as per agreement.

In case of default from workers, their employer (hiring agency) will have to pay a penalty of Rs 100 per offense.

These fines will be collected into workers' welfare funds. Money thus collected will be utilized for supporting welfare programmes for workers and their families.

A display board should be kept at site which would list the names of workers / teams and agencies following safety program in the best manner. This would be updated weekly.

During training and workshops, the names of persons / teams / agencies that are best following safety program shall be announced and they shall be felicitated.

On completion of the work, shields for best person / team / agencies following safety program in different categories shall be awarded.

Record of attendance will be put in place by the Contractor as per the direction of Engineer-in-Charge of APMCF and the Safety Manager and all the Safety Supervisors will record their presence in the system. Recovery as suggested will be made for failure to record such presence / non availability of safety personals.

In case of an accident resulting in death / permanent disability of a worker, a recovery of Rs. 10 Lakh per death / permanent disability will be made for the contract values more than Rs. 20 crores. The recovery for the contracts, less than Rs. 20 crores shall be @ 0.5% of the contract amount per death / permanent disability. The money so recovered will be kept in the "Workers Welfare Fund" and will be at the sole discretion of the APMCF/SBI for utilizing to support the welfare programs of the workers.

This recovery shall be in addition to recovery (recoveries) or compensation under any other Statute / Act / Provision of Contract. However, the total recovery on this account shall not exceed 2% of the contract value.

74.0 Standard Operating Procedures (SOPs) and Guidelines for Construction Sites for COVID-19 Outbreak/Similar Such Situations

i) The agency shall follow all the COVID 19/Any Epidemic protocols enforced by state / central Government/ GIFT Authority etc. from time to time and the guidelines issued by SBI from time to time as per directions of the APMCF /SBI and nothing extra payable on this account.

ii) The Agency/contractor shall install inspection lifts of minimum 8-10-person capacity for inspection of officers. Each tower should have independent inspection lift. Agency shall ensure they are in safe working conditions throughout the execution period and safety of the persons.

iii) Above mentioned Lifts shall be installed at each building immediately after completion of 3rd Slab above ground level.

75.0 PRODUCT DELIVERY, STORAGE AND HANDLING OF CHEMICALS

i) The contractor shall construct storage space for Chemicals materialsto ensure that the storage conditions are as recommended by the manufactures.

ii) All the materials shall be procured and delivered in sealed containerswith legible and intact labels.

iii) All the chemicals (polymers, epoxy, water proofing compound, plasticizer, Polysulphide, SBR based elastomeric, APP (Atactic iv) Polypropylene Polymer), all exterior and interior paints, polish etc.) shall be procured in convenient packs say 20 liters/kg} capacity packing only or as approved

by the APMCF /SBI, and not in bigger capacity containers, say 200-liter (kg) drums unless otherwise specifically permitted by the APMCF /SBI. One sample from each lot of the chemical procured by the contractor shall be tested in a laboratory as approved by the APMCF /SBI.

v) All material required for the execution of the work shall be got approved, procured and deposited with the Contractor's supervisory staff. The watch and ward of such material shall, however, remain to be the responsibility of the contractor and no claim, whatsoever, on this account shall be entertained. Different containers of each chemical shall be serially numbered on packing and consumed in that order. Day-to-day account of receipt, issues and balance shall be regulated by the Department and proper account shall be maintained at site of work in the prescribed form as per the standard practice.

vi) All the chemicals shall be procured by the contractor directly from the manufacturer. In exceptional circumstances, the contractor may be allowed to procure the materials from the authorized dealers of the manufacturers, if specifically permitted by the APMCF /SBI.

Vii) The original copies of challan /cash memos towards the quantity of various chemicals procured shall be made available by the contractor at the request from the APMCF /SBI and a copy of the same shall be kept in record.

Viii) The Name of manufacturers, manufacturer's product identification, manufacturer's mixing instructions, warning for handling and toxicity and date of manufacturing and shelf life shall be clearly and legibly mentioned on the labels of each container.

ix) The contractor shall submit for the chemicals procured, manufacturer's and / or authorized dealer's certificate regarding supplying and verifying conformance to the material specifications, as specified.

x) All filled containers shall be handled in safe manner and in a way to avoid breaking container seals.

xi) Empty containers of the chemicals should not be removed from site till the completion of work and shall be removed only with the written approval of the APMCF /SBI.

Xii) All arrangements for measuring, dosing and mixing material / chemicals at site have to be made by the contractor.

Xiii) Contractor shall suitably advise his site Engineer and all the workers as regards safe handling of chemicals. Necessary protective and safety equipment in form of hand gloves, goggles etc. shall be provided by the contractor and be also used at site.

Xiv) All incidental charges of any kind including cartage, storage and wastage and safe custody of material etc. shall be borne by the contractor and no claim, whatsoever, shall be entertained on this account.

xv) The chemicals shall be tested in an independent laboratory as approved by the APMCF /SBI at the frequency as specified. If required, more samples may have to be tested as per the directions of the Engineer-in- Charge of APMCF. Nothing extra shall be payable on this account.

76.0 BASIC RATES/PRICE VARIATION (ESCALATION)/VARIATIONS

Basic rates of the various materials are given in the price Bid, any variation in above rates shall be paid as per GCC No 42a

ESCALATION

The rate quoted shall be firm throughout the tenure of the contract (inclusive of ex-tension of time If any granted) and will not be subject to any fluctuation due to in-crease in cost of materials, labour, taxes, octroi, transportation on work contract unless specifically provided in these documents

77.0 LABOUR CAMP/LABOUR MOVEMENTS

- i) The said work is to be carried out within the Gift City allotted Plot and very rare place is available for Labour Camp. Contractor should take note of this while quoting the rates.
- ii) Contractor needs to allot space to labour camp outside allotted plot at no extra cost to SBI. Daily to and fro movement of the labour shall be carried out at no extra cost to SBI. Required Approval from local governing Authority for labour camp shall be taken by the Contractor of such labour camp.
- lii) In & Out timing of as per shifts to be fixed for Labourers and within that time labour movement to be carried out. In other time no movement of labours shall be permitted except for the special permission from the APMCF /SBI.
- iv) As this project comes under premises of Gift City Authority, utmost care shall be taken to avoid nuisance to occupants of GIFT City from labourers, material/machinery movement. If it is found that some labours are creating nuisance then those labourers shall be removed off the site immediately.
- v) Movement of labourers shall be carried out as per norms by the GIFT Authority.

78.0 Site Staff to be deployed at Site by the Contractor:

Requirement of Technical Representative(s) :					
Sr. No.	Qualification	Requirement of Technical Staff			
		Tower-I	Tower-II	Minimum Experience (Years)	Designation of Technical Staff
1	Graduate Engineer	1		20 (and having experience of one similar nature of work)	Chief Project Manager with Civil Engineering discipline
2	Graduate Engineer	1		15 (and having experience of one similar nature of work)	Project Engineer with in Civil Engineering discipline
3	Graduate Engineer	1	1	10 respectively	Project / Site Engineer (Civil)
4	Graduate Engineer	1		10	QA/QC Civil Engineer
5	Graduate Engineer	1		Above 7 yrs respectively	Billing Engineer & Planning Engineer (Civil)
6	Graduate / Diploma Engineer	1		Above 7 yrs /10 yrs respectively	Safety Engineer/ Manager
7	Graduate / Diploma Engineer	1		Above 7 yrs /10 yrs respectively	PHE Services Civil/ MECH/Elec Engineer
8	Graduate Engineer	1	1	Above 7 yrs	Electrical Engineer

9	Site Surveyor	1	05 yrs. Experience with equivalent Certificate	Site Surveyor
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Note: -

- 1) Above mentioned staff shall be deployed at site during the currency of Contract. However, Project cum Planning Engineer, QA/QC Engineer and Safety Manager/Engineer has to be compulsorily at site throughout the duration of work.
- 2) The above designated persons should perform their duties and responsibilities with respect to their functional areas as per sound Engineering Practices and with highest professional standards as defined and practiced in Building Construction Industry.

79.0 Deleted.

80.00 Provision of Special Safety Features during execution

i) The providing & fixing Safety nets at various levels of Buildings as per instruction from APMCF /SBI. Safety Net shall be of Garware nylon Ropes made of three layers of (100 mm X 100 mm square with 8 mm thick nylon rope.), net with 2.5 mm nylon rope with 25mm x 25 mm square and mono filament net on top having width of 5.0 mts. horizontal to the periphery of the Building with supporting structure of 50 mm dia MS hollow (40 nb) pipe duly anchored on slab/beam with 10 mm thick base plate and anchor fastener (hilt) 4 Nos. at all corners, and free end of pipe to be tied up with upper floor column with the help of nylon rope 16 mm dia. same supporting system is to be followed for every 4.5 Mtr. in such a way to have a proper slope during Construction and removing and re fixing part of the same as and when required/ necessary for smooth progress of the work. This total provision shall be provided at every third floor of all the 2 Towers.

ii) MS/Doka Safety Platforms/Or its equivalent: - MS/Doka Safety Platforms/Or its equivalent with side railing shall be erected throughout the periphery of Proposed Buildings while doing exterior works at heights. Platform shall be as per manufacturer's specifications and suitable for Conventional method of construction (RCC+Brick/Block work) with necessary brackets, Supporting system, fasteners, ms Plates etc. The stability and load-bearing capacity of all components and units must be checked and design to be done accordingly during all phases of the construction work. Strict attention to and compliance with the functional instructions, safety instructions and load specifications are required to be followed by the contractor while installation and during Usage. Non-compliance can cause accidents and severe injury (risk of fatality) and considerable damage to property. The Contractor must give due consideration to any and all effects of the weather on the equipment and regards both its use and storage (e.g. slippery surfaces, risk of slipping, effects of the wind, etc.) and implement appropriate precautionary measures to secure the equipment and surrounding areas and to protect workers. All connections must be checked at regular intervals to ensure that they are secure and in full working order. Threaded connections and wedged connections have to be checked and retightened as necessary in accordance with activity on the job site and especially after out-of-the-ordinary occurrences (e.g. after a storm).

Suitable skilled and experienced Safety Manager/Engineer shall ensure installation and usage throughout the duration of Project.

iii) No extra payment shall be done against these works and contractor shall take a note of this while quoting the rates.

81.00 (a) Availability of Barricades on Site

Barricades to the site already installed in part areas by the SBI by taking additional area other than available plot area for site logistics during construction. During construction these barricades if required to be rearranged/shifted / newly done by the Contractor at no extra cost to SBI.

As site is already having barricades partially, Contractor to take note of this while quoting item rates of works. As SBI has acquired additional area for the site logistic, GIFT Authority charging specific amount against that additional area, this amount shall be paid by the contractor and provision of the same to be considered in quoted rates and no extra claim shall be entertained. In case during tenure of work Contractor wishes to reduce logistic area, he will be allowed to do so but removal/re shifting of barricades shall be done by the Contractor at no extra cost to SBI.

82.0 SAFETY CODE

SAFETY MEASURES AT SITE:

1. All personnel at site should be provided with Helmets and Safety Boots with some Identification Mark. Visitors also should be provided with Helmets. It should be ensured that these are used properly.
2. First Aid Box should be kept at site with all requisite materials.
3. No one should be allowed to inspect / work at a height without Safety Belt.
4. 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 as suitable footholds and handholds shall be provided on the ladder, and the ladder shall be given an inclination not steeper than $\frac{1}{4}$ to 1 ($\frac{1}{4}$ horizontal and 1 vertical).
5. Scaffolding or staging more than 3.5 meters above the ground or floors, swung or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached, bolted, braced and otherwise secured at least 1 Meter 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 openings 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.
6. Working platforms, Gangways, and Stairways should be so constructed that they do not sag unduly or unequally, and if the height of the platform or the Gangway or the Stairway is more than

3-5 Meters above ground level or floor level they should be closely boarded, should have adequate width and should be suitably fenced, as described.

7. Every opening in the floor of a building or in a working platform be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 1 Meter.

8. 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 9 Meters in length while the width between side rails in rung ladder shall in no case be less than 30cms for ladder up to and including Meters in length. For longer ladders this width should be increased at least 6mm for each additional 30 cms. Uniform step spacing shall not exceed 30 cms.

9. Adequate precautions shall be taken to prevent danger from electrical equipment. For electrical online works gloves, rubber mats, and rubber shoes shall be used.

10. All trenches 1.2 Meters or more in depth shall at all times be supplied with at least one ladder for each 30 Meters length or fraction thereof. Ladder shall be extended from bottom of the trench to at least 1 Meter above the surface of the ground. The sides of the trenches, which are 1.5 Meters or more in depth shall be stepped back to give suitable slope, or securely held by timber bracing, so as to avoid the danger of sides collapsing. The excavated materials shall not be placed within 1.5 Meters of the edge of the trench or half of the depth of the trench whichever is more cuttings shall be done from top to bottom. Under no circumstances undermining or under cutting shall be done.

11. Before any demolition work is commenced and also during the process of the work :-

a) All roads and open areas adjacent to the Work Site shall either be closed or suitably protected.

b) No electrical cable or apparatus which is liable to be a source of danger over a cable or apparatus used by the operator shall remain electrically charged.

c) 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 so overloaded with debris or materials as to render it unsafe.

d) All necessary personal safety equipment as considered adequate by the Site Engineer should be kept available for the use of the persons employed on the Site and maintained in a condition suitable for immediate use; and the Contractor should take adequate steps to ensure proper use of equipment by those concerned.

e) Workers employed on mixing Asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective goggles.

- f) Those engaged in whitewashing and mixing or stacking of cement bags or any materials which is injurious to the eyes shall be provided with protective goggles.
- g) Those engaged in welding works shall be provided with Welder's protective eye-shields.
- h) Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.
- i) When workers are employed in sewers and manholes, which are in use, the Contractor shall ensure that the manhole covers are opened and are 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 and boards to prevent accident to the Public.

12. Use of hoisting machines and tackle including their attachments, anchorage and support shall conform to the following standard or conditions: -

- a) These shall be of good mechanical construction, sound material and adequate strength and free from patent defect and shall be kept in good repairs and 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.
- c) 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 scaffold, winch or give signals to the operator.
- d) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or lowering or as means of suspension the safe working load shall be ascertained by adequate means.
- e) Every hoisting machine and all gear referred to above shall be plainly marked with the safe working load. In case of hoisting machine having a variable safe working load, each safe working load of the conditions under which it is applicable shall be clearly indicated. No part of any machine or of any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.
- f) Motor, Gearing, Transmission, Electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards, 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 to the minimum the risk of any part of a suspended load becoming accidentally displaced.
- g) When workers are employed on electrical installation, which are already energized, insulating mats, wearing apparel such as gloves, sleeves, and boots as may be necessary

should be provided. The workers should not wear any rings, watches and carry keys or other materials, which are good conductors of electricity.

13. All scaffolds, 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 shall be provided at or near places of work.

83.0 Provision of BIS codes, CPWD Manuals, CPWD trade specific guidelines, Catalogues, etc.:

Contractor has to arrange all the relevant BIS codes, CPWD Manuals, catalogues, technical details from manufactures, etc. as mentioned in the technical bid & Price Bid and has to be kept at site till closure of the project.

84.0 Conditions specific to Project:

a) In response to the tenders invited by Bank/Architect, the CONTRACTOR have inspected the site and surroundings of the works specified in the tender documents and have before accepting the Contract, satisfied themselves by careful examination about the nature of the work and nature of the site and local conditions, quantities nature and magnitude of work, the availability of labour and material necessary for the execution of work, the means of access to work site, the supply of power and water thereto and the accommodation they may require and have made local and independent enquiries and obtained complete information as to the matters and things referred to, or implied in the Contract or having any connection therewith and have considered the nature and extent of all probable and possible situations, delays, hindrances, or interferences to or with the execution and completion of work to be carried out under the Contract being awarded hereunder and have examined and considered all other matters, conditions, and things and probable and possible contingencies thereto affecting the execution and completion of work and which might have influenced them in accepting the Contract.

b) The CONTRACTORS shall provide, execute and complete all the works mentioned in the CONTRACT and shall do and perform all other acts and things mentioned or described in the CONTRACT or which are to be implied there from or may be reasonably necessary for the completion of the said works and the times and in the manner and subject to the terms and conditions or stipulations mentioned in the CONTRACT.

c) It has been understood by the parties hereto that the Bank/Architect will have right to make reasonable changes in the drawings and designs during the progress of the construction works without prejudice to the CONTRACT. Notwithstanding anything to the contrary contained in any of the Annexure hereto the CONTRACTORS shall commence the work and shall complete the same as per stipulated date of Completion

d) The Contractors do hereby agree that the amount of liquidated damages specified in conditions of contract/ special conditions of contract represents a genuine and fair estimate of the loss likely to be suffered by the Bank in the event of the works not being completed in time.

e) It is specifically and distinctly understood and agreed between the Bank and the CONTRACTORS that the CONTRACTORS shall have no right, title or interest in the site made available by the Bank

for the execution of the works or in the building, structures or works executed on the said site by the CONTRACTORS in the goods articles, materials etc. brought on the said site (unless the same specifically belongs to the CONTRACTORS) and the CONTRACTORS shall not have or deemed to have any lien or charge whatsoever for unpaid bills and it will not be entitled to assume or retain possession or control of the site or structure and the Bank shall have an absolute and unfettered right to take full possession of the site and to remove the CONTRACTORS, their servants, agents and materials belonging to the CONTRACTORS lying in the site.

f) The CONTRACTORS shall be allowed to enter upon the site for execution of the works only for the purpose of executing the contract work and shall not have any claim, right, title or interest in the site or the structures erected thereon and shall not enter upon at any time without assigning any reason.

g) The Contractor shall afford every reasonable facility for the carrying out of all works relating to civil works, installation of lifts, Telephone, electrical installations, fittings and other ancillary works in the manner laid down in the said Conditions, and shall make good any damages done to walls, floors, etc. after the completion of his work.

h) The APMCF/SBI reserves to itself the right of altering the drawings and nature of the work by adding to or omitting any items of work or having portions of the same carried out without prejudice to this Contract.

85.0 Penalty/Fines imposed by the GIFTL

Contractor shall note that during the period of construction if any penalty /fines imposed due to non-compliance of GIFTL norms, rules & regulations, time period of construction etc. same shall be paid by the Contractor without any extra cost to SBI. This penalty /fines shall be in addition to the Liquidated Damages as per Clause No 8 of GCC of Tender.

16.0 IMPORTANT GIFTCL REGULATIONS AND NORMS

NO EXTRA shall be paid for complying with and/or implementation of any of the below listed clauses

1) The Contractor shall install a 'Display Board' at the conspicuous place on site indicating: - i) Name & address of developer, architect, structural engineer and contractor. ii) Building name, Zone, Road etc. iii) Date and No. of development permission. iv) Approved FSI/Built-up area, no. of buildings and floors permitted.

2) The contractor shall have to carry out and submit Fire Audit before applying for plinth completion certificate and shall obtain and submit final Fire NOC from Fire Officer before applying for Occupancy Certificate. The contractor shall provide at his own cost all firefighting requirements along with necessary accessories as prescribed in National Building Code and as per Fire Officer/Fire Advisor's remarks.

3) The Contractor shall follow all the Energy Conservation Building Code (ECBC) norms.

4) CONTRACTOR shall obtain all applicable NOC's Permissions and assist Bank / Architects / GIFT in all forms of documentation, data, and any specific requirement for final NOC from all the relevant Authorities before applying for Occupancy Certificate of the building.

Contractors should get final NOC/CERTIFICATE from component authority/GIFT in place of Provisional NOC/CERTIFICATE with all charge/expense.

5) Environmental Clearance obtained by GIFTCL is subject to a number of conditions. The Contractor is required to comply with these conditions in so far as they are related to your development. Contractor to ensure that no such violation is found from contractor's side, until his work is completed in all respects.

6) GIFT UDA reserves the right to amend or add any condition during the progress of works, if required necessary and the same shall be binding on the developer – Contractor to take Note.

7) Contractor is required to submit Shop Drawings & As Built Drawings : Building Information Modeling in REVIT format; No Extra shall be paid for this.

8) Contractor is required to construct building in compliance with GIFT Area DCRs

9) The contractor shall comply with Environment, Health and Safety (EHS) guidelines as listed below.

ENVIRONMENTAL HEALTH AND SAFETY (E.H.S.) GUIDELINES FOR THE CONTRACTORS

Preamble: GIFTCL aims to achieve the highest standards in Environmental, health & safety (EHS) performance during the construction phase. All the CONTRACTORS should demonstrate successful

track record with regard to the EHS performance. GIFTCL shall support the efforts and initiatives that are instigated by the CONTRACTORS to achieve the highest standards in EHS performance. These guidelines are applicable to all types of construction activities undertaken by OWNERS & their contractors working in GIFT city.

This EHS guideline covers minimum environmental, health & safety obligations to be followed by various developers working in GIFT city. A copy of EHS guidelines along with project with project specific EHS requirement will be given to the Developers at the time of issue of development permission.

Contractor's Responsibilities and Obligations

a) It will be sole responsibility of the CONTRACTOR to ensure all applicable legal compliances related to Environment, Health and Safety.

b) The CONTRACTOR shall submit a detailed EHS Plan along with the details of the person responsible to GIFTCL/ GIFTUDA and shall be responsible for EHS performance of their sub-contractors too.

c) The CONTRACTOR will strictly comply with various rules and orders made by Gujarat Government under the Building and other Construction Workers (Regulation of Employment & Condition of Service) Act, 1996.

d) It shall be responsibility of the CONTRACTOR that all the employees at site are protected from the occupational hazards of the work or any other work carried out in the vicinity.

e) The CONTRACTOR shall identify and exercise all necessary precautions for pollution control & safety, health of all his workmen and other persons who may be affected by his services.

f) GIFTCL has in place required environmental clearance under EIA notification 2006. The CONTRACTOR shall be fully responsible for complying with the applicable conditions stipulated under environmental clearance. Also, the CONTRACTOR is responsible for complying with all other Central's & State Government's regulatory requirements along with other GIFTCL/GIFTUDA's requirements.

Obligations for Environmental Protection

a) Necessary license/consents shall be obtained by the CONTRACTOR for RMC/Hot Mix Plant from Gujarat Pollution Control Board (GPCB) under Air act/Water act & all conditions of the said license/consent shall be fulfilled.

b) All minerals for the project shall be brought from the approved sources/quarries having valid No Objection Certificate (NOC)/Consolidated Consent and Authorization (CCA) from Gujarat Pollution Control Board (GPCB).

- c) The transportation of construction material like soil, sand, cement and aggregates etc. to the site from the source should be transported in the truck properly covered by tarpaulin or suitable material.
- d) Sprinkling of water on the site at least twice a day as per site condition to suppress the dust should be done
- e) Construction equipment, machines and transportation vehicles should be in appropriate condition meeting the pollution control norms and should be inspected periodically for noise and emissions levels.
- f) Periodic maintenance of construction machinery, transportation vehicles should be undertaken, and engines of all vehicles should be thoroughly maintained so as to keep noise and emissions levels within limits.
- g) Diesel generator sets used during the construction phase of more than 15 KVA should be enclosed type.
- h) The oil/grease handling area should be kept effectively impervious to prevent surface and ground water contamination by oil/grease. Also need to clean these areas after periodic intervals.
- i) Safe drinking water is to be supplied to the workers at site/camps and periodic inspection / cleaning of water tanks is to be done.
- j) Sufficient sanitation facilities should be provided at site before starting construction activities, in order to maintain hygienic conditions at site/camp.
- k) The wastewater generated from the worker camps, workshops, washing equipment etc shall be disposed of in an environmentally sound manner.
- l) Dumping of any type of construction waste in neighboring sites, landscaped area, and natural drains is strictly prohibited. It should be dumped at designated site only.
- m) Garbage generated at site/workers camps should not be dumped anywhere near the construction site or worker camps. Waste should be segregated as Biodegradable, Non-Biodegradable, recyclable, hazardous waste at source itself and put in separate colour coded bins. It shall be disposed of at designated Government approved disposal site only.
- n) Hazardous waste such as waste oil, paint, solvents, wood preservatives, pesticides, adhesives and sealants shall be handed over to the GPCB authorized vendors only.
- o) Recyclable waste such as plastics, glass fiber insulation, roofing etc shall be given to authorized vendors.
- p) All topsoil excavated during construction activities should be stored for use in horticultural works / landscape development at designated sites.

- q) Any activity resulting in Air, Water and Land pollution will be considered as a serious offence.
- r) It is recommended to have silt fences to prevent spillovers of excavated soil to areas outside the working area.
- s) Stockpiles of materials near natural drains/ neighboring plot shall be avoided.
- t) The entire project area shall be cleaned and checked before the on - set of monsoons to ensure free flow of storm water runoff.

Obligations for Health & Safety of workers

- a) Safety and work specific induction is a must before work starts on site.
- b) It is necessary to provide a dedicated and competent EHS supervisor to take care of environmental, health & safety at site. If the CONTRACTOR employs 100 workmen, he shall appoint one Safety Officer with the required qualifications and experience.
- c) It is the responsibility of the CONTRACTOR not to allow any of his employees to work in unsafe conditions, nor with unsafe equipment and to take all necessary measures to prevent accidents.
- d) The construction site shall be barricaded (at least 3m height) as per design approved by architect with adequate signage. All site areas having risk of falling need to be barricaded properly. Adequate safety instructions and signage shall be displayed at site.
- e) The CONTRACTOR shall provide periodic safety training to all his employees/workers commensurate to their roles.
- f) good housekeeping must always be maintained. All roads, passages, walkways, aisles, must always be kept clear of materials to avoid slips, trips and falls.
- g) Safety Talk / Toolbox Talk are to be conducted daily for workmen to make them aware about the hazards associated with their role.
- h) In case of any accident or incident Mass Toolbox Talk need to be given amongst all the workmen as an awareness.
- i) The CONTRACTOR shall provide adequate and suitable Personal Protective Equipment (PPEs) to all concerned personnel. PPEs like safety helmet (IS 2925), safety shoes (puncture resistance), Safety Belts, hand gloves (PYC type/rubber/cotton/leather) according to nature of work, high visibility jacket, earmuffs, safety goggles etc. are mandatory at construction sites.
- j) All PPEs, safety devices and safety guards are to be maintained properly and should be kept sound and operative. To ensure PPEs usage by employees, a register bearing signature or thumb impression of the employee issued with such PPE shall be maintained. Periodic replacement also needs to be noted in register.

- k) For the smooth traffic movement, the CONTRACTOR needs to assign signalman or traffic controller around the construction site.
- l) Construction/maintenance activities carried out at height of 3 meters and above shall be controlled and should be as per IS code IS 4014.
- m) Health and safety requirements for excavation shall be as per the IS code (IS 3764). Excavation site should be properly barricaded with sufficient safety signage.
- n) Necessary Health and safety requirement for confined space (basements etc.) need to be followed. Proper access/egress, oxygen level, illumination level and supervisor with log sheet, emergency vehicle need to check before start of confined space work. Inspection of construction equipment shall be carried out prior to their deployment by EHS Supervisor.
- o) Makeshift arrangement as parts of scaffolding, work benches, electricity board etc. are strictly prohibited. Damaged or defective tools shall not be allowed at site.
- p) Electrically operated tools shall be inspected periodically.
- q) Earth Leakage Circuit Breakers (ELCB) should be used on all temporary electrical connections and ELCB testing records need to be maintained.
- r) The temporary cables used shall be free from damaged insulation, kinks or improperly insulated joints.
- s) Proper grounding shall be ensured for all switchboards & electrical equipment.
- t) Well maintained apparatus, such as torches, manifolds, regulators or pressure reducing valves, Gas cutting sets with flashback arrestor, welding machines with crimping clamps shall be used in hot work activity.
- u) First aid facilities with professional first aid shall be readily available for 24 hours at site.
- v) Material Safety Data Sheet (MSDS) shall be displayed on site for paints, pesticides, adhesives, sealants and similar kinds of materials.
- w) Combustible material such as wooden waste, empty tins, paints, and adhesives needs to be removed from site on periodic basis.
- x) Fire extinguisher near DG sets/ combustible material storage area is required and to be maintained properly to avoid fire hazards.
- y) Arrangement of the emergency medical facility shall be readily available along with respective site supervisors.

Disposal of construction waste:

The contractor has to carry out proper and efficient disposal of all kinds of construction waste generated from the site strictly as per IGBC norms without any additional cost to the client.

Installation of safety nets

The contractor must install high quality safety nets all-round the building below a high-level work area so as to reduce the distance of fall of any object or person from the working site as per the norms of Indian Health and Safety Act. Safety nets must be designed to deflect and absorb the energy of a fall so as to reduce the likelihood of a person being injured. There must be enough clear space below the net so that as the net deflects, the person who has fallen does not strike an obstacle or the ground. Proper installation of safety nets will allow people to work at height without restricting their movement.

Installation of green shade nets (To Avoid Dusting)

The contractor must install high quality green nets all-round the building so as to prevent accumulation of constructional dust, grinding dust and all other types of harmful sand, cement, and stone dust particles into the surrounding area which can hamper the ambient air quality of the surrounding area. The contractor shall not charge any additional cost to the client for doing the same.

Records, Documentation and Reporting

- a) The CONTRACTOR has to maintain all the records related to various Environmental, Health & Safety related NOCs, licenses, certificates, permissions, monthly reports etc at the site office.
- b) PPE registers with bearing signature or thumb impression of employees issued with such PPE's need to be maintained along with the competency records of the skilled workmen.
- c) The CONTRACTOR will submit a quarterly EHS compliance report.

Audit and Inspections

- a) The CONTRACTOR must provide evidence of its satisfactory EHS performance and compliance through monthly EHS report in prescribed format mentioning details of contractor & sub-contractor to the Environment Division of GIFTCL in first week of every month.
- b) The CONTRACTOR has to attend the meetings called by Environmental division of GIFTCL as and when required.
- c) GIFTCL reserves the right to carry out EHS inspection or audit of the construction site at any time.
- d) These periodical audits will be done by third party or audit team assigned by Environmental division of GIFTCL. After receiving the audit report, the CONTRACTOR should prepare compliance report and need to submit to GIFTCL within stipulated time.

Cost Recovery and Penalty

- a) Noncompliance of EHS guidelines by the CONTRACTOR will attract serious attention of the GIFTCL's Management and GIFTCL will be in position to exercise its authority.
- b) GIFTCL may issue notice to the CONTRACTOR to deploy a more competent site-in-charge and/or other personnel.
- c) GIFTCL reserves the rights to implement EHS measures at site in case the CONTRACTOR fails to implement. The cost of the same will be recovered from the CONTRACTOR.
- d) In case of repeated non-compliance of EHS guidelines by the CONTRACTOR, GIFTCL / GIFTUDA reserves the rights to take strict action and issue a stop work notice or and may impose a fine.

Emergency Response

- a) The CONTRACTOR has to prepare and implement an Emergency Preparedness Plan. Details of responsible officials for handling emergency situations along with their name, designation and contact numbers have to be displayed at various locations within the site.
- b) In case of any emergency like fire, explosion, toxic gas release or any incident, immediate information is to be communicated to various helplines: MEDICAL: 108 FIRES: 101 SECURITIES: 100
- c) Any emergency in GIFT area can be extremely dangerous; hence it is to be reported immediately to the SECURITY DEPARTMENT of GIFTCL at +91-79- 30018300.

GIFT CITY REGULATIONS Regulation 6**Payment of Wages**

- i) Wages due to every worker shall be paid to him directly. All wages should be paid in current currency or coins or in both.
- ii) Wages of every worker employed on the Contract shall be paid where the wage period is one week, within THREE days from the end of the Wage period, and in any other case before the expiry of the 7th day or 10th day from the end of the wage period according as the number of workers does not exceed 1,000 or exceeds 1,000.
- iii) When employment of any worker is terminated by or on behalf of the Contractor, the wages earned by him shall be paid before expiry of the day succeeding the one on which his employment is terminated.
- iv) Payment of wages shall be made at the Work Site on a working day except when the work is completed before expiry of the wage period in which case final payment shall be made at the Work Site within 48 hours of the last working day and during normal time. NOTE: The term "Working Day" means a day on which the work on which the labour is employed is in progress.

Regulation 7 - Register of Workmen:

A register of workmen shall be maintained in the Form appended to the regulations and kept at the work site or as near to it as possible, and relevant particulars of every workman shall be entered therein within THREE days of his employment.

Regulation 8 - Employment Card:

The Contractor shall issue an employment card in the Form appended to these regulations to each worker on the day of work or entry into his employment. If a worker already has any such card with him issued by the previous employer, the Contractor shall merely endorse that Employment Card with relevant entries. On termination of employment, the Employment Card shall again be endorsed by the Contractor and returned to the worker.

Regulations 9 - Register of Wages, etc.:

- i) A Register of Wages cum Muster Roll in the Form appended to these regulations shall be maintained and kept at the Work Site or as near to it as possible.
- ii) A wage slips in the form appended to these regulations shall be issued to every worker employed by the Contractor at least a day prior to disbursement of wages.

Regulation 11 – Register of Accidents

The Contractor shall maintain a register of accidents in such form as may be convenient at the workplace 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 of Time when admitted to hospital
- h) Date of discharge from the hospital
- i) Percentage of loss of earning capacity and disability as assessed by the medical Officer.
- j) Claim required to be paid under Workmen's Compensation Act.
- k) Date of payment of compensation
- l) Amount paid with details of the person to whom the same was paid
- m) Authority by whom the compensation was assessed.
- n) Remarks

Regulation 20 – Amendments

The Employer may, from time to time, add to or amend these Regulations and issue such directions as it may consider necessary for the purpose of removing any difficulty which may arise in the demonstration thereof.

NO EXTRA shall be paid for complying with and/or implementation of any of the above listed clauses.

17.0 Scope for IGBC / Green Building Platinum Rating compliance

Terms & Conditions – IGBC / Green Building Platinum Rating Compliance

1. General Scope of Contractor

- The Contractor shall be fully responsible for ensuring compliance with IGBC Green Homes (Version 3) rating system requirements.
- Contractor's obligations include coordination with the Green Building Consultant, PMC, Architect, Structural & MEP Consultants, statutory bodies, and IGBC during the entire construction period.
- The Contractor shall collect, maintain, and share all required data, documents, and certifications with the PMC/Employer for submission to IGBC.

2. Coordination & Documentation

- Prepare and submit all site-level documents, test results, invoices, photographs, as-built drawings, and compliance reports required for IGBC submission.
- Maintain registers for material procurement (GreenPro / eco-labelled products, FSC certified wood, low-VOC paints, etc.) and for on-site testing.
- Cooperate with IGBC Accredited Professionals engaged by the Employer/Consultant.

3. Execution Obligations

- Implement construction practices strictly as per IGBC requirements:
 - Soil erosion & dust control measures.
 - Waste segregation & recycling yard.
 - Labor welfare facilities, sanitation, and awareness sessions.
 - Use of certified eco-labeled products, alternative materials (AAC blocks, GGBS, etc.).
 - Compliance with water/energy efficiency measures.
- Ensure that "Do's & Don'ts" signage (Green Awareness) are prominently displayed on site.

4. Site Visits of IGBC Committee Members / External Auditors

- Contractor shall coordinate and arrange all site visits for IGBC committee members, external auditors, or representatives.
- Contractor shall provide required logistics including:
 - Local transportation within the project city.
 - Air travel (to & from project city) as required.
 - Minimum **3-star hotel accommodation** (with breakfast) for committee members/inspectors.
 - On-site arrangements such as safety gear, escorting, and presentation materials.

5. Financial Obligations

- Contractor shall bear all costs related to IGBC compliance including:
 - IGBC registration fees, certification charges, and liaison costs with the Institution (unless otherwise stated in BOQ).
 - Costs of conducting specialized tests (slurry tests, waste audits, water/air quality testing, etc.).
 - Arrangements for site visits and hospitality as per Clause 4 above.
- No additional payment shall be made by the Employer on this account; all such costs shall be deemed included in the Contractor's quoted rates.

6. Mandatory Conditions During Construction

- No smoking, no spillage, and no uncontrolled disposal of waste on site.
- Dust suppression by water sprinkling and covering materials.
- Compliance with rainwater harvesting, wastewater reuse, and green education measures.
- Maintain safety, sanitation, and welfare facilities for construction workers as per IGBC credit requirements.
- Ensure strict compliance with *environmental, health, and safety* practices in line with IGBC and statutory standards.

7. Non-Compliance

- Any deviation or failure to adhere to the IGBC compliance requirements resulting in the project losing credit points shall be considered a breach of contract.
- In such case, the Employer reserves the right to recover the costs or impose penalties equivalent to the loss caused due to non-compliance.

18.0 Brief Scope of work**1.0 Brief Scope of work is as follows:**

i. The Contractor may have to execute all required works at his own cost, if left omitted in above scope, for making the building fit for occupation and functional use by the user department. Nothing extra shall be paid on this account.

ii. Execution of the works and construction for Projects per approved drawings, design and plans as well as obtaining clearances required for occupation of the building from the local bodies.

iii. Scope of work, Schedule of Quantities, General Conditions, Additional and other conditions/specifications for Civil, E&M and Horticultural works have been given in detail in respective chapters & schedules of this bid document and same may be referred.

iv. All following works and allied work shall be part of scope of Contractor.

a) Civil Work

b) Plumbing & Sanitary Works

c) Electrical, Fire Alarm and CCTV Work

d) Fire Fighting and Fire Protection Work

v) Execution of work

a) The Contractor should visit/revisit and examine the site of work and satisfy himself as to the nature of the existing roads, municipal drains, supply lines and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding, incorrect information on any of these points or on grounds of insufficient description, shall be allowed.

b) The work shall be carried out in conformity with the drawings & design and within the requirements of architectural, electrical, structural and other specialized services drawings.

c) The Contractor shall cooperate with all trades and agencies working on the site. He shall make provisions for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction schedule. All support to the civil structures shall be provided with dash fasteners.

d) On award of the work, Contractor shall submit a schedule of construction as per clause of the agreement for approval of the AME/SBI. All dates and schedules agreed upon shall be strictly adhered to within the stipulated time of completion/ commissioning along with the specified phasing, if any.

vi) Completion drawings

On completion of work, Contractor shall submit six complete set of "Asbuilt drawings" along with Soft copies, Cad Files, PDF, etc. to the APMCF /SBI. These drawings shall have the following information.

1. Location of all mechanical equipment with layout and piping connections and mechanical equipment.
2. All shop drawings shall be updated from time to time for the purpose of making completion drawings.
3. No completion certificate & occupancy certificate shall be issued unless the above drawings are submitted. Piping and drainage works shall be tested as specified under the relevant clauses of specifications.
4. Contractor or his associate agency engaged to do this work must hold a valid plumbing or any other as required license by the municipal authority or other competent authority under whose jurisdiction the work falls.

vii) ALL NOC's/Permissions/Approvals required before/after completion of any/all Specialized Works like, tree cutting permission/Garden NOC, /Power Supply/Distribution Company's NOC/Approval, Final Fire NOC and Final, Plumbing, Water Supply, Drainage, Water Meter NOC from the local bodies/GIFT Authority are to be secured by the contractor. Further Contractor has to complete the work as required by the GIFT Authority/ Local Authorities / AUDA/ and assist the APMCF/Architect in related documentation, if required, for getting the completion certificate and occupancy certificate.

Statutory fees paid by the contractor will be reimbursed by the Owner on submission of authentic documents/receipts in the name of the Owner.

viii) Development works

The work is to be carried out completely in all respect including services. The Agency is required to connect all the external services like Water Supply, Sewerage, Drainage, Electric Supply, LAN/WAN, Telephone Lines etc. to the main lines of the authorities/service providers or any other agency and this shall be considered as integral part of Scope of work and deemed to be included in the quoted price of the agency. The Agency shall supply all documents required in obtaining all mandatory approvals and shall also extend full support to getting all required statutory & Municipal approval "Occupation and Completion" or any other document required to declare all assets eligible for bringing it in use.

a. Roads and Pathways

- i. Approach and peripheral roads & pathways as per fire guidelines and functional requirements, to the building for Construction as per site requirements.

- ii. The construction of guard rooms, SS gates, wicket gates, dustbins, sign boards, guide maps, location boards, direction boards and numbering etc. All complete as per the approved drawings of local bodies and direction of APMCF/SBI

b. Storm water drains, sewer lines, rainwater harvesting

- i. Construction of storm water drains, sewer lines, rainwater harvesting in the external area around the building i/c connection to the trunk sewer line/STP etc. as per given schedule of Quantities.
- ii. Execution of the roof top rainwater harvesting system for collection of rainwater including laying of pipelines and construction of substructures / superstructures as per given schedule of Quantities. etc included in the scope of work.

c. Internal water supply

- i. Execution of the Internal water supply system in all building components.
- ii. Providing and laying of internal water supply grid with external water supply grid network in all building components.

d. External water supply

- i. Execution of water supply system of the whole campus.
- ii. Providing and laying water supply lines around the building and connection to Concerned Local Authority main water line which is to be connected to underground water tank.

ix) Defects Liability Period: As per Clause No. 1.1.18 (a) of GCC.

x) Facilities for Site Staff

Facilities for the Site Staff shall be provided as mentioned in special conditions in part. The quoted amount by the contractor shall include these elements also.

xi) Health & Safety Manual provisions

- a. The Contractor will comply of the provisions contained safety, Health and Environment guidelines failing which he / they will be liable for the penalties on each violation subject to compounding of the same to maximum of such default as mentioned in the various unsafe act / unsafe conditions in this manual. This apart from the other fines/ levies / penalties, are mentioned in the documents elsewhere. It is incumbent upon the contractor to ensure in undertaking all health and safety compliance for safety of all concern to generate safety conscious and safety regulatory as his primary statutory duties or responsibilities in the contract.
- b. General pest control, fogging, fumigation etc. should be carried out regularly and adjoining areas.

xii) SAFETY MEASURES:

The site of construction shall be under surveillance using CCTV cameras and its viewing rights shall be given to SBI officers with backup of data for 30 days. Installation and operation of the same is under the scope of work. Nothing extra shall be payable on this account.

Before starting of works the permission for cutting of trees and / or Transplanting of the trees shall be obtained by the Contractor from GIFT Authority/Local Governing Authority or any other authority of the State Government, and execution of cutting and transplanting the trees or any other action in this regard will be taken by the contractor at his own cost. Contractor to take note of this while quoting the rates.

xiii) Specialized Civil, Electrical & Mechanical works:

The Bidder must associate himself with agencies of the appropriate eligibility for each specialized nature of items/work listed in Tender Document. Such works shall be got executed only through associated agencies specialized in these fields. The Bidder whose tender is accepted shall indicate the name(s) of his associated specialized agencies those fulfilling the eligibility criteria laid down in Tender Document after award of work and at least 30 days before commencement of such items / work but within 90 days of award of work with their credentials whichever is earlier for the approval of the APMCF /SBI of that component, whose decision shall be final and binding.

xvi) Rate Analysis

The L1 contractor shall provide detailed Rate Analysis for all items of work within 15 days of opening of Price Bid. Rate analysis shall include break up of materials, labour, wages, fixtures, transportation, installation, wastages, Octroi, levies, all cess, royalties, all taxes (but excluding GST), machinery, enabling works such as scaffolding, cleaning, overheads, profit, statutory expenses, incidental charges Water and Electricity Charges and his overheads and profits for the same and all related expenses to complete the work

Xvii) The Work shall be carried out as per Minimum Specifications, particular specifications and drawings (Architectural, Structural and MEP). Any deviation, extra items & substitute Items shall be dealt as per Clause of General Conditions of Contract.

Note: All works has to be executed as per specifications provided in the bid document, CPWD Specifications-2019 (with updated correction slips) Vol-I & Vol. II, and National Building Codes 2016, Relevant BIS Code (in case of difference, if any, stringent / higher specification of the two shall be followed). In absence of Tender Specification, CPWD, IS Codes, MoRTH Specifications, National Building Code 2016, Specifications, or sound engineering practices shall be adopted as per order of precedence defined in the contract. (Refer clause 1 of SCC).

The scope of work & specifications is given in general, but they are not exhaustive, i.e., does not mention all the incidental works required to be carried out for complete execution of the item of

work. The work shall be carried out, all in accordance with true intent and meaning of the specifications and the drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings and/ or described in the specifications, provided that the same can be reasonably inferred their form. There may be several incidental works, which are not mentioned in the contract document/specifications but will be necessary to complete the item in all respects. All these incidental work/ costs which are not mentioned but are necessary to complete the work shall be deemed to have been included in the overall amount quoted by the contractor for various components of work. No adjustment of rates shall be made for any variation in quantum of incidental works due to variation/change in actual working drawings. Also, no adjustment of rates shall be made due to any change in incidental works or any other deviation in such element of work (which is incidental to the items of work and are necessary to complete such items in all respects) on account of the directions of APMCF /SBI. Nothing extra shall be payable on this account.

In case, some of items are missing in the scope of work or specifications in the bidding documents same shall be taken from the specification mentioned in similar type of items mentioned for similar type of buildings in the scope of work or shall be executed as given in the CPWD Specifications, NBC-2016, IS Codes or according to sound engineering practices so as to make the building including related services fully functional. No claim whatsoever may be entertained at later stage. All costs of providing and making buildings with services, landscape and horticulture works are fully complete in aspects unless specifically mentioned in the contract document and making buildings with services fully functional are included in the cost tendered for this work.

19.0 APPENDIX-I: ESTABLISHING SITE LABORATORY AND TESTING OF MATERIALS

Equipment for conducting necessary tests (as per CPWD Specifications 2019 Volume-I&II) shall be provided and installed at site, in the well-furnished site laboratory by the agency at his own cost, as and when required. The following laboratory equipment should be in general or as required and be set up at site laboratory: -

S No	Equipment	Numbers/ As required
1.	100 MT compression testing machine, electrical-cum- manually operated)	1
2.	Slump cone, steel plate, tamping rod, steel scale, scoop	6
3.	Vicat Apparatus with Desk pot	3
4.	Megger & earth resistance tester	3
5.	Pumps and pressure gauges for hydraulic testing of pressure	3
6.	Weighing scale platform type 100 Kg capacity	3
7.	Graduated glass measuring cylinder	As per requirement
8.	Sets of sieves of 450 mm internal dia for coarse aggregate [100mm, 80mm, 40mm; 2mm; 12.5mm, 10mm; 4.75mm complete with lid and pan	3
9.	Sets of sieves of 20mm internal dia for fine aggregate [4.75mm; 2.36mm; 1.18mm; 600 microns; 300microns & 150 microns, with lid and pan]	3
10.	Sieve Brushes and sieve shaker capable of 20mm and 300mm dia sieves, manually operated with timing switch assembly	5
11.	Cube moulds size 70mmx70mmx70mm	30
12.	Cube moulds size 150 mm x 150 mm x 150mm	60
13.	Ultrasonic Test Equipment (For concrete)	3
14.	Hot air oven temp. Range 50°C to 300°C- sensitivity 1degree	3
15.	Electronic balance 600gx0.1g., 10kg and 50 kg	3
16.	Physical balance weight up to 5 kg	3
17.	Digital thermometer up to 150oc	3
18.	Air Content of concrete testing machine	3
19.	Measuring jars 100ml, 20ml, 500ml	3 No. each
20.	Gauging trowels 100mm & 20mm with wooden handle	12
21.	Spatula 100mm & 20mm with long blade wooden handle	12
22.	Vernier calipers 12" & 6" size	3 each

23.	Digital PH meter least counts 0.01mm	3 each
24.	Digital Micrometer least count. 0.01mm	3 each
25.	Digital paint thickness meter for steel 500 microns Range	3
26.	GI tray 600x450x50mm, 450 300x40mm, 300x250x40mm	3 Nos. each
27.	Electric Motor mixer 0.25 cum capacity	3
28.	Rebound hammer test digital rebound hammer	3
29.	Screw gauge 0.1mm-10mm, least count 0.05	3
30.	Water testing kit	3
31.	Motorized sieve shaker	3
32.	Pruning Rods 2 Kg weight length 40 cm and ramming face 25 mm ²	3
33.	Extra Bottom plates for 15 cm cube mould	21
34.	Standard Vibration Table for gauging the cubes	3
35.	Pocket concrete penetrometer 0 to 50kg/ sq.cm	3
36.	Concrete temperature measuring thermometer with Brass protection sheath 0- 100 degree centigrade	3
37.	Mortar Cube Vibrator	3
38.	Dial type spring balance preferably with zero correction knob capacity 100 kgs. reading to ½ kg	2
39.	Counter scale capacity 1 kg and 10 kg	2
40.	Iron Weight of 5 kg, 2 kg, 1 kg, 500 gm, 20 gm, 100 gm	2 each
41.	Brass Weight of 50 gm, 2 gm, 10 gm, 5 gm, 2 gm, 1 gm	2 each
42.	Measuring cylinder TPX or Poly propylene capacity 100 ml, 500 ml, 250 ml, 100 ml	2 each
43.	Pyrex, corning or Borosil beakers with cover capacity 500ml, 20 ml, 50 ml	3 each
44.	Wash Bottles capacity 500 ml	12
45.	Thermometers 1-100 degree centigrade / max. and Min/Dry and wet with table	6
46.	Set of box spanner ratchet	3
47.	Hammer 1lb & 2lb	3 each
48.	Distance meters (of 100 meter)	2
49.	Hacksaw with 6 blades	4
50.	Measuring tape (5 meter)	10
51.	Depth gauge 2 cm	6
52.	Shovels & Spade	6
53.	Steel plates 5 mm thick 75x75 cm	6

54.	Plastic or G.I. Buckets 15 liters, 10 liters,5 liters	3 each
55.	Wheelbarrow	12
56.	Floor Brushes, hair dusters, scrappers, wire brushes, paint brushes, shutter steel plat oil, kerosene with stoveetc.	12 each
57.	Any other equipment for site tests as outlined in BIS codesand as directed by the APMCF /SBI.	As per site requirement

20.0 Appendix-II: PLANT AND EQUIPMENT REQUIRED TO BE OWNED / TAKEN ON LEASE BY THE CONTRACTOR

Sl.No.	Equipment	Tentative Numbers
1	Builder's hoist	7/ As Required
2	Centralized concrete batch mix plant of capacity 60 cum per hour (fully automatic with computer control)	1/ As Required
3	Excavator cum loader (JCB 3D model or equivalent)	2/ As Required
4	Compressor machine minimum 20 CFM with rock Breaker	5/ As Required
5	DG set of minimum capacities of 62.5 KVA.	As per requirement
6	Mini batching plant (6 cum./hr.).	2/ As Required
7	Transit mixers.	As per requirement
8	Concrete pump.	3/ As Required
9	Boom lifter	7/ As Required
10	Needle Vibrators.	6/ As Required
11	Screed leveler.	6/ As Required
12	Plate Vibrator.	6/ As Required
13	Automatic Ring making machine (Reinforcement).	2/ As Required
14	Dumper / Tripper.	6/ As Required
15	Reinforcement bending machine.	3/ As Required
16	Reinforcement cutting machine.	6/ As Required
17	Power driven earth rammer (Soil Computer).	2/ As Required
18	Total Station Machine.	2/ As Required
19	Water tanker (Minimum capacity of 5000 liters)	5/ As Required
20	Welding machine 400 Ampere.	5/ As Required
21	Screener for coarse sand and fine sand.	6/ As Required
22	Centrifugal mono block water pump minimum capacity 2HP.	6/ As Required
23	Road roller 8 to 10 tons.	2/ As Required
24	Vibratory roller.	2/ As Required
25	Drilling machine.	As per requirement
26	Double H Frame MS scaffolding and staging materials.	4000 Sq.mt. / As Required

27	Air compressor.	6 Nos/ As Required
28	Floor grinding / polishing machines.	6 Nos/ As Required
29	Granite cutting machine.	6 Nos/ As Required
30	Ceramic tile cutting machine.	12 Nos/ As Required
31	Granite polishing machine.	6 Nos/ As Required
32	Granite hand polishing machine.	12 Nos/ As Required
33	Mobile tower crane.	2 Nos/ As Required
34	Tower Crane with necessary covering length /Area required for the Construction of Twin Towers	1 Nos/As Required
35	Any other machinery required for completion of the work as per decision of APMCF /SBI.	As per actual requirement
36	Officers' inspection Lift	One per tower
37	Pile foundation machinery	As per requirement
38	Shuttering for Residential building	As per requirement

Note: The above list is only indicative and not exhaustive. However, quantity may be optimized commensurate to progress of work with the approval of APMCF /SBI.

21.00 LIST OF MATERIALS FOR CIVIL WORKS

The materials, accessories, fittings, etc. be used in the civil shall be one of the following particular make or equivalents IS Make. The direction of selection of any particular make shall be rest with APMCF/SBI.

Material Make List		
Sr. No.	Material	Brand / Manufacturer Name
1	Cement	Ambuja, Birla, Ultratech, ACC , Lafarge and L&T or as approved.
2	T.M.T Bars	TISCON (TATA)/ SAIL / Jindal/RINL/ Bajaj As approved.
3	Ready mix Concrete	Lafarge/ Godrej/ Ultratech/ACC/ JK Cement/ Birla as approved.
4	Anti Termite Treatment	PCI/ Godrej/ Hi-care or Equivalent as approved.
5	Coupler	DEXTRA/ Unitech/ J. K. Industries/ Lokpal industries or Equivalent as approved.
6	Autoclaved Aerated (AAC) Blocks	Siporex/ Aerocon/ Biltech/ Ecolite/ Ascolite/ BRIXSO/ECO GREEN or as approved.
7	BWP Grade Door/Flush Door	Century/Anchor/ Green/ Archid/Duroddor/Kit Ply as approved.
8	Veneer	Archid/ Greenply/ Century/ Duro/Century/Exotic Veneer, Signature/Kit as approved.
9	Laminates	Archid/ Greenply/ Century/ Royal Touch/ Greenlam/ as approved.
10	FRP Door	Durian/ Astral/ Durofenster/ Engineer Ply/ as approved.
11	Aluminum Section	Jindal/ Indal/ Hindalco/ as approved.
12	Steel Sections	Jindal/ JSW/ TATA/ RINL/as approved.
	Poly carbonate Sheet	Sunlite/ Lexan/ Thermoclear as approved.
14	Vitrified Tiles	Kajaria/Somany/Nitco/H.R Johnson/Simpolo/ as approved.

15	Ceramic Tiles	Kajaria/Somany/Nitco/H.R Johnson/Simpolo/ as approved.
16	Rubberised Flooring	Asian/ Sunflex/ Ecoflex/ Aditya/Field Turf or as approved.
17	Texture paint	Asian Paint/ Jotun/ Nerolac / Burger/ Dulux/ Ultratech or approved.
18	Synthetic Enamel Paint (Low VOC)	Asian / Nerolac / Berger/ Dulux or approved.
19	Gypsum	Saint Gobain/ Gyproc India as approved.
20	Acrylic emulsion Paint with low VOC content	Asian / Nerolac / Berger/ Dulux or approved.
21	Oil bound distemper (Low VOC)	Asian / Nerolac/ Berger/ Dulux or as approved.
22	Acrylic Smooth Emulsion Exterior Grade paint (Low VOC)	Asian / Nerolac/ Berger/ Jotun/ Dulux or as approved.
23	Cement Paint	First quality paint of Asian paints, Shalimar/ Nerolac / Indigo/Jotun / snowcem Topcem, Nitcocem / As approved.
24	White Cement	Birla/ J K Cement/ Ultratech or as approved.
25	Putty	Birla, Asian, Nerolac, Berger, JK or as approved.
26	Neeru	Ishan gold/ Saraswati Gold/ Laxmi with IS Mark or as approved.
27	UPVC Sliding/Openable Windows	Fenesta, Deceuninck, Saint Gobain, Tostem, Koemmeling, Prominance or equivalent as approved
28	UPVC Sliding/ Openable Door	Fenesta, Deceuninck, Saint Gobain, Tostem, Koemmeling, Prominance or equivalent as approved
29	Gypsum Plain Board	Saint Gobain/ Armstrong/ India Gypsum/Gyproc or Equivalent As Approved.
30	Toughened, Plane, Fire rated Glass – (All High Performance)	Indo Asahi Glass/ MODIGUARD/ SAINT GOBAIN /FG/ASI or as approved.
31	Glass door fixtures	Dorma/ Hettich/ dorset/ Haffle or as approved.
32	Waterproofing chemicals	Dr. Fixit /MYK Arment /Cico/ Sica/ Fosroc/ BASF / kerakol / As approved.

33	Acrylic Sheet	Sanmati Acrylics/ Acrylic Sheet India/ Acry plus / as approved.
34	Admixture & Plasticiser	Dr. Fixit/Cico/ MYK Arment/ Fosroc /Sica/ BASF / kerakol / As approved.
35	Construction Chemical	Foscroc / Myk /Cico /Sica /Kerakol / BASF/ Dr. Fixit/ As approved.
36	Rebarring	Hilti/ Fischer / Fosroc/ as approved.
37	All Hardware fittings	Godrej/ Hettich/ Haffle/ Ebco/ Dorma/ Dorset or as approved.
38	Kerb Stone	Vyara Tiles / Shivalik Pavers/ JP Blocks
39	Metal Door	Marin Door/ Sehgal Door/Hormann India Pvt. Ltd.
40	Plywood	Kitply/Century/Greenply/Anchor/Duro
41	Steel Spikes	Pigeno, Bird Flee Pegion Control, Spike Zone
42	Stack/Puzzle Car Park	Klus/WHOR/Pari/RR Parkon/Dantal
43	Rolling Shutters	Gujrat Rolling Shutters/Swastk Rolling Shutters, Gandhi Automation or as approved
44	Chequered Steel Plate	TISCO/ SAIL / ZPSS/ LISCO As approved.
45	Speed Breaker	Krishna Rubber Industries/ Haiku Enterprises/Protector Fire Safety Pvt. Ltd.
46	Cement Concrete Pavers	GK Concrete, Hindustan Tiles/Neptune Industries Ltd/PAVIT
47	Paver Tile 25 mm Thk	Kajaria/Somany/Unistone/Pav it
48	GI Frame/Sections/Chanel	Saint Gobain/ Armstrong/ India Gypsum/Gyproc or Equivalent As Approved.

Notes:-

- 1) Note: - Besides the above makes, Bank/ APMCF has the right to permit use of any equivalent brand / material matching the specified criteria / quality standards.
- 2) The contractor should obtain prior approval from APMCF / SBI before placing order for any specific materials. APMCF / SBI may / delete any of the make or brands out of the above list.
- 3) All materials should conform to relevant standards and codes of BIS.

- 4) Materials with I.S.I. mark shall be used duly approved by the SBI/APMCF.
- 5) If any material is found to be not up to the mark, the contractor will have to produce original bills/certificate from the manufacturer or his authorized Distributor for authenticity and genuineness of the material for consideration and as per make approved by the SBI/APMCF. The same will not be considered for payment.
- 6) In exceptional case only, equivalent material's makes (Which are not mentioned in above list) shall be permitted that too with dual approval from SBI/APMCF. SBI reserves the right to accept or reject materials without assigning reason.

22.0 PROFORMAS/TABLES OF VARIOUS TESTS

Sr. No	Particulars	Nos
1.	Record of Cement/Received/Used/Balance.	Table I
2.	Proforma of Paint/Lead/CICO Register	Table II
3.	Proforma for Reinforcement Bars Received	Table III
4.	Format of Receipt of Materials at Site	Table IV
5.	Format of Monthly Progress Report (Annexure X)	Table V
6.	Proforma for Bulkage Test of Sand Register	Table VI
7.	Proforma for Silt Test Register	Table VII
8.	Proforma for Sieve Analysis of Fine Aggregate Register	Table VIII
9.	Proforma for Sieve Analysis of Coarse Aggregate Register	Table IX
10.	Proforma for Slump Test Register	Table X
11.	Proforma of Cube Test Register (ANNEXURE-XI)	Table XI
12.	Proforma for Hindrance to Work (ANNEXURE-VIII)	Table XII
13.	Proforma for Running A/c. Bill	Table XIII
14.	Format for Memorandum for Payment	Table XIV
15.	Format of Measurement Book (ANNEXURE- XX)	Table XV
16.	Format of Site Order Book (ANNEXURE- XVI)	Table XVI
17.	Format For Application by Contractor for Extension Of Time. (Annexure- VII)	Table XVII
18.	Details of Insurance Policies (ANNEXURE - XVII)	Table XVIII
19.	Prebid Query Form (Annexure XIX)	Table XIX
20.	Format Of Certificate of Payment By APMCF	Table XX
21.	Pre-Contract Integrity Pact	Annexure XVIII
22.	Guarantee Bonds Of Civil Works Format Of Guarantee To Be Executed By the Firm/ Contractor In Respect Of the Work Of Pre-Construction Anti-Termite Treatment	Annexure XXI
23.	Proforma Of Guarantee Bond for Waterproofing Treatment to Basement (Walls & Bottom Slab), Underground Reservoir, Overhead Reservoir, Terrace, Staircase Tower & Sunken Floor Of Washrooms.	Annexure XXII

Note: I) Contractor has to get the above record maintained in registers at site and to be kept securely at site.

TABLE-I

RECORD OF CEMENT RECEIVED / USED / BALANCE

S. No.	Cement in stock Bags	Cement received (Bags)	Total Cement received (Bags)	Source from which received	Description of work where cement is used	Number of cement bags consumed	Balance in stock	Signature of Contractor & APMCF
1	2	3	4	5	6	7	8	9

TABLE-II**RECORD OF PAINT / LEAD / CICO REGISTER**

Name of work :

Name of the Contractor :

Agreement No.:Date of Receipt	Source Receipt with Ref. To S.O./ Indent	Qty. Received	Progressive Total	Item of work for which issued with approx. qty. work done in case of paint only	Date of issues	Quantity issued	Qty. returned at the end of the day	Total issued	Delay Balance at hand	Contractors' initials	Site Engineers initials	Signature of APMCF
1	2	3	4	5	6	7	8	9	10	11	12	13

Register for bitumen should be maintained. The format will be similar to that for cement.

TABLE-III

BANK FOR REINFORCEMENT BARS RECEIVED (In KGS.)

Truck No.	Challan No.	Name of Supplier	Binding Wire	6mm dia.	8mm dia.	12m m dia.	16mm dia.	20m m dia.	25mm dia.	Total Received
1	2	3	4	5	6	7	8	9	10	11

Number of diameters given is only illustrative. Open more columns for other diameters wherever needed.

TABLE-IV

FORMAT OF RECEIPT OF MATERIALS AT SITE

Sr. No.	Description	Opening balance	Receipt during month	Consumption during month	Closing balance	Total Quantity received till date
1	Cement (M.T.)					
2	Mild steel (M.T.)					
3	Tor steel (M.T.)					
4	Coarse aggregate (cu.mt.)					
5	Fine aggregate (cu.mt.)					
6	Teak wood (cu.mt.)					
7	Bricks (Nos.)					
8	Tiles (Nos.)					

Sr. No.	Description of work	Date of Commencement	Due date of completion	Percentage progress achieved
1	General building work			
2	Security equipment work			
3	Pest control treatment work			
4	Sanitary & Plumbing work			
5	Electrical work			
	Fire Fighting Works			
7	Other work			

TABLE-V

FORMAT OF MONTHLY PROGRESS REPORT (Annexure X)

Name of work:

Progress report for the month:

Report No.:

Sr No.	Description	Approximate quantity executed (Till Previous Month)	Details of work location where work is done	Approximate quantity executed (Current Month)	Total Quantity Executed
A.	GENERAL BUILDING WORK:				
1	Foundation work				
2	Reinforcement fabrication				
3	Shuttering work				
4	Reinforced cement concrete				
5	Masonry work				
6	Wood work				
7	Plastering work				
8	Flooring work				
9	Glazing work				
10	Roof treatment work				
11	Painting work				
B.	Pest control treatment				
C.	Security equipment work				
D.	Sanitary and plumbing work:				
1	Water supply				
2	Drainage work				
3	Fitting and fixtures				
E.	Electrical installation work				
F.	Fire Fighting Works				
G.	OTHER TRADES				

TABLE-VI

FOR BULKAGE TEST OF SAND REGISTER

Sr. No.	Date of Test	Volume of dust sand in Cylinder inundated & stirred	Volume inundated Sand in Cylinder	Percentage of Bulkage	Signature of Site Engineer	Signature of Contractor	Initial of APMCF
1	2	3	4	5	6	7	8

TABLE-VII

PROFORMA OF SILT TEST REGISTER

Sr. No.	Date of Test	Height of Sand in Cylinder inundated & stirred	Height of Silt	Max percentage of silt as specified	Percentage of silt obtained	Signature of Site Engineer	Signature of Contractor	Initial of APMCF
1	2	3	4	5	6	7	8	9

TABLE-VIII

PROFORMA SIEVE ANALYSIS OF FINE AGGREGATE REGISTER

Sr.No	Date of Test	Wt. of Material to be tested	Sieve as per I.S. designation	Wt. of Sand retained in sieve	% retained in each sieve successively	Cumulative % retained in each sieve	F.M.	Signature of Site Engineer	Signature of Contractor	Signature of APMCF

TABLE-IX

PROFORMA OF SIEVE ANALYSIS OF COARSE AGGREGATE REGISTER

S. No.	Date of Testing	Wt. of Material to be tested	Nominal size of Aggregate	I.S. Sieve designation	Standard passing for graded aggregate. of nominal size	Test Result	Obtained passing	Signature of Site Engineer	Signature of Contractor	Signature of APMCF
1	2	3	4	5	6	7	8	9	10	11

TABLE-X

PROFORMA FOR SLUMP TEST REGISTER

Sr. No.	Date of Testing	Type of work for which slump taken	Specified slump		Slump Obtained		Signature of Site Engineer	Signature of Contractor	Signature of APMCF
			When Vibrators are used	When Vibrators are not used	When Vibrators are used	When Vibrators are not used			
1	2	3	4	5	6	7	8	9	10

TABLE-XI

ANNEXURE-XI

PROFORMA OF CUBE TEST REGISTER

Sr. No.	Date of Casting	Identification Mark & Location in which the representative concrete is placed	Mix Proportion	Date of Testing	Crushing Strength as on Date of Test	Crushing Strength at 28 Days	Average Crushing Strength at 28 Days	Remarks	Signature of Site Engineer
1	2	3	4	5	6	7	8	9	10

**TABLE-XII
ANNEXURE-VIII.**

PROFORMA FOR HINDRANCE TO WORK

Name of Work : Date of Start of work:
 Name of Contractor : Period of Completion :
 Agreement No. : Dt. of Completion of work :

S.No.	Nature of Hindrance	Date of Occurrence of Hindrance	Date of which Hindrance was removed	Period of which Hindrance	Signature of Site Engineer/ Engineer	Remarks
1	2	3	4	5	6	7

TABLE XIII

PROFORMA FOR RUNNING A/C BILL

- i. Name of Contractor / Agency :
- ii. Name of Work :
- iii. Sl.No. of this Bill :
- iv. No. & Date of previous Bill :
- v. Reference to Agreement No. :
- vi. Date of Written order to commence :
- vii. Date of Completion as per Agreement :

S.No.	Item Description	Unit	Rate (Rs.)	As per Tender	
				Quantity	Amount (Rs.)
1	2	3	4	5	

Up to Previous R.A. Bill		Up to Date (Gross		Present Bill		Remarks
Quantity	Amount (Rs.)	Quantity	Amount (Rs.)	Quantity	Amount (Rs.)	
6		7		8		9

Note: 1. If part rate is allowed for any items, it should be indicated with reasons for allowing such a rate. _____

 Net Value since previous bill

2. If ad-hoc payment is made, it should be mentioned specifically.

CERTIFICATE

The measurements on the basis of which the above entries for the Running Bill No. -----
----- were made have been taken jointly on ----- and are recorded at
pages ----- to ----- of measurement book No. -----
-----.

Signature and date of Contractor	Signature and date of Architects Representative (Seal)	Signature and date of Site Engineer
-------------------------------------	--	--

The work recorded in the above-mentioned measurements has been done at the site
satisfactorily as per tender drawings, conditions and specifications.

----- Signature & Date of Architect	----- Signature & Date of Site Engineer	----- Signature & Date of Bank's Engineer
---	---	---

TABLE - XIV

MEMORANDUM/CERTIFICATE FOR PAYMENT

R/A BILL NO.

1.	Total value of work done since previous bill (A)	Rs. -----
2.	Total amount of secured advance due since Previous Bill (B)	Rs. -----
3.	Total amount due since Previous Bill (C) (A+B)	Rs. -----
4.	PVA on account of declaration in price of Steel, Cement and other materials and labour as detailed in separate statements enclosed.	Rs. -----
5.	Total amount due to the Contractor	Rs. -----
	<u>OBJECTIONS:</u>	
i)	Secured Advance paid in the previous R/A	Rs. -----
ii)	Retention money on value of works as per accepted tenders up to date amount Rs.	Rs. -----
	Less already recovered	Rs. -----
	Balance to be recovered	Rs. -----
iii)	Mobilization Advance, if any	
(a)	Outstanding amount (principal + interest) as on date	Rs. -----
(b)	To be recovered in this bill	Rs. -----
iii.	Any other Departmental materials cost to be recovered as per contract, if any	Rs. -----

iv.	Any other Departmental service charges to be recovered if any, as per contract (water, power etc.) enclosed statement.	Rs. -----
	Total Deduction as per contract (F)	Rs. -----
	Adjustments, if any ----- Amount less received by Contractor in ----- --- R/A Bill (as per statement of Contractor)	Rs. -----
	P.V.A.	Rs. -----
	Total amount payable as per contract (E+F+G)	Rs. -----
	(Rupees ----- in words)	

The bill amount to Rs. ----- (both figures and words) has been scrutinized by us after due checking of the measurements of work as required and is recommended for payment.

Date: -----

Signature of Architect with Seal

The bill amount to Rs. ----- certified by consultants has been scrutinized by me after due test checking of measurements of works as required and is recommended for payment for an amount of Rs.....

Date : -----

Signature of SBI Engineer

<u>STATUTORY DEDUCTION:</u>		
i)	Total Amount due (E)	Rs. -----
ii)	Less I.T. Payable	Rs. -----
iii)	Less S.T. Payable	Rs. -----
	Net Payable	Rs. -----

These figures given in the Memorandum for payment has been verified and bill passed for payment
 ----- (in words and figures)

Date: -----

 Signature of the Premises Officer

Table XV

FORMAT OF MEASUREMENT BOOK (ANNEXURE- XX)

MEASUREMENT BOOK

Item No.	Description	Unit	No	Length (L)	Breadth /Width (B)	Depth/H eight (H)	Quantity	Remarks

Site Engineer
Contractor

Architect

(Head of Architect Consultant)

Checking/Test checking Engineer

Date of checking/Test checking

Table XVI

FORMAT OF SITE ORDER BOOK (ANNEXURE- XVI)

Name of the work_____

Date of Commencement_____

Sr. No	Remarks/ Instructions of the site Engineer/ Architect	Dated Initials of site Engineer/ Architect	Initials of the Contractor for having received the instructions	Action taken with date	Dated initials of the site Engineer	Remarks of the Architects APMCF/SBI Officials
1	2	3	4	5	6	7

Table XVII

Format for Application by Contractor For Extension Of Time (Annexure- VII)

1.	Name of the Contractor				
2.	Name of the work as given in the Agreement				
3.	Agreement WO				
4.	Tender amount				
5.	Date of commencement of work				
6.	Period allowed for completion as per agreement				
7.	Date of completion as per agreement				
8.	Period for which extension of time has been given				
			<u>Date</u>	<u>Month</u>	<u>Year</u>
	a)	1st extension vide Bank's Letter No.			
	b)	2nd extension vide Bank's Letter No.			
	c)	3rd extension vide Bank's Letter No.			
9.	Reasons for which extensions have been previously given (copies of the previous applications should be attached)				
10.	Period for which extension is applied for and the reasons thereof including hindrances, time for extra work assigned, if any etc.				

Signature of Contractor

Recommendation of Architects

Signature of Architect

Table XVIII

DETAILS OF INSURANCE POLICIES (ANNEXURE - XVII)

Type of policies	Name of Insurance	Amount Rs.	Policy No.	Validity
CAR policy including 3rd party liability				
Workmen's Compensation				
Any other Policy				

Remarks :

1. This is only an 'on-account' payment and is not to be interpreted either as approval of work, materials brought or affixed at site or for that matter with approval of any sort.
2. The quantum of work done and materials delivered at site have been certified by.....
3. Should you wish to audit such work, kindly contact the undersigned and obliged.

APMCF/Architects

Table XIX

Annexure XIX

Prebid Query Form

Vendor name	Sr. No	Tender Page No	Tender Clause No	Existing Clause	Query Suggestion

TABLE: -XX

FORMAT OF CERTIFICATE OF PAYMENT BY APMCF

Certificate No. Interim /	Dated	
Client	Project No.	Building work / Interior work
	Particulars:	
Contractor:	Contract / Letter No.	Dated:
	Contractor's Bill No.	Dated:

This is to certify that the amount given below (*) is due to your Contractors for the work done by them and/or against materials delivered at site and/or for advance towards contract on the above-mentioned project.

Advance against contract Rs _____

Less: Advance adjusted to-date Rs. _____

Balance Advance Rs. _____

Advance against material delivered at site Rs. _____

Amount of work done to-date Rs _____

Total Rs _____

Less: Retention on work done Rs _____

Less: Previously certified up to Rs _____

PRESENT CERTIFICATE (*) Rs. _____

RUPEES.....

The cost of cement or any other material supplied by you or payments made by you directly, if any and not covered herein above, should be adjusted before making the payment of the certified amount (*). Necessary Deduction U/S194C of the income Tax 1961 and sales tax may be made before paying the above certified amount. With a copy of this letter, we are intimating the Contractors to call on you for the necessary payment.

Remarks if any : The details of Insurance policy are given in the next page.

Signature of APMCFs

Enclosures: Bill

23.0 PRE-CONTRACT INTEGRITY PACT

State Bank of India hereinafter referred to as “The Principal” And hereinafter referred to as “The Bidder / Contractor”

Preamble

The Principal intends to award, under laid down organizational procedures, contract/s for -----The Principal values full compliance with all relevant laws of the land, rules, regulations, economic use of resources and of fairness/transparency in its relations with its Bidder(s) and /or Contractor(s). In order to achieve these goals, the Principal will appoint an Independent External Monitor (IEM), who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

Section 1- Commitments of the Principal.

1. The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles: -

a. No employee of the principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

b. The principal will during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential/additional information through which the Bidder(s) could obtain an advantage in relation to the process or the contract execution.

c. The Principal will exclude from the process all known prejudiced persons.

2. If the Principal obtains information on the conduct of any of its employees which is a criminal offence under the IPC/PC Act, or it there be a substantive suspicion in this regard, the principal will inform the Chief Vigilance Officer and in addition can initiate disciplinary actions.

Section 2 “Commitments of the Bidder(s)/ Contractor(s)

1. The Bidder(s)/Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.

a. The Bidder(s) / contractor(s) will not, directly or through any other persons or firm, offer promise or give to any of the Principal employees involved in the tender process or the execution of the contract or to any third person any material or other benefit which

he/she is not legally entitled to, in order to obtain in exchange any advantage or during the execution of the contract.

The Bidder(s)/Contractor(s) will not enter with other Bidders into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.

c. The Bidder(s)/Contractor(s) will not commit any offense under the relevant IPC/PC Act; further the Bidder(s) /Contractors will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

d. The Bidder(s)/Contractor(s) of foreign origin shall disclose the name and address of the Agents/representatives in India, if any. Similarly, the bidder(s)/contractor(s) of Indian Nationality shall furnish the name and address of the foreign principals, if any. Further details as mentioned in the "Guidelines on Indian Agents of Foreign Suppliers" shall be disclosed by the Bidder(s)/Contractor(s). Further, as mentioned in the Guidelines all the payments made to the Indian agent/representative have to be in Indian Rupees only. Copy of the "Guidelines on Indian Agents of Foreign Suppliers as annexed and marked as Annexure.

e. The Bidder(s)/Contractor(s) will, when presenting his bid, disclose any and all payments he has made, is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.

2. The Bidder(s)/Contractor(s) will not instigate third persons to commit offenses outlined above or be an accessory to such offenses.

Section 3: Disqualification from tender process and exclusion from future contracts
If the Bidder(s)/Contractor(s), before award or during execution has committed a transgression through a violation of Section 2, above or in any other form such as to put his reliability or credibility in question, the Principal is entitled to disqualify the Bidder(s)/Contractor(s) from the tender process or take action as per the procedure mentioned in the "Guidelines on Banning of business dealings. Copy of the Guidelines on Banning of business dealings"i.

Section 4 : Compensation for Damages

1. If the Principal has disqualified the Bidder(s) from the tender process prior to the award according to Section 3, the principal is entitled to demand and recover the damages equivalent to Earnest Money Deposit/Bid Security.

2. If the Principal has terminated the contract according to Section 3, or if the principal is entitled to terminate the contract according to Section 3, the Principal shall be entitled to demand and recover from the Contractor liquidated damages of the Contract value or the

amount equivalent to Performance Bank Guarantee.

Section 5 : Previous Transgression

1. The Bidder declares that no previous transgressions occurred in the last three years with any other company in any country conforming to the anti-corruption approach or with any other public sector enterprise in India that could justify his exclusion from the tender process
2. If the bidder makes incorrect statement on this subject, he can be disqualified from the tender process for action can be taken as per the procedure mentioned in "Guidelines on Banning of business dealings".

Section 6: Equal treatment of all Bidders/Contractors/Subcontractors.

1. The Bidder(s)/Contractor(s) undertake(s) to demand from all subcontractors a commitment in conformity with this Integrity Pact, and to submit it to the principal before signing the contract.
2. The principal will enter into agreements with identical conditions as this one with all bidders, contractors, and subcontractors.
3. The principal will disqualify from the tender process all bidders who do not sign this Pact or violate its provisions.

Section 7: Criminal charges against violation Bidder(s)/Contractor(s)/Subcontractor(s)

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or subcontractor which constitutes corruption, or if the principal has substantive suspicion in this regard, the principal will inform the same to the Chief Vigilance Officer.

Section 8: Independent External Monitor/Monitors

- (1) The principal appoints competent and credible Independent External Monitor for this Pact. The task of the Monitor is to review independently and objectively whether and to what extent the parties comply with the obligations under this agreement.
- (2) The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the Chairman, SBI.
- (3) The Bidder(s)/Contractor(s) accepts that the Monitor has the right to access without restriction to all project documentation of the principal including that provided by the Contractor. The Contractor will also grant the Monitor, upon his request, and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractors. The Monitor is under contractual obligation to treat the information and documents of the

Bidder(s)/Contractor(s)/ Subcontractor(s) with confidentiality.

(4) The principal will provide the Monitor with sufficient information about all meetings among the parties related to the Project provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.

(5) As soon as the Monitor notices, or believes to notice, a violation of this agreement, he will so inform the Management of the Principal and request the Management to discontinue or take corrective action, or to take other relevant action. The monitor can in this regard submit non-binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action.

(6) The Monitor will submit a written report to the Chairman, SBI within 8 to 10 weeks from the date of reference or intimation to him by the principal and, should the occasion arise, submit proposals for correcting problematic situations.

(7) Monitor shall be entitled to compensate on the same terms as being extended to / provided to Independent Directors on the SBI Board.

(8) If the Monitor has reported to the Chairman SBI, a substantiated suspicion of an offense under relevant IPC/PC Act, and the Chairman SBI has not, within the reasonable time taken visible action to proceed against such offense or reported it to the Chief Vigilance Officer, the Monitor may also transmit this information directly to the Central Vigilance Commissioner.

(9) The word Monitor" would include both singular and plural.

Section 9 – Pact Duration

This pact begins when both parties have legally signed it. It expires for the Contractor 10 months after the last payment under the contract, and for all other Bidders & months ---- the contract has been awarded. If any claim is made / lodged during this time, the same shall be binding and continue to be valid despite the lapse of this pact as specified above, unless it is discharged / determined by Chairman of SBI.

Section 10 - Other provisions

This agreement is subject to Indian Law, Place of performance and jurisdiction is the Registered Office of the Principal, i.e. Premises & Estate Department, 2nd Floor, Local Head Office, Plot No-53a, SBI Tower, Gift City, Gandhinagar – 382355

Changes and supplements as well as termination notices need to be made in writing. Side agreements have not been made.

If the Contractor is a partnership or a consortium, this agreement must be signed by all partners or consortium members.

Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

For & on behalf of the principal
Office Seal

For & On behalf of Bidder/ Contractor
(Office Seal)

Place -----

Date -----

Witness 1: (Name & Address) _____

Witness 2: (Name & Address) _____

Annexure- XXI

24.0 FORMAT OF GUARANTEE TO BE EXECUTED BY THE FIRM/ CONTRACTOR IN RESPECT OF THE WORK OF PRE-CONSTRUCTION ANTI-TERMITE TREATMENT

(On non-judicial Stamp Paper of Rs. 500/- or as per latest Govt. Rules)

The agreement made this Day of_____ Two Thousand_____ between Assistant General Manager, Premises & Estate Department, 2nd Floor, Local Head Office, Plot No-53a, SBI Tower, Gift City, Gandhinagar – 382355 of one part and_____ (Name of the Firm/ Contractor (hereinafter called the Guarantor) of the other part.

WHEREAS THIS AGREEMENT is supplementary to the Contract (hereinafter called the Contract dated made between the Employer of the one part and the Guarantor of the part) whereby the Firm/Contractor interlaid undertook to render the building/ structure completely free of any infestation of termites, and whereas the Guarantors agreed to give guarantee to the effect that the said building/ structure shall remain free from infestation for the period of 10 years from the date of Completion of pre-construction anti-termite treatment as per IS Code.

Now the Guarantor hereby agrees to make good all defects and render the building/ structure free from any infestation of termites, during this period of guarantee and to the satisfaction of the employer. The Guarantor also agrees to take up such rectification work at his own cost, and within one week from the date of issue of notice from the Employer, calling upon him to rectify the defects.

The decision of the Employer as to the cost by the Guarantor will be final and binding in the case, the Guarantor fails to commence the work as per the above notice and the work is got done through the other Contractor, that if the Guarantor fails to execute the preconstruction anti-termite treatment or commits breach thereunder then the Guarantor will indemnify the principal and his successors against all loss, damaged caused, expenses otherwise which may be incurred by him by any reason of any default on the part of the Guarantor in performance and observance of this agreement, as to the amount of loss and /or damage and / or cost incurred by the Employer, the decision of the Employer will be final and binding. In witness where of these presents have executed by the obligator and by and for of behalf of the Employer on the day, month and year first above written,

Signed
and delivered by State Bank of India, by
In the presence of

Signed and delivered by the hands of Contractor
In presence of

Annexure- XXII

25.0 PROFORMA OF GUARANTEE BOND FOR WATERPROOFING TREATMENT TO BASEMENT (WALLS & BOTTOM SLAB), UNDERGROUND RESERVOIR, OVERHEAD RESERVOIR, TERRACE, STAIRCASE TOWER & SUNKEN FLOOR OF WASHROOMS.

(On non-judicial Stamp Paper of Rs. 500/- or as per latest Govt. Rules)

FORM OF GUARANTEE IN RESPECT OF WATER PROOFING WORKS The Agreement made this day oftwo thousand and seventeen between (Hereinafter called the Guarantor of the one part) and the Asst. General Manager, Premises & Estate Department, Local Head Office, Premises & Estate Dept., GIFT City, Gandhinagar, Gujarat-382355 (hereinafter called the other part.)

WHEREAS THIS agreement is supplementary to a contract (hereinafter called the Contract), dated and made between the GUARANTOR OF THE ONE part and STATE BANK OF INDIA other part, whereby the Contractor, inter alia, undertook to render the buildings and structures in the said contract recited completely water and leak-proof.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the effect that the said structures will remain water and leak-proof for 10 years from the date giving of water proofing treatment.

NOW THE GUARANTOR hereby guarantees that water proofing treatment given by him will render the structure completely leak-proof and the minimum life of such water proofing treatment shall be 10 years to be reckoned from the date after the maintenance period prescribed in the contract.

Provided that the guarantor will not be responsible for leakage caused by earthquake or structural defects or misuse of roof or alteration and for such purpose.

- (a) Misuse of roof and other waterproofed surface shall mean any operation which will damage proofing treatment, like chopping of firewood and things of the same nature which might cause damage to the waterproof surface.
- (b) Alteration shall mean construction of any additional work by removing the water proofing treatment in parts.
- (c) The decision of the SBI/APMCF with regard to cause of leakage shall be final.

During this period of guarantee, the guarantor shall make good all defects and in case of any defect being found render the building water proof to the satisfaction of the Architect/ PMC at his cost and shall commence the work for such rectification within seven days from the date of issue of the notice from the SBI/APMCF calling upon him to rectify the defects failing which the work shall be got done by the owner by some other Contractor at the GUARANTOR's cost and risk. The decision of the SBI/APMCF as to the cost, payable by the Guarantor, shall be final and binding.

That if Guarantor fails to execute the water proofing or commits breach there under, then the Guarantor will indemnify the Principal and his successors against al lose, damage, cost expense or otherwise which may be incurred by him by reason of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement As to the amount of loss and/or cost incurred by the Owner the decision of the Architect/PMC will be final and binding on the parties.

IN WITNESS WHEREOF these presents have been executed by the obligor and by And for and on behalf of the Asst. General Manager, Premises and Estate Department, Premises & Estate Dept., Local Head Office, GIFT City Gandhinagar, Gujarat-382355, on the day, month and year first above written.

SIGNED, SEALED AND delivered by OBLIGOR in the presence of ----

h)

i)

SIGNED FOR AND ON BEHALF OF THE STATE BANK OF INDIA BY In the presence of ----

1.

2.

26.0 MATERIAL TEST LIST & TESTING FREQUENCY CHART

A chart showing the recommended time and quantity scheduled for conducting test on various building materials is given. Please ensure that tests are carried out according to the above guidelines. Contractor's rate should include for necessary expenditure for testing including transport of samples of following tests.

Sr. No	Material	Test	Frequency of Testing	Applicable IS Code
1	Cement	Fineness, Consistency, Setting Time, Compressive Strength, Soundness	One test for every 50 MT or part thereof	IS 4031, IS 269, IS 12269
2	Sand (Fine Aggregate)	Sieve Analysis, Silt Content, Bulking, Specific Gravity	One test per 100 cum or change of source	IS 2386
3	Aggregates (Coarse)	Sieve Analysis, Water Absorption, Specific Gravity, Impact Value, Crushing Value, Flakiness/Elongation Index	One test per 100 cum or change of source	IS 2386, IS 383
4	Concrete	Slump Test, Cube Compressive Strength (7 & 28 days)	Slump – every 20 cum / each shift; 3 cubes per 30 cum	IS 1199, IS 516
5	Design Mix Concrete	Mix Proportioning, Trial Mix, Workability, Strength	Initial design mix; field verification whenever source changes	IS 10262, IS 456
6	Reinforcement Steel	Tensile Strength, Bend & Re-bend Test	One test per 25 MT or part thereof per lot	IS 1786
7	Structural Steel	Tensile Strength, Yield Stress, Elongation	One test per 40 MT or part thereof per lot	IS 2062
8	AAC Blocks	Compressive Strength, Dry Density, Water Absorption	Once per 50,000 blocks or change of source	IS 2185 (Part 3)
9	Natural Stone	Water Absorption, Compressive Strength, Flexural Strength	Once per 1000 sqm of flooring/cladding or change of source	IS 1124, IS 1121, IS 1706
10	Ceramic Tiles	Dimensions, Water Absorption, Modulus of Rupture, Breaking Strength	Once per 2000 sqm or change of source	IS 13755, IS 13630
11	Vitrified Tiles	Water Absorption, Modulus of Rupture, Surface Quality, Dimensions	Once per 2000 sqm or change of source	IS 15622
12	Teak Wood (Timber)	Moisture Content, Density, Visual Grading	One test per 10 cum or change of source	IS 287, IS 1708
13	Flush Door Shutter	Dimensions, Squareness, End Immersion, Knife Test, Flexural Strength	One test per 100 doors or change of source	IS 2202

14	Earth Filling / Compaction	Moisture Content (OMC), Field Density Test, Proctor Test	One test per 500 sqm or 500 cum; Proctor test for each soil type	IS 2720, IS 10379
15	Paving Blocks	Compressive Strength, Water Absorption, Abrasion Resistance, Dimensions	One test per 5000 blocks or part thereof	IS 15658
16	Plum Concrete	Proportion check, Workability, Cube strength of PCC mix	As per PCC frequency (3 cubes per 30 cum); random checks	IS 456
17	Red Earth / Soil for Landscaping	Silt Content, pH Value, Organic Matter	One test per 500 cum or change of source	Horticulture norms
18	Shrubs / Plants	Survival Rate, Height & Bag Size	100% visual inspection; 6 months survival guarantee	Horticulture norms
19	Water	pH, Chloride, Sulphate, Organic matter	One test for each new source, then once every 3 months	IS 3025, IS 456
20	Bricks	Compressive Strength, Water Absorption, Efflorescence, Dimensions	One test per 20,000 bricks or part thereof	IS 3495, IS 1077, IS 12894
21	Mortar	Workability, Compressive Strength	One set of cubes per 50 cum of mortar	IS 2250
22	Admixtures	Compatibility with cement, Setting time, Compressive Strength	One test per batch or change of source	IS 9103
23	Waterproofing Membranes	Thickness, Tensile Strength, Tear Resistance, Water Absorption	One test per 5000 sqm or change of source	ASTM D5147, IS 1346
24	Bitumen	Penetration, Softening Point, Ductility, Specific Gravity	One test per 20 MT or change of source	IS 1201-1220, IS 73
25	Bituminous Mix	Marshal Stability, Flow Value, Gradation	One test per 400 sqm of road laid	MoRTH Specs, IS 1201-1220
26	Structural Glazing	Glass Thickness, Toughening, Sealant Adhesion	One test per 500 sqm of glazing or per lot	ASTM C1184, IS 2553
27	Paints & Coatings	Dry Film Thickness, Adhesion, Shade/Gloss	Random per 500 sqm or per lot	IS 2395, IS 101
28	Fire Doors	Dimensions, Fire Resistance Test, Smoke Leakage Test, Hardware Performance	One test per 100 doors or per batch / change of source	IS 3614, IS 16933, NBC 2016
29	Aluminum Sections	Chemical Composition, Mechanical Properties, Dimensional Tolerance	One test per 5 MT or change of source	IS 733, IS 1285
30	Toughened Glass	Thickness, Fragmentation Test, Impact Resistance,	One test per 500 sqm or change of source	IS 2553 (Part 1), IS 2835

		Strength		
31	Laminates (Decorative / Industrial)	Dimensions, Thickness, Appearance, Abrasion Resistance, Scratch Resistance, Water Absorption	One test per 200 sheets or change of source	IS 2046, IS 1328
32	Aluminum Composite Panel (ACP Sheet)	Thickness, Peel Bond Strength, Coating Adhesion (PVDF/Lumiflon), Flexural Strength, Fire Performance (FR grade)	One test per 500 sqm or change of source	ASTM D1781, IS 15986
33	Diaphragm Wall – Verticality	Koden Test (Verticality and Continuity)	At least one test per panel / as directed by Engineer	IS 9556, Project Specs
34	Diaphragm Wall – Integrity	Cross Hole Sonic Logging (CSL), Low Strain Integrity Test	As per project specification – generally one CSL per panel	ASTM D6760, IS Code (Project based)

27.0 Detailed Technical Specifications of Civil Works**SECTION – A: EARTH WORK****Excavation in all kinds of soil, including soft murum, hard murum, soft rock.****Item No 1- i & ii****i. Applicable Standards:**

Excavation works shall conform to IS 1200 (Part 1 – Method of measurement of earthwork), IS 3764 (Safety code for excavation work), IS 2720 (Soil testing methods), IS 4081 (Safety code for blasting and related drilling operations, where applicable), and CPWD Specifications (Earthwork).

ii. Scope of Work:

The scope includes excavation in all kinds of soil such as soft murum, hard murum, and soft rock, whether in wet, dry, loose, or slushy conditions, to the required depth, width, and levels as shown on drawings or as directed by the Engineer-in-Charge (SBI/APMCF). The work shall include clearing site vegetation, shrubs, tree roots, and other organic material prior to excavation.

iii. Execution and Method of Work:

Excavation shall be carried out using mechanical means (hydraulic excavators such as poclain, JCB, dozers, rock breakers) or manual means, as required. Depth and dimensions shall be true to lines, levels, and grades specified in drawings. Excavated material suitable for backfilling shall be stacked separately, while surplus or unsuitable material shall be carted away and disposed of at approved locations outside the site, as directed by SBI/APMCF/GIFT City/Municipal authorities, at no extra cost. Temporary measures such as stepping, sloping, trimming, dressing of sides, and grading shall be carried out to ensure stability of excavated faces. Where necessary, chiseling, wedging, or other approved methods shall be adopted for removal of hard strata.

iv. Dewatering and Safety Measures:

Where excavation is below water table or in wet/slushy conditions, adequate pumping and bailing out of water shall be done using dewatering pumps of sufficient capacity to always maintain a dry working condition. Suitable shoring, strutting, timbering, or other protective measures shall be adopted to ensure safety and prevent collapse of excavation sides. Sprinkling of water shall be carried out as required for dust control and compaction. Safety precautions as per IS 3764 shall be strictly followed.

v. Disposal and Backfilling:

Surplus excavated material shall be disposed of outside the premises at locations approved by the Engineer-in-Charge at any lead distance also includes levelling of the same. Suitable excavated material shall be reused for backfilling, in layers not exceeding 200 mm thickness, watered, compacted, and consolidated as directed. Loose pockets in excavation shall be removed and replaced with compacted backfill to achieve proper stability.

vi. Classification of Depths:

The excavation shall be measured and paid under the following categories:

- From 0 to 6 m depth below ground level.
- From 6 to 18 m depth below ground level.

vii. Measurement:

Excavation shall be measured in cubic meters (Cu m) of the volume excavated to the dimensions shown in the drawings or as directed. Measurement shall be inclusive of side slopes, working space, and dewatering operations, but payment shall be restricted only to the excavation volume within the plot area. No extra payment shall be made for disposal, trimming, shoring, sloping, or working space.

viii. Rate Inclusions:

The rate for excavation shall include:

- Clearing site of vegetation, shrubs, and roots.
- Excavation in soil/soft rock by mechanical or manual means.
- Stacking suitable material for backfilling.
- Disposal of surplus material outside the site at any lead distance also includes levelling of the same.
- Bailing/pumping out water with dewatering pumps as required.
- Temporary stepping, sloping, trimming, dressing, and grading.
- Safety measures include strutting, shoring, and barriers.
- Sprinkling of water for dust control and compaction.
- Making good of loose pockets with compacted backfill.
- All labour, tools, equipment, fuel, transport, and incidental work are complete.

Item No 1- ii**i. Applicable Standards:**

Excavation in hard rock or old foundations shall conform to IS 1200 (Part 1 – Method of measurement of earthwork), IS 3764 (Safety code for excavation work), IS 4081 (Safety code for blasting and drilling operations, where permitted), IS 2720 (Soil and rock testing methods), and relevant CPWD Specifications for earthwork and demolition.

ii. Scope of Work:

The scope includes excavation in all types of hard rock, boulders, or dismantling of old foundations, by mechanical means (hydraulic excavator, rock breaker) or by manual means using chisels, hammers, and other suitable tools, to any depth, height, or lift as required for foundations, trenches, pits, or other works. The scope also includes removal and safe disposal of

all excavated rock/debris from site as directed by SBI/APMCF, at no extra cost.

iii. Method of Excavation:

Excavation in hard rock shall be executed by chiseling, wedging, mechanical rock breaking, or hydraulic rock breaker mounted on excavator. Blasting shall not be permitted unless specifically approved in writing by the Engineer-in-Charge and local authorities. Old foundations shall be dismantled carefully to avoid damage to adjoining structures. Excavated rock shall be broken down to manageable sizes before removal.

iv. Dewatering and Safety Provisions:

Where excavation is carried out below the water table or in wet conditions, continuous pumping and bailing shall be done using suitable dewatering pumps of required capacity to maintain a dry and safe working environment. Proper temporary stepping, sloping, trimming, dressing of sides, and necessary shoring/strutting shall be provided to prevent collapse or sliding of rock or adjoining soil strata. All works shall strictly follow IS 3764 and applicable safety codes.

v. Cleaning and Finishing of Excavation:

The excavation shall be carried out true to line, level, and dimensions as per drawings. The bottom of the excavation shall be leveled, trimmed, and dressed neatly, ensuring firm and sound strata for foundation bearing. All loose rock pieces, debris, and fractured material shall be removed completely. The sides shall be trimmed vertically or stepped, as directed, to ensure stability.

vi. Disposal of Excavated Rock/Material:

All surplus or unsuitable rock/debris shall be carted away and disposed of outside the project premises at locations approved by municipal authorities, without causing any environmental hazard or obstruction. Usable rubble or stone, if directed, shall be stacked separately for reuse.

vii. Rate Inclusions:

The quoted rate shall be inclusive of:

- Excavation in hard rock or old foundation using approved mechanical/manual means.
- Chiseling, wedging, or rock breaking by mechanical breaker.
- Stacking of useful material, and disposal of surplus/debris off-site.
- Bailing/pumping of water with dewatering pumps.
- Provision of sloping, stepping, trimming, and shoring as required.
- Sprinkling of water for dust suppression.
- All labour, tools, plants, fuel, scaffolding, transport, and incidentals to complete the work.

viii. Mode of Measurement:

Excavation in hard rock or dismantling of old foundation shall be measured in cubic metres (Cu m) of volume excavated, based on drawings and as directed by the Engineer-in-Charge. No separate measurements shall be made for lifts, dewatering, disposal, breaking, trimming, or

working space, as these are deemed included in the quoted rate.

Item No -3 Close timbering over areas including strutting, shoring and packing cavities

i. Applicable Standards:

The work shall conform to IS 3764 (Safety code for excavation work), IS 4081 (Safety code for blasting and related operations, if applicable), CPWD Specifications (Earthwork and Timbering), and relevant provisions of IS 1200 (Part I – Earthwork measurement).

ii. Scope of Work:

The scope covers providing and fixing close timbering in trenches, pits, shafts, or other excavations in all kinds of soil to prevent collapse of sides and ensure safety during excavation and construction. The work includes strutting, shoring, sheeting, and packing cavities where required, complete as directed by the Engineer-in-Charge.

iii. Materials:

Timber planks (laggings) shall be of approved quality hardwood/softwood, well-seasoned, free from sapwood, cracks, splits, or insect damage. Struts, walers, and runners shall be of sufficient size and strength to resist earth pressure. Steel sections or hydraulic jacks may be permitted in place of timber, subject to approval. All materials shall conform to IS 4021 (Timber for general building construction) and IS 4990 (Plywood shuttering boards) where applicable.

iv. Method of Timbering:

Close timbering shall consist of placing timber sheeting planks vertically or horizontally in close contact against the face of the excavation, supported by walers and strutted at suitable intervals. Packing of cavities behind sheeting shall be done with wedges or earth to ensure tight contact. Strutting and shoring shall be tightened progressively as excavation proceeds to prevent slips or collapse. Additional supports should be provided in wet or loose soils.

v. Safety and Stability:

All timbering works shall be carried out strictly in accordance with IS 3764 safety code. Care shall be taken to ensure that the excavation remains stable and safe for workers. Struts shall be tightened regularly to take up pressure due to settlement or shrinkage. In saturated or running soil conditions, additional sheeting and bracing shall be provided.

vi. Removal of Timbering:

Timbering shall be removed gradually after completion of permanent construction, ensuring no damage to the completed work or collapse of the excavation sides. Voids created by withdrawal of timber shall be filled with sand, lean concrete, or approved material, compacted in layers.

vii. Measurement:

Measurement shall be taken of the **face area timbered**, in square metres (Sq m), based on the actual surface of excavation timbered. No separate measurement shall be made for struts, walers, wedges, or packing cavities.

viii. Rate Inclusions:

The rate shall include cost of all timber, struts, walers, wedges, nails, and accessories; labour for fixing, tightening, maintaining, and removing timbering; packing cavities with earth/sand; filling voids after removal; tools, equipment, scaffolding, and incidentals necessary for safe completion of the work.

Item No. 4a. - Providing, Filling and banking with outside Murum in foundations, trenches, plinths, area levelling

i. Applicable Standards:

Filling and compaction work shall conform to IS 2720 (Methods of test for soils), IS 10379 (Method for field density of soil), IS 1498 (Classification and identification of soils for general engineering purposes), IS 1200 (Part 1 – Method of measurement of earthwork), and CPWD Specifications for Earthwork and Backfilling.

ii. Materials:

Murum used for filling shall be good quality, well-graded natural murum, free from organic matter, roots, rubbish, or other deleterious materials. It shall have suitable physical properties to achieve the required compaction and stability. The material shall be brought from approved borrowed areas or quarries with valid royalty/permits as directed by SBI/APMCF.

iii. Scope of Work:

The work includes excavation, supplying, transporting, and filling murum into foundations, trenches, plinths, and for area levelling. The filling shall be done in uniform layers not exceeding 200 mm thickness, with each layer broken into clods, watered, compacted by mechanical means (roller, plate compactor, vibratory compactor) and rammed manually with wooden or steel rammers in inaccessible areas. Dressing and finishing of filled/embankment surfaces shall be carried out to the required level and gradient.

iv. Method of Execution:

Before filling begins, the area shall be cleared of all loose debris, organic material, and standing water. Excavated foundations, trenches, or plinths shall be approved by the Engineer-in-Charge prior to filling. Filling shall be done in layers; each layer being compacted to the optimum moisture content (OMC) as determined by Proctor's test. Where necessary, dewatering shall be carried out continuously during filling operations. Level benchmarks (RLs) shall be recorded before and after filing, and the difference in levels shall be multiplied by the plan area to arrive at the executed quantity.

v. Compaction and Testing:

Each layer shall be compacted using vibratory rollers or plate compactors until the specified density is achieved. The compacted murum shall meet a minimum of 95% of the Standard Proctor Density (SPD) or as specified. Field density tests (sand replacement or core cutter method as per IS 2720) shall be conducted at intervals approved by the Engineer-in-Charge. Any layer failing to meet density requirements shall be loosened, re-watered, and re-compacted until compliance is achieved.

vi. Dewatering and Safety Measures:

Where filling is carried out below groundwater level, adequate pumping and bailing of water shall

be done to maintain dry conditions. Necessary precautions such as temporary bunds, drains, or diversion of water shall be provided to ensure quality and safety of work.

vii. Measurement:

The quantity of murum filling shall be measured in **cubic meters (Cu m)** based on the difference in levels (before and after filling) multiplied by the plan area, after making necessary deductions for foundations, pits, and other openings. Measurement shall include all labour, material, transport, compaction, and testing.

viii. Rate Inclusions:

The rate shall include cost of:

- Excavation, royalty, loading, transport, and unloading of murum.
- Laying in layers, watering, breaking colds, ramming/compacting each layer.
- Bailing/pumping of water, if required.
- Use of machinery such as rollers, vibratory compactors, dumpers, and JCBs.
- Conducting field density tests including Proctor density test.
- Labour, scaffolding, tools, and incidental work to complete the item.

Item No 4b: Providing, Filling, and banking with approved quality excavated earth available on site in foundations, trenches, plinths, dumping yard area & levelling

Same as above but with approved quality excavated earth on site and also in dumping yard.

Item no- 05 Dry rubble stone soling

i. Applicable Standards:

The work shall conform to IS 1597 (Construction of stone masonry – Code of practice), IS 1200 (Method of measurement for stonework), IS 2720 (Soil compaction & testing), and CPWD Specifications for Road & Foundation Works.

ii. Materials:

Dry rubble stone soling shall be constructed using locally available hard, durable stones of size ranging from 80 mm to 150 mm, free from weathered skin, cracks, organic impurities, or other deleterious materials. Stone chips, murum, or coarse sand shall be used as filling material in voids.

iii. Preparation of Surface:

The subgrade/foundation base shall be cleared of all loose material, vegetation, or standing water and dressed to the required lines, levels, and slopes. Any soft pockets shall be excavated and replaced with suitable approved material, compacted to achieve the required bearing capacity before soling work commences.

iv. Laying of Stones:

Stones shall be laid to the specified thickness of 23 to 30 cm in horizontal courses, hand-packed, and set on their broadest ends. Larger stones shall be used at edges and corners. Stones shall be placed closely, leaving minimal interstices, and properly leveled to avoid rocking.

v. Filling of Voids and Packing:

Interstices between stones shall be tightly filled with stone chips and finer aggregates. Remaining voids shall be blinded with murum/sand and compacted with water sprinkling to achieve interlock. Where required, additional packing shall be done manually to maintain uniformity.

vi. Compaction:

After hand packing and filling of voids, the soling surface shall be compacted with a mechanical vibratory roller of 8–10 ton capacity in passes until the surface is uniformly compacted, stable, and free of settlements. Edges and inaccessible areas shall be compacted manually with rammers.

vii. Watering:

Controlled sprinkling of water shall be carried out during compaction to facilitate settlement of finer material into voids and to achieve proper bonding between soling stones and blinding material.

viii. Surface Finish:

The finished soling surface shall be true to required lines, levels, slopes, and camber as per approved drawings. Tolerance in level shall not exceed ± 10 mm.

ix. Measurement:

Measurement shall be taken in **cubic meters (Cu m)** of finished soling surface area X average depth /ht of Soling. No separate measurement shall be made for stone chips, blinding material, watering, or compaction.

x. Rate Inclusions:

The quoted rate shall include cost of all materials (stones, chips, murum/sand), labour, hand-packing, compacting, watering, equipment (rollers, rammers), transport, tools, and incidental works required for complete execution as per design and drawings, to the satisfaction of SBI/APMCF.

SECTION B – ANTI TERMITE TREATMENT**BOQ Specified****i. Applicable Standards:**

The work shall be carried out as per IS 6313 (Part II) – 1981 (Code of practice for anti-termite measures in buildings), IS 8944 – 1978 (Specifications for chlorpyriphos emulsifiable concentrate), relevant CPWD specifications, and any latest amendments thereof.

ii. Scope of Work:

The scope covers providing and applying chemical emulsion treatment to the bottom surface and sides of excavations in foundations, plinth beams, plinth filling, retaining walls, periphery, pipes, conduits, and basement areas in order to form a continuous chemical barrier against termite entry.

iii. Approved Chemicals:

The anti-termite treatment shall be carried out using ISI-marked chemicals such as:

- Chlorpyriphos 20% EC (to be diluted to 1% concentration), OR
- Imidacloprid 30.5% SC (Premise, Bayer or equivalent) at 0.075% concentration.

The make of chemicals shall be from approved manufacturers such as **PCI, Godrej, Hi-Care, Gharda Chemicals, Bayer**, or equivalent as approved by the Engineer-in-Charge.

iv. Guarantee:

The agency shall furnish a written guarantee for a minimum period of **10 years** against termite infestation, executed on a non-judicial stamp paper of requisite value, in the format approved by the Client/Bank.

v. Method of Treatment:**1. Treatment to Soil below the Raft/Foundation Base:**

The excavated surface shall be uniformly treated with chemical emulsion at the rate of **5 litres per square metre** before soling and PCC. Side walls of excavation up to the height of rafts shall also be treated. Roding shall be carried out where necessary to facilitate deep penetration of the chemical.

2. Treatment along Retaining Walls/Diaphragm Walls:

The soil in contact with retaining walls shall be treated with chemical emulsion at **5 litres per square metre** during backfilling operations to ensure a continuous barrier.

3. Treatment along External Perimeter of Building:

Holes shall be made with an iron rod at intervals of 150 mm along the external perimeter to a depth of 300 mm. Chemical emulsion shall be poured **5 litres per running metre** to establish continuity of barrier.

4. Treatment to Expansion Joints:

All expansion joints shall be treated with chemical emulsion at the rate of **5 litres per running metre** to prevent termite ingress through these joints.

5. Treatment around Pipes and Conduits:

Soil surrounding all pipes, conduits, and service entry points shall be treated @ **5 litres per square metre** or per running metre of pipe, ensuring thorough saturation of soil around such vulnerable areas.

6. Treatment to Internal Basement Areas:

Columns, footings, vertical and horizontal surfaces in contact with soil/murum filling (below basement/ground floor) shall be treated thoroughly with chemical emulsion to ensure continuity of the barrier.

vi. Execution Conditions:

The treatment shall only start after site survey, upon completion of excavation and before soling/PCC. Application shall be carried out by trained personnel using pressure pumps or hand sprayers, ensuring uniform distribution without runoff or pooling.

vii. Measurement:

Only the **plan area of basement** as per drawings shall be measured in square meters for payment. No extra payment shall be made for Roding, spraying, drilling, pumping, or incidental work.

viii. Rate Inclusions:

The quoted rate shall include cost of approved chemical, mixing, dilution, labour, tools, sprayers, pumps, drilling/rodding, scaffolding (if required), safety measures, protective gear for workers, guarantee documentation, and incidental work required to complete the treatment as per specifications.

SECTION C – STEEL REINFORCEMENT

Item No.-7 & 8 Reinforcement Steel Works

i. Applicable Standards:

Steel reinforcement shall conform to IS 1786 (High strength deformed steel bars & wires, TMT Bars for concrete reinforcement), IS 1139 (Hot rolled mild steel & medium tensile bars), IS 2502 (Code of practice for bending & fixing of bars), IS 432 (Mild steel for RCC), IS 1608 (Mechanical testing of metals), IS 15630 (Testing of rebars), and CPWD specifications.

ii. Materials:

Reinforcement shall be TMT bars of Fe 500/Fe 500D grade, high yield strength, corrosion-resistant, supplied by reputed manufacturers such as **SAIL, TISCON, RINL, JINDAL, JSW** or equivalent approved by the Engineer-in-Charge. Bars shall be free from rust, scales, oil, grease, paint, mud, or any defects that may impair bond with concrete.

iii. Scope of Work:

The work includes straightening, cutting, bending, cranking, hooking, welding (if approved), and binding reinforcement in position as per approved bar bending schedules (BBS) and drawings, for use in all structural elements – walls, columns, beams, slabs, shear walls, diaphragm walls, retaining walls, staircases, chajjas, pergolas, lintels, fins, water tanks, septic tanks, etc.

iv. Bar Bending Schedule & Fixing:

A detailed BBS shall be prepared and maintained for all reinforcement works. Bars shall be bent to correct shapes using bar-bending machines or approved manual methods, without causing cracks at bends. All reinforcement shall be placed, fixed, and supported with cover blocks of micro-concrete (not brick or stone) of appropriate thickness, ensuring specified cover as per drawings/IS 456.

v. Binding & Accessories:

Reinforcement shall be tied at intersections with annealed GI binding wire of minimum 18 gauge. Rate shall include cost of chairs, spacer bars, cover blocks, hooks, pins, and other accessories required for maintaining proper cover and spacing.

vi. Laps, Splicing & Welding:

Laps, splicing lengths, and anchorage shall be as per IS 456 and drawings. Laps will be measured and paid separately. Welding of bars shall not be permitted unless specified, and when permitted, shall conform to IS 2751 & IS 9417.

vii. Measurements & Weight:

Measurement of steel is strictly as per I.S. Code. Weights shall be calculated by taking Average weight of 3 no. samples of steel rods and if derived actual weight is less than theoretical weight but within a limit of IS : 1786-2008 or latest than payment will be done as per theoretical weight only. If derived weight is less than limit of IS : 1786-2008 then that lot will be rejected and contractor should immediately remove this lot from site without any extra cost.

If the derived actual weight is found more than the standard weight, then nothing shall be paid extra for the difference in derived actual weight and standard weight.

viii. Rate Inclusions:

The quoted rate shall be inclusive of procurement, transportation, straightening, cutting, bending, placing, tying, cover blocks, chairs, binding wire, scaffolding, labour, and incidental works required to complete reinforcement installation at all heights.

ix. Testing & Quality Control:

1. Physical Tests:

- Tensile Strength, Yield Stress, and Elongation shall be tested as per IS 1786.
- Bend and Re-bend tests shall be carried out as per IS 1599.

2. Chemical Tests:

- Sulphur (S) and Phosphorus (P) content shall be within IS 1786 limits.
- Corrosion resistance tests shall be carried out if CR bars are specified.

3. Frequency of Testing (as per IS 1786 & CPWD norms):

- **One sample per 25 MT or part thereof** for each size of bar received at site.
- Each sample shall consist of **three bars** of minimum 1.2 m length.
- For smaller projects: At least **one test per lot per diameter** of reinforcement shall be conducted.
- Additional tests may be ordered by the Engineer-in-Charge, especially if quality is in doubt.

4. Acceptance Criteria:

- Bars failing in physical or chemical tests shall be rejected and removed from site.
- Test certificates from manufacturer's QA/QC department shall be submitted along with every consignment.

x. Storage & Handling:

Reinforcement shall be stacked by diameter on raised platforms clear of ground and protected from moisture, rusting, and contamination. Different diameters shall be stored separately with proper identification.

Item No. 9 - Reinforcement Couplers

i. Applicable Standards:

Reinforcement couplers shall conform to **IS 16172: 2014 (Mechanical splices for reinforcing bars – Specification)**, IS 1786 (for TMT bars), and ACI 318/BS EN ISO 15835 (for reference in case of international equivalents). Testing and acceptance criteria shall also follow IRC:112 and CPWD

guidelines where applicable.

ii. Materials & Approved Makes:

Couplers shall be manufactured from high-grade carbon steel or alloy steel, conforming to relevant IS specifications, with adequate tensile strength not less than the parent reinforcement bar. Approved make include **DEXTRA, Unitech, J.K. Industries, Lokpal Industries**, or equivalent approved by Engineer-in-Charge (SBI/APMCF).

iii. Scope of Work:

The work includes supplying, threading, enlarging reinforcement bar ends by cold forging (if required), installing parallel-threaded mechanical couplers, protecting the prepared bars from corrosion/damage, and fixing couplers in position as per drawings.

iv. Performance Requirements:

- Couplers shall develop **at least 125% of the characteristic yield strength (fy)** of the parent bar.
- Failure shall occur in the bar and not at the coupler joint.
- Couplers shall be capable of transferring axial tension and compression without slip.
- Connections shall maintain structural integrity under cyclic/seismic loading conditions.

v. Installation Method:

1. Reinforcement bars shall be cut square and ends enlarged by cold forging (if required) to achieve correct diameter for threading.
2. Threads shall be cut with precision threading machines conforming to ISO metric thread standards.
3. Parallel-threaded couplers shall be screwed onto the prepared bar ends to full length using torque wrenches.
4. Protective caps shall be used for couplers before final connections to prevent dirt, corrosion, or damage.
5. Connections shall be inspected and approved before concreting.

vi. Protection & Handling:

Bars shall be carried out to avoid damage to threads. Threaded ends shall be covered with plastic caps until immediately prior to use. Any bar with damaged thread shall be re-threaded or replaced.

vii. Testing & Quality Assurance:

- **Type Tests:** To be carried out at NABL/approved laboratory to demonstrate compliance with IS 16172.
- **Acceptance Tests (Frequency):** At least **3% of coupler connections or minimum 3 samples per lot**, tested for tensile strength equal to parent bar.
- **Slip Test:** Maximum slip at 0.6 fy shall not exceed **0.1 mm**.
- **Fatigue Test:** For seismic zones, cyclic tests shall be carried out as per IS/IRC/ASTM standards.

viii. Measurement:

Measurement shall be taken as **number of couplers** fixed in position as per drawings, irrespective of bar diameter/length.

ix. Rate Inclusions:

The rate shall include cost of:

- Supply of couplers of approved make.
- Bar-end preparation (cutting, forging, threading).
- Fixing and connecting couplers with required torque.
- Protection of threads, covering caps, and anti-corrosion measures.
- All labour, equipment, threading machines, torque wrenches, consumables, QA/QC tests, and incidental works.

Items-9a to 9g above specifications to be followed as above

SECTION – D : PCC / RCC WORKS**1. Applicable Codes & Standards**

All PCC/RCC works shall conform to the latest editions of the following IS codes:

- IS 456: 2000 – Code of Practice for Plain and Reinforced Concrete
- IS 10262: 2019 – Concrete Mix Proportioning (Design Mix)
- IS 383: 2016 – Specifications for Coarse and Fine Aggregates
- IS 8112 / IS 12269 / IS 1489 – Cement specifications
- IS 9103 – Specification for Concrete Admixtures
- IS 1786 – High Strength Deformed Steel Bars for RCC
- IS 516 – Method of Tests for Strength of Concrete
- IS 1199 – Sampling and Analysis of Concrete
- IS 4926 – Ready Mixed Concrete
- IS 3025 series – Testing of water

2. Materials**i. Cement**

Cement shall conform to IS 269 (OPC 33 grade), IS 8112 (OPC 43 grade), IS 12269 (OPC 53 grade), IS 1489 (Part I & II – PPC), and IS 455 (Portland Slag Cement). Only fresh cement, free from lumps and stored in dry, moisture-proof godowns, shall be used. Cement older than three months from the date of manufacture shall not be used without retesting. Testing shall be carried out as per IS 4031 (various parts) for fineness, consistency, setting time, compressive strength, and soundness. Bags shall be stacked on raised platforms with proper ventilation, not exceeding 15 bags in height. Contractor shall maintain batch-wise records of cement received and consumed at site.

ii. Fine Aggregates (Sand)

Fine aggregates shall conform to IS 383: 2016. Sand shall be clean, hard, strong, and durable, free from dust, clay, silt, alkali, mica, or organic matter. Grading shall be within the limits of Zone I, II, or III as per IS 383, and Zone IV sand shall not be used without special approval. Silt content shall not exceed 8% by weight (as per IS 2386 Part II), and the fineness modulus shall be between 2.3 and 3.2. Moisture correction shall be applied when bulking exceeds 3%. Regular sieve analysis and silt content tests shall be performed on sand supplied to site. In case of non-availability of river sand, crushed stone sand (M-sand) may be used, subject to meeting IS 383 requirements and prior approval from Engineer-in-Charge.

iii. Coarse Aggregates

Coarse aggregates shall conform to IS 383: 2016. Aggregates shall be hard, dense, strong, durable, and clean, obtained from crushed granite, trap, basalt, or other approved stones, and shall be free from clay, dust, mica, coal, or organic impurities. The maximum size of aggregate shall generally be 20 mm for RCC work, 40 mm for mass concrete, and 10–12.5 mm for thin structural members, unless otherwise specified in drawings. Flaky and elongated particles shall not exceed 35% by weight. The crushing value, impact value, and abrasion value shall not exceed 30% each (as per IS 2386 Part IV). Water absorption shall not exceed 2%, and specific gravity shall not be less than 2.6. Aggregates shall be tested periodically, at least once per 100 cum or on change of source, for compliance with IS requirements.

iv. Water

Water used for mixing and curing concrete shall conform to IS 456:2000 requirements. It shall be clean, potable, and free from oils, acids, alkalis, organic matter, salts, or other harmful substances. The pH value shall not be less than 6. The total dissolved solids shall not exceed the limits specified in IS 3025. Chloride content shall not exceed 500 mg/l for RCC work, and sulphate content shall not exceed 2000 mg/l. Suspended matter, organic impurities, and sugar content shall be negligible. Water from lakes, ponds, or wells shall be used only after approval based on test results. Testing frequency shall be at least once for each new source and thereafter once every three months or whenever quality is suspected.

v. Admixtures

Admixtures shall conform to IS 9103:1999 (Specification for Admixtures for Concrete). Only approved admixtures such as plasticizers, superplasticizers, retarders, accelerators, and air-entraining agents shall be used to improve workability, control setting, or enhance durability. The dosage shall be strictly as per manufacturer's instructions and approved design mix. The admixtures shall not contain chlorides or other chemicals harmful to reinforcement or concrete durability. Fly ash, GGBS, silica fume, or metakaolin may be used as supplementary cementitious materials (SCMs) in accordance with IS 1489 and IS 3812, subject to Engineer-in-Charge's approval. Tests for setting time variation, compressive strength variation, drying shrinkage, and uniformity shall be carried out for each batch or as directed. Manufacturer's test certificates shall be submitted with every supply lot.

vi. Mix Design & Batching

Concrete shall be **Design Mix** prepared in accordance with IS 10262:2019. The contractor shall submit mix designs with supporting laboratory trial reports for approval before commencement. RMC shall be produced in automated batching plants with computerized control and weight-batching. Transit mixers shall deliver concrete to site with delivery challans showing grade, batch time, slump, admixture details, and quantity. Site batching, where permitted, shall use weight-batching only; volumetric batching shall not be allowed.

vii. Transporting, Placing & Compaction

Concrete shall be transported from batching plant to site in transit mixers and placed directly at point of laying using pumps. Placement shall be done within 90 minutes of batching. Retarding admixtures may be permitted for longer hauls. Concrete shall be placed in layers not exceeding 300 mm, compacted with needle and surface vibrators to achieve full compaction and avoid honeycombing. Cold joints shall be avoided, and construction joints shall be as per approved drawings.

viii. Form work & Shuttering

Form work shall be of waterproof plywood (minimum 12 mm thick) for slab & Beams with support of steel shuttering, properly braced, watertight, and capable of withstanding loads. Canting, staging, strutting, and scaffolding shall be of steel material and included in the contractor's scope. All exposed surfaces shall be finished smoothly. De-shuttering shall be done only after concrete has gained adequate strength as per IS 456 guidelines.

Sr. No.	Structural Element	Minimum Period Before Removal (Days)	Reference Code (IS 456:2000, Clause 11.3)
1	Vertical form work (Columns, Walls, Beams sides)	1 – 2	IS 456
2	Slab formwork (props left under)	3	IS 456
3	Beam soffit formwork (props left under)	7	IS 456
4	Props for Slabs (spanning up to 4.5 m)	7	IS 456
5	Props for Slabs (spanning over 4.5 m)	14	IS 456
6	Props for Beams & Arches (spanning up to 6 m)	14	IS 456
7	Props for Beams & Arches (spanning over 6 m)	21	IS 456

ix. Curing

All RCC work shall be cured for a minimum of 7 days for OPC and 10 days for PPC/fly ash-based concrete. Curing shall be by ponding, covering with wet hessian, or continuous sprinkling. Curing compounds may be used with prior approval.

x. Testing & Quality Control

Slump test shall be conducted for each batch as per IS 1199. Standard cubes of 150 mm size shall be cast and tested at 7 and 28 days as per IS 516; one set of six cubes shall be prepared for every 30 cum of concrete or part thereof. Concrete shall conform to characteristic compressive strength (fck) of the designated grade. Additional tests such as rebound hammer or ultrasonic pulse velocity (IS 13311) shall be conducted if required.

Sr. No.	Grade of Concrete	Test Age (Days)	Compressive Strength Requirement (N/mm ²)	Test Method (IS Code Reference)
1	M20	7	≥ 15.0	IS 516 (Compressive Strength of Concrete)
		28	≥ 20.0	IS 516
2	M25	7	≥ 17.0	IS 516
		28	≥ 25.0	IS 516
3	M30	7	≥ 20.0	IS 516
		28	≥ 30.0	IS 516
4	M35	7	≥ 23.0	IS 516
		28	≥ 35.0	IS 516
5	M40	7	≥ 26.0	IS 516
		28	≥ 40.0	IS 516

xi. Measurement & Payment

Concrete shall be measured in cubic metres (Cum) at site. The rate shall be inclusive of batching, mixing, transporting, pumping, placing, compaction, curing, shuttering, scaffolding, finishing, and all leads and lifts. Reinforcement steel shall be measured and paid separately.

x. Rate Includes:

Rate shall include cement, aggregates, admixtures, water, RMC batching/transportation, pumping, placing, compaction, curing, form work, scaffolding, finishing, testing, openings, cut outs, sleeves, and incidental works complete. Contractor has to do the rectification / dismantling & redo as per decision given by structural consultant at his own cost

BOQ Specified Items: 11a to 11f- Up to Plinth RCC Works (at all heights & depths)

All above general specifications to be followed except for various items of works- Footings, Shear Walls, Columns, Ramp, pardi, Slabs, roof, balconies, landings, access, platforms, sloping slabs of ramps, Staircase, beam, plinth beam & lintels etc.

All slabs' surfaces shall be form finished/rendered for the direct application of Painting on the same.

BOQ Specified Items: 12a to 12e- All RCC Works above Plinth levels (at all heights & depths)

All above general specifications to be followed except for various items of works- Shear Walls, Columns, Ramp, pardi, Slabs, roof, balconies, landings, access, platforms, sloping slabs of ramps, Staircase, Chajjas, beam, plinth beam, sills & lintels etc.

Item No .13-Diaphragm Wall**i) Applicable Codes**

The work shall be carried out in accordance with applicable standards such as IS 9556:1980 for diaphragm walls, IS 2911 (Part 4) for deep foundations, IS 456:2000 for plain and reinforced concrete, IS 9103:1999 for admixtures, IS 1786:2008 for reinforcement steel, IS 2502:1963 for bending and fixing of bars, and all other relevant Indian or international codes as approved by the Engineer-in-Charge.

ii) Materials

Materials shall include M30 grade concrete with design mix having slump in the range of 180 to 220 mm. Concreting shall be executed by the tremie method ensuring continuous placement and minimum embedment of 200 mm of the tremie pipe into fresh concrete. Suitable admixtures shall be used as per IS 9103 to improve workability and durability without impairing strength. Reinforcement shall consist of Fe500 or Fe550 TMT bars conforming to IS 1786, fabricated into cages with stiffeners, spacers and centralizers, and lowered in position as per approved drawings. Bentonite or polymer slurry shall be used for stabilizing the trench, with slurry properties maintained within specified limits of 30–60 seconds Marsh viscosity, density between 1.03–1.12 g/cc, pH between 9–11, and sand content less than 4 percent. Water stops of PVC or HDPE with

minimum width of 230 mm shall be provided at all panel joints. Anchors and structural steel members such as MS plates, angles, channels and stiffeners shall be provided as per design; structural steel and anchors shall be paid under separate items.

iii) Execution

Execution of work shall begin with construction of guide walls followed by excavation of panels using hydraulic grab with slurry circulation. The rig used shall have a minimum capacity of 20 tonnes, shall not be more than three years old, and shall be equipped with free fall winch for hard strata excavation, verticality control system with Koden testing facility, and free Kelly suspended grab. The verticality of the wall shall be within the tolerance of 1 in 200 as per IS code. Reinforcement cages shall be fabricated, tied, bound, and lowered in panels with overlaps conforming to IS 2502. Tremie concreting shall be carried out continuously until completion of the panel and concrete cubes shall be tested at 7 and 28 days. Panel joints shall be provided with water stops and stop ends where required. Any honeycombing observed shall be repaired by chipping, cleaning, and grouting, and all joints shall be rendered watertight. Anchors shall be installed as per design by drilling, fixing, and grouting with cement slurry prepared in mechanical mixers, followed by stressing and de-stressing as required. Excavated muck and used bentonite slurry shall be disposed of off-site in accordance with statutory authority requirements.

Quality control shall be ensured at every stage. Concrete shall be tested for slump and compressive strength. Reinforcement shall be inspected prior to lowering. Verticality of panels shall be verified by Koden or sonic method. Anchors shall be load tested before acceptance.

iv) Rate Inclusion

The quoted rate shall include the cost of excavation using hydraulic grab, guide wall construction, slurry preparation, fabrication and lowering of reinforcement cages (excluding cost of reinforcement & Structural Steel), tremie concreting with M30 grade concrete including cement and admixtures, provision of stop ends and water stops, rendering and joint treatment, repair of honeycombing, grouting and anchor works including cost of anchors and safe disposal of slurry and muck. The rate shall also include the cost of all labour, equipment, tools, machinery, transport, staging, scaffolding, shuttering where required, curing, lifts and leads, and provision of waterproofing guarantee against leakage through the diaphragm wall. Contractor shall insure that all visible surfaces shall be finished neatly for application painting if any honeycombing observed shall be rectified and rendered at no extra cost. Any temporary structure / structural component like Guide wall, P.C.C. etc. to be done without any extra cost.

v) Mode of measurement

Measurement shall be made in cubic metres of finished concrete diaphragm wall executed as per drawings and specifications. The thickness and depth shall be measured as per approved drawings. Reinforcement steel and structural steel shall be measured and paid separately under their respective items. No separate payment shall be made for guide walls, slurry preparation, stop ends, water stops, shuttering, anchors, anchoring, testing, curing, surface rendering or disposal, as these shall be deemed to be included in the quoted rate.

SECTION – E: MASONRY WORK

AAC Block Work Masonry

i) Applicable Codes

The work shall be carried out in accordance with IS 2185 (Part 3):1984 for autoclaved aerated concrete blocks, IS 6041:1985 for AAC block masonry, IS 1905:1987 for structural use of unreinforced masonry, IS 456:2000 for plain and reinforced concrete, IS 9103:1999 for admixtures for concrete, IS 2502:1963 for bending and fixing of bars, and any other relevant Indian Standards or international codes as approved by the Engineer-in-Charge.

ii) Materials

The AAC blocks shall be Grade-I conforming to IS 2185 (Part 3), with density in the range of 550–650 kg/m³ and a minimum compressive strength of 3–4 N/mm². Blocks shall be of approved sizes as shown in drawings and shall be of make such as Siporex, Aerocon, Biltech, Ecolite, Ascolite Ultratech or equivalent as approved by the Project Manager. The blocks shall be laid in polymer-modified thin joint adhesive mortar supplied in ready-mix form and used as per manufacturer's specifications, with joints not exceeding 3–4 mm in thickness. For horizontal reinforcement, RCC patli beams (lintels) of 100 mm thickness shall be provided at every 1.00 m vertical interval, reinforced with 2 nos. 8 mm dia TMT bars and 6 mm dia stirrups at 300 mm c/c, cast in M20 grade concrete using approved cement, sand, and aggregates. Form work of adequate strength shall be used to ensure proper shape and finish. Reinforcement steel shall be measured and paid separately.

iii) Execution

The block masonry shall be laid true to line, level and plumb, with vertical joints staggered and a minimum overlap of 100 mm. Blocks shall be placed with 3–4 mm thick adhesive mortar bed, spread evenly to achieve proper bonding. At every 1.00 m vertical height, a 100 mm thick RCC patli beam shall be cast monolithically in M20 grade concrete, with reinforcement placed and tied securely as per specifications. The concrete shall be properly compacted and cured for at least 7 days. AAC block joints shall be cured as per adhesive manufacturer's instructions. Joints shall be raked out for finishing where required. Independent double legged steel scaffolding shall be provided for safe execution at all heights, depths and leads. The entire work shall be carried out strictly as per the drawings and as directed by the Project Manager to his full satisfaction.

iv) Rate Inclusion

The quoted rate shall include the cost of supplying and laying Grade-I AAC blocks of approved make, polymer modified adhesive mortar including mixing and application, laying, plumbing and aligning of masonry, raking of joints, construction of RCC patli beams of 100 mm thickness in M20 grade concrete including centering, shuttering, mixing, placing, compaction and curing, as well as scaffolding, labour, tools, plant, machinery, transport and all incidental works to complete the

item in every respect. The rate shall exclude reinforcement steel in patli beams/lintels, which will be measured and paid separately under the respective item.

v) Mode of Measurement

Measurement of AAC block masonry shall be taken in cubic meters of the net volume of block work executed as per drawings or in Sqm as specified in the BOQ Item. The RCC patli beams shall not be measured separately. Reinforcement steel used in patli beams shall be measured and paid separately under the relevant reinforcement item. No separate payment shall be made for adhesive mortar, curing, shuttering, scaffolding, wastage, leads or lifts, as these are deemed to be included in the quoted rate.

Item No.14- Autoclaved Aerated Cement blocks (Grade1) masonry 100mm thick

Above Specs to be followed but for 100 mm thk Grade-1 AAC Blocks, and mode of Measurement shall be in Sq m.

Item No.15- Autoclaved Aerated Cement blocks (Grade1) masonry 150 mm thick & Above for Below Plinth Level

Above Specs to be followed but for 150 mm thk & Above, Grade-1 AAC Blocks for Below Plinth Work and mode of Measurement shall be in Cum.

Item No.16- Autoclaved Aerated Cement blocks (Grade1) masonry 150 mm thick & Above for Below Plinth Level

Above Specs to be followed but for 150 mm thk & Above, Grade-1 AAC Blocks for Above Plinth Work and mode of Measurement shall be in Cum.

SECTION - F: PLASTER WORK**External Double Coat Plaster (20–25 mm thick)****i) Applicable Codes**

The work shall be executed in accordance with IS 1661:1972 – Code of Practice for Application of Cement and Cement-Lime Plaster Finishes, IS 2402:1963 – Code of Practice for External Renderings and Finishes, IS 9103:1999 – Admixtures for Concrete and Mortar, IS 2645:2003 – Integral Waterproofing Compounds, IS 1542:1992 – Sand for Plaster, and other relevant Indian Standards as directed by the Engineer-in-Charge.

ii) Materials

The plaster shall consist of clean coarse sand conforming to IS 1542 mixed with Ordinary Portland Cement (43 or 53 grade) or PPC as approved. The plaster shall be applied in two coats of average total thickness 20 to 25 mm. The base coat shall be 12 to 15 mm thick cement plaster in proportion 1:4 (1 cement : 4 sand) mixed with integral waterproofing compound (MYK Laticrete, SIKKA, Dr. Fixit, CICO, FOSROC or equivalent as approved) and adhesive in the proportion recommended by the manufacturer, together with Polypropylene Fiber (Recron 3S Reliance IL or equivalent) added in specified proportion. The top coat shall be 8 to 10 mm thick cement plaster in proportion of 1:4 (1 cement: 4 sand). Fibre-mesh of approved quality shall be provided at all junctions of brickwork and RCC, and at chase cuts are made for electrification and plumbing. Only MS double-legged scaffolding shall be used for execution.

iii) Execution

The base surface shall be prepared by cleaning and roughening to ensure proper bond. The first coat of 12 to 15 mm thick plaster with cement mortar 1:4 mixed with waterproofing compound and polypropylene fibre shall be applied uniformly in all positions including at heights and depths. The base coat shall be kept rough for receiving the finishing coat and shall be cured for not less than 2 days. Fibre mesh shall be fixed at all junctions of brickwork and RCC and wherever required to prevent cracks. The finishing coat of 8 to 10 mm thick plaster in cement mortar 1:4 shall then be applied, and the surface finished by taking out grains to obtain the desired sand faced finish. Grooves, drip moulds, strips, bands, finishing at the top of chajjas in slope, and other architectural features shall be neatly executed as per drawings and instructions of the Engineer-in-Charge. Curing shall be done for a minimum of 14 days. Strictly double-legged MS scaffolding shall be erected for plastering at all heights and dismantled after completion.

iv) Rate Inclusion

The quoted rate shall include providing and mixing of cement, sand, waterproofing compound, polypropylene fibre, adhesive, water, scaffolding, labour, tools, plants, and all incidental items required for the work. The rate shall also include surface preparation, laying of plaster in two coats, application of fibre mesh at junctions, finishing with sand faced texture, grooves, bands, drip moulds, curing, and working at all heights, depths, sub-structure, superstructure, lifts and

leads. No extra payment shall be made for scaffolding, surface preparation, fibre mesh, grooves, drip moulds, strips, bands, or chajja finishing, as these are deemed to be included in the quoted rate.

v) Mode of Measurement

Measurement shall be taken only for the **net surface area of plaster applied**, expressed in square metres, as per approved drawings. No separate or additional payment shall be made for dhar, kani, grooves, strips, bands, drip moulds, chajjas, junction treatment, scaffolding, curing, or fibre mesh. Deductions and additions for openings, chajjas, projections, and offsets shall be as per IS 1200 (Method of Measurement of Building Works).

BOQ Specified Items

Item No 17- External Double coat plaster Below plinth

Above specs to be followed for External Double coat plaster below Plinth Works.

Item No 18- External Double coat plaster Above plinth

Above specs to be followed for External Double coat plaster below Plinth Works.

Item No 18- External 15mm thick plaster in single coat

Above general specs to be followed but for 15 mm thk Single coat plaster at specified Location.

Item No.19- Internal cement plaster 15mm thickness in a single coat without neeru

Above general specs to be followed but execution to be followed as below.

The base surface shall be cleaned of dust, laitance, loose mortar, oil, or any other foreign matter and made sufficiently rough to receive plaster. Gaps along wooden door frames, conduits, and chases for plumbing/electrical works shall be filled before plastering. The surface shall be moistened prior to application. Plaster shall be applied in a single coat of average 12 mm thickness, spread evenly and finished smooth or rough as directed, without neeru finish. Fibre mesh shall be provided at all junctions of RCC and brickwork and along weak planes to avoid cracks. Polypropylene fibres shall be mixed in the plaster mortar. The plaster shall be cured for a minimum of 15 days with continuous sprinkling. Scaffolding (single/double as required) shall be provided with proper support for working at all heights, ensuring safety and accessibility.

Item No. 20- Internal smooth finish cement plaster in a single coat 12 mm thick

Above general specs to be followed but execution to be followed as below.

The surface to be plastered shall be cleaned, roughened where necessary, and wetted before application. Gaps along wooden frames and chase cuts for conduits shall be filled. The plaster shall be applied in a single uniform coat of about 12 mm average thickness in cement mortar 1:4. Polypropylene fibres shall be mixed uniformly into the mortar. Fibre mesh shall be fixed at RCC-masonry junctions and chase locations. The surface shall be finished with 1:3 neat cement punning to obtain a smooth and even finish. Scaffolding (single/double as required) shall be erected to allow safe working at all heights. The plaster shall be cured continuously for a minimum of 15 days after application.

SECTION – G : MARBLE & GRANITE WORK

General Specifications

i) Applicable Codes

The stone works shall be executed in accordance with IS 1121, IS 1122, IS 1124 (Methods of Test for Natural Building Stones), IS 1597 (Construction of Stone Masonry), IS 1200 (Part 12 & 13) for method of measurement, IS 1542:1992 (Sand for Plaster), IS 9103:1999 (Admixtures for Mortar), and other relevant Indian Standards as approved by the Engineer-in-Charge. Work shall also comply with manufacturer's specifications for adhesives (Araldite, Cladex, MYK Laticrete or equivalent).

ii) Materials

Stone shall be of approved type, uniform in shade and texture, sound, durable, and free from cracks, cavities, or defects. Approved varieties may include Granite, Marble, Kota, Kadappa, or equivalent as specified. For flooring and cladding, stone thickness shall generally be 18–25 mm; for kitchen otta, window sills in single or double layer, jambs single or double layer, door frames single or double layer and Treads, Risers, thickness shall be 25–40 mm unless otherwise specified or as specified in the BOQ or as directed.

Cement shall be OPC/PPC of approved grade. Sand shall be clean, screened, and washed river sand /Stone Crush+Dust conforming to IS 1542. Bedding mortar shall normally be cement mortar 1:4 (1 cement: 4 sand), with neat cement slurry at 2.0 kg/m² spread over the bedding before placing stones if require white cement shall be used as directed by Engineer In cahрге. **Stone adhesives such as Araldite, Cladex, MYK Laticrete or equivalent approved brands** shall be used in place of or in addition to cement mortar, particularly for vertical cladding, skirting, dado, kitchen otta, window sills in single or double layer, jambs single or double layer, door frames single or double layer and Treads, Risers. Adhesives shall be applied as per manufacturer's instructions.

Joints shall be filled with neat cement slurry or epoxy grout matching the shade of stone. Stainless steel cramps/dowels shall be used for cladding as per design.

iii) Execution

The base surface shall be cleaned, roughened, and wetted before laying. A bedding layer of cement mortar 1:4 shall be laid for flooring and levelling. Stones shall be machine cut, dressed, and polished as specified. They shall be set in position over the bedding mortar with a thin layer of cement slurry or with **approved stone adhesive (Araldite, Cladex, MYK Laticrete, etc.)** wherever required to be applied as per manufacturer's instructions to ensure proper bonding.

For cladding works, stones shall be fixed on prepared backing surfaces using adhesives and secured with stainless steel cramps/dowels where necessary. For skirting, kitchen otta, window sills, jambs, and door frames, stones shall be cut to size, edges moulded/chamfered/polished and fixed with mortar or adhesives as specified. Surfaces shall be tapped gently with a wooden mallet to ensure uniform bedding and alignment. Joints shall be narrow and filled with coloured slurry or grout.

Surfaces shall be finished by grinding and polishing where specified, or by providing a honed finish. Finished work shall be protected from damage, staining, or chipping by covering with POP

or PVC sheets as directed.

Mirror Polishing to Kota

The base shall be cleaned and prepared before laying. Kota stone slabs shall be laid over the mortar bed with neat cement slurry applied underneath and tapped with a wooden mallet to bring them to line, level and slope. Joints shall be kept as thin as possible and filled with neat cement slurry pigmented to match the stone. After curing for at least seven days, polishing shall be carried out in four stages. The first grinding shall be done with coarse grade carborundum stone (No. 60/80) to remove high spots and lippage. The second grinding shall be carried out with medium grade carborundum stone (No. 120) to even out the surface, followed by fine grinding with carborundum stone (No. 320) to obtain smoothness. The final mirror polishing shall be done with oxalic acid applied uniformly and polished with machine until a glossy finish is achieved. For mirror-like finish, tin oxide or other approved polishing agents shall be applied in the final stage. Edges, corners, skirting, steps and areas not accessible to machines shall be finished manually with carborundum blocks and polishing powder. On completion, the surface shall be washed, cleaned, and protected until handing over. The final surface shall be uniform, smooth, glossy and free from scratches, stains and waviness.

iv) Rate Inclusion

The quoted rate shall include the cost of supplying approved quality stone, cutting, dressing, moulding, polishing, finishing, and laying in position with cement mortar bedding, neat cement slurry, or approved adhesives like Araldite, Cladex, MYK Laticrete or equivalent. It shall include filling of joints with matching epoxy slurry or grout, polishing or chamfering of edges, forming grooves, nosing, mouldings, rounding, drip moulds, and finishing of kitchen otta, window sills, Treads, Raisers, and door frames.

The rate shall further include scaffolding, labour, curing, tools, plants, transportation, wastage, lifting, leads, and working in substructure and superstructure. No extra payment shall be made for making openings, cut outs for Sinks, basins, taps etc., grooves, chamfer edges, moulding, rounding, nosing, overlaps, cutting for services, or edge finishing as these are deemed included. The contractor shall cover and protect finished surfaces with POP/PVC sheets and shall be solely responsible for replacement at his own cost if stones are found broken, cracked, or with shade variation.

v) Mode of Measurement

Flooring, dado, cladding, and skirting shall be measured in square metres of the finished visible surface area executed. Kitchen otta, window sills, jambs, and door frames shall be measured in square metres or as specified in the BOQ. Thickness of stones shall not be measured separately. No separate payment shall be made for grooves, chamfers, nosing, overlaps, polishing, edge moulding, adhesives, or protection works, as these are deemed to be included in the rate. Deductions and additions for openings, offsets, projections, and reveals shall be as per IS 1200.

Item No. 22. Granite Stone Vanity counters, window sills, facias

Item No 22a: -Area of slab up to 0.50 sq m

All above general specifications to be followed for Area (plan area for counters, Sills/Vertical for jams) of Slab up to 0.5 Sq m, Mode of Measurement shall be exposed visible area of application/Installation.

Item No 22b: -Area of slab above 0.50 sq m

All above general specifications to be followed for Area (plan area for counters, Sills/Vertical for jams) of Slab above 0.5 Sq m, Mode of Measurement shall be exposed visible area of application/Installation.

Item No. 23.- providing opening of required size & shape for wash basin/vanity counter

providing opening of required size & shape for wash basin vanity counter and similar location in marble/ Granite/ stonework, including necessary holes for pillar taps etc. including moulding, rubbing and polishing of cut edges, cleaning etc. Complete at all levels as per direction of APMCF/SBI his entire satisfaction.

Mode of Measurement

Measurement shall be considered combining or Single number for Wash Basin + Basin tap, no separate measurement shall be considered for each item.

Item No. 24.- Granite Stone of work for wall lining up to any height (Lift Cladding, Skirting, Riser, Door Frame etc.)

All above general specifications to be followed for Granite Stone Cladding, lining, Door Frames (Single /Double Layer). Mode of Measurement shall be exposed visible area of application/Installation Overlapped areas shall not be measured separately.

Item No 25.- Polished Granite stone flooring & Treads

All above general specifications to be followed for Granite Stone flooring & treads. Mode of Measurement shall be exposed visible area of application/Installation Overlapped areas shall not be measured separately. No separate payment shall be made for Groove cuttings, Edge Polish, Chamfering, Nosing as per design and drawings etc.

Item No 26.-Kota stone slab flooring, & skirting

All above general specifications to be followed but for 25 mm thk Kota Stone Flooring and Skirting including mirror polishing as per above given general specs as per Design and drawing. Mode of Measurement Shall be Sq m of exposed visible area.

Item No 27.-Pre Polished Kota stone slab over 25 mm thick in Tread of steps

All above general specifications to be followed but for 25 mm thk Pre Polished Kota Stone Treads of Staircase and Skirting. Mode of measurement shall be exposed visible area in per Sq m.

Item No 28.-Pre Polished Kota stone slab over 25 mm thick in Tread of steps

All above general specifications to be followed but for 25 mm thk Pre Polished Kota Stone Risers of Staircase. Mode of measurement shall be exposed visible area in per Sq m.

Item No 29.-Granite Kitchen Platform

All above general Specifications to be followed in addition to following procedure to be carried out for installation,

The kitchen platform shall be constructed to a minimum finished height of 750 mm or as shown in drawings. Vertical support shall be fixed in position first, properly aligned and secured with Araldite adhesive. The Kota/Kadappa stone base slab shall then be laid and finished from the top, followed by fixing the 18 mm thick granite stone slab with mirror polishing and full round moulded edges. A granite band of 50–60 mm Height/width or as per drawing shall be fixed at the edges, also rounded and moulded, to give a finished appearance. Cut-outs for stainless steel sink, taps, and gas pipes shall be neatly made at specified locations. All joints shall be treated with epoxy-based joint filler mixed with pigment matching the granite shade. The completed surface shall be mirror polished, smooth, free of cracks, stains, or shade variation. The work shall be executed with proper curing and necessary scaffolding in all positions. Rate shall be inclusive of all making openings, cut outs for Sinks, basins, taps etc., grooves, chamfer edges, moulding, rounding, nosing, overlaps, cutting for services, or edge finishing etc.

SECTION- H: WOOD WORKS

i) Applicable Codes

The work shall conform to IS 2202 (Part I & II): 1999 for flush door shutters, IS 4020:1998 for testing of flush door shutters, IS 303:1989 and IS 710:2010 for plywood and blockboard including **BWP (Boiling Water Proof) grade**, IS 1328:1996 for decorative laminated veneers, IS 848 for synthetic resin adhesives, IS 3564 for door locks, IS 4992 for hinges, and IS 1200 (Part XII) for method of measurement. All timber/boards shall be **FSC (Forest Stewardship Council) certified**, ensuring sustainable and legal sourcing.

ii) Materials

The shutters shall be factory-made, solid core type, constructed from **FSC certified BWP grade blockboard/plywood** of approved make of thickness **as specified in the BOQ**. Both faces shall be finished with **minimum 1.0 mm thick decorative laminate** of approved make as per the **Approved Material List** (e.g. Greenlam, Merino, Century, Formica, or equivalent approved). Laminates shall be hot-pressed with phenol formaldehyde adhesive. All four edges of shutters shall be finished with **5 mm thick hardwood lipping**, kiln-seasoned and chemically treated, bonded with waterproof adhesive, and **polished to match the laminate shade or as directed by the Engineer-in-Charge**.

Hardware shall be provided strictly as per the **approved hardware list in the BOQ** and shall include hinges, locks, handles, bolts, stoppers, door closers (where specified), and other necessary fixtures. Makes shall be as per the **Approved Material List** (e.g. Godrej, Dorma, Hafele, Hettich, or equivalent approved). All hardware shall be brass CP coated unless specified in BOQ with corrosion-resistant finish.

iii) Execution

The shutters shall be delivered in ready-to-install condition and fixed in position after checking the alignment, plumb, and level of frames. Hinges shall be secured with counter-sunk screws. Locks, handles, and fittings shall be installed at specified locations with proper recess cutting and machine drilling, ensuring neat finishing. Laminate surfaces shall be smooth, free of scratches, bubbles, or warping. Edges shall be finished with **5 mm thick hardwood lipping polished to match laminate**. Proper installation clearances shall be maintained: 3 mm at the top, 2 mm at the sides, and 6–10 mm at the bottom depending on flooring. Cut-outs for locks, handles, and other hardware shall be machine-cut and sealed with BWP adhesive. A protective covering (PVC tape or removable film) shall be maintained until completion to prevent scratches or shade variation.

iv) Rate Inclusion

The quoted rate shall include supply, transport, and installation of **FSC certified BWP grade laminated shutters** of BOQ-specified thickness with 1 mm laminate of approved make, **5 mm thick hardwood lipping polished to match laminate**, and all hardware items of approved make as per BOQ/approved list. It shall also include adhesives, screws, fasteners, making cut-outs, fixing fittings, scaffolding, labour, tools, plant, and protection of shutters until handing over. No extra payment shall be made for adhesives, polishing of lipping, fixing hardware, cut-outs, screws, or protection. Any shutter found defective, warped, scratched, shade-variant, or damaged shall be

replaced by the contractor at his own cost.

v) Mode of Measurement

Measurement shall be taken in **square meters of finished shutter area** executed as per approved drawings. Hardware items included in the BOQ shall be deemed part of this item and not measured separately unless otherwise specified. No extra measurement shall be made for **5 mm hardwood lipping with polishing to match laminate**, adhesives, screws, hardware fixing, or protective covering. Deductions shall be made for glass or louver openings as per IS 1200.

Item No 30- Main Door Shutter with Laminate

Above general Specifications to be followed but for **40 mm thk FSC Certified BWP Grade Door Shutters** with 1 mm thk laminate on both sides of shutter.

Item No 31- Internal Door Shutter with Laminate

Above general Specifications to be followed but for **32 to 35 mm thk FSC Certified BWP Grade Door Shutters** with 1 mm thk laminate on both sides of shutter.

Item no 32. Teak Wood Door Frame

i)Applicable Codes:

The work shall be carried out in accordance with IS: 4021 (Timber Door, Window and Ventilator Frames), IS: 287 (Seasoning of Timber), and other relevant IS standards. Workmanship shall conform to good construction practices and as directed by the Engineer-in-Charge.

ii)Materials:

The door frame shall be made from approved quality second-class seasoned teak wood, free from knots, cracks, sapwood, and other defects, with a moisture content not exceeding 12%. The frame shall be provided in the required sectional size, design, and profile as shown in drawings. The portion of wood in contact with masonry, plaster, or RCC shall be painted with two coats of black japan paint for protection against moisture and termites. Six mild steel hold fasts shall be used per frame, fixed in cement concrete blocks of mix 1:2:4 and approximate size 200 × 200 × 150 mm.

iii)Execution:

Frames shall be fixed in true line, level, and plumb, with proper arrangements made for accommodating aldrop, tower bolts, and slip way (tadi). Necessary recesses and grooves shall be neatly cut to receive the fittings. The visible portions of the frame shall be finished with two or more coats of melamine polish of approved shade, applied over a properly prepared surface. Work shall be completed in accordance with approved drawings and instructions of the Engineer-in-Charge.

iv) Rate Inclusions:

The quoted rate shall be inclusive of the cost of all materials, labor, tools, and plant, as well as black japan paint, melamine polish/enamel paint, primer, hold fasts, screws, nails, adhesives, cement concrete, curing, wastage, taxes, and all incidental charges required for proper completion of the work.

v) Mode of Measurement:

Measurement shall be taken in Cubic meter of the frame, measured by the Sectional dimensions

of the finished frame in position. No extra payment shall be made for hold fasts, painting, polishing, hardware recesses, or any other incidental work to frame fixing.

Item No 33- Solid FRP Doors for Toilet and Utility Area

i) Applicable Codes:

The work shall be carried out in accordance with IS: 4020 (Tests for Wooden and FRP Door Shutters), IS: 14756 (FRP Composite Materials), and other relevant IS standards, along with good engineering practices as directed by the Engineer-in-Charge.

ii) Materials:

The door shutters shall be **solid FRP construction**, factory-made, waterproof, with a thickness of **32–35 mm**, of approved design and quality, conforming to the approved sample by SBI/APMCF. The FRP shutter shall be manufactured using high-grade polymer resins reinforced with fiberglass, providing high strength and dimensional stability. The shutter shall be termite-proof, rot-proof, resistant to moisture, and chemically stable. The **minimum density shall not be less than 600–650 kg/m³** to ensure adequate strength, durability, and resistance against impact and bending. Approved makes include **Durian, Astral, Durofenster, Engineer Ply, or equivalent**.

iii) Execution:

Each door shutter shall be provided with **3 nos. 125 × 30 mm stainless steel butt hinges, stainless steel tower bolts**, and a **100 mm stainless steel handle**. A **knob-type lock** of approved make such as **Godrej, Enox, Dorma, Haffle, Ozone, or equivalent** shall be provided. Frames and shutters shall be installed in correct line, level, and plumb, ensuring smooth operation. All fittings shall be corrosion-resistant and fixed with necessary screws.

iv) Rate Inclusions:

The quoted rate shall include the cost of all materials, factory finishing, hardware fittings (hinges, bolts, handles, locks), labor, tools and plants, wastage, taxes, and incidental works required for proper fixing and completion. No separate payment shall be made for screws, adhesives, or surface finishing.

v) Mode of Measurement:

Measurement shall be taken in **square meters (Sq m)** of the finished door shutter, including all fittings, measured from the clear opening size. The rate shall cover all specified fittings and accessories. No separate measurement shall be taken for hinges, handles, locks, or other hardware.

Item No -34 Aluminum doors for shaft

i) Applicable Codes:

The work shall conform to IS: 733 (Wrought Aluminum and Aluminum Alloys – Extruded Bars, Rods, Tubes and Sections), IS: 1285 (Wrought Aluminum and Aluminum Alloys – Extruded Sections), IS: 5523 (Anodic Coatings on Aluminum and its Alloys), and relevant IS standards for fabrication and installation of aluminum doors. Powder coating shall conform to IS: 13871 with minimum thickness as per manufacturer's specifications.

ii) Materials:

The frame shall be fabricated from **50 × 50 × 2 mm thick aluminum square hollow section**, fixed into the wall with **10 mm dia double threaded carbon steel galvanized dash fasteners** of minimum 5-micron coating and 120 mm depth. The shutter shall consist of **50 × 25 × 2 mm aluminum hollow sections** for verticals and horizontals, with **25 × 25 × 2 mm aluminum hollow pipe stiffeners** welded to the outer frame at both sides, leaving a 50 mm clear opening. All aluminum sections shall be powder coated from all sides with a uniform and durable finish. Hinges shall be **100 × 75 × 4 mm aluminum butt hinges (6 Nos.)**, and the locking arrangement shall be a **nickel chromium brass cupboard lock of 40 mm size**, complete with handles.

iii) Execution:

The aluminum doors shall be fabricated to the required size and profile as per approved drawings and securely fixed in position in true line, level, and plumb. All joints shall be welded or mechanically fastened to ensure rigidity. Powder coating shall be applied evenly to all exposed and hidden surfaces. Hinges, locks, and handles shall be fitted securely with stainless steel screws. All welding shall be properly ground and finished to provide a neat and uniform appearance. The entire installation shall be carried out as per detailed drawings and instructions of the Engineer-in-Charge.

iv) Rate Inclusions:

The quoted rate shall be inclusive of the cost of aluminium sections, galvanized dash fasteners, powder coating, hinges, locks, handles, welding, finishing, screws, consumables, labor, tools, plants, wastage, taxes, and all incidental charges required for complete execution. No separate payment shall be made for welding, powder coating, or fixing of hardware.

v) Mode of Measurement:

Measurement shall be taken in **square meters (Sqm)** of the finished shutter including the frame, measured from the clear outer dimensions of the door unit. Hinges, locks, handles, welding, powder coating, and all hardware shall be deemed inclusive in the quoted rate and shall not be measured separately.

SECTION-I: STEEL WORK**Structural Steel Works- General Specification****i) Applicable Codes:**

All structural steel works shall conform to IS: 2062 (Hot Rolled Medium and High Tensile Structural Steel), IS: 800 (Code of Practice for General Construction in Steel), IS: 808 (Dimensions for Hot Rolled Steel Sections), IS: 816 and IS: 9595 (Welding Codes), IS: 4000 (High Strength Bolts in Steel Structures), IS: 1367 and IS: 3757 (High Strength Bolts, Nuts and Washers), and other relevant IS standards. The work shall also be executed as per approved design, detailed drawings, manufacturer's specifications, and instructions of the Engineer-in-Charge.

ii) Materials:

The materials shall consist of structural steel of approved grade E250/E350 as per IS: 2062, free from rust, cracks, laminations, and other surface defects. Rolled sections, plates, pipes, and hollow sections shall be procured only from approved manufacturers such as **SAIL, TATA, JSW, or equivalent**. Anchor fasteners shall be of **Hilti, Fischer, or equivalent** make, welding electrodes shall conform to IS: 814, and bolts, nuts, and washers shall conform to IS: 1367/IS: 3757.

iii) Execution:

Fabrication shall be carried out strictly in accordance with approved shop drawings. Cutting shall be done by mechanical shearing, flame cutting, or plasma cutting, with edges cleaned of burrs. Welding shall be carried out with full penetration where specified, following IS: 816/9595. Bolting and riveting shall be executed using calibrated torque wrenches to ensure correct tightening. The erection of members shall be done in proper line, level, and plumb before final welding/bolting. Suitable scaffolding, staging, lifting equipment, and safety measures shall be used for erection at all heights. After fabrication and erection, all steel surfaces shall be cleaned, surface prepared, and finished with one coat of approved zinc chromate/epoxy primer and two or more coats of synthetic enamel paint or as specified.

iv) Rate Inclusions:

The quoted rate shall be inclusive of the cost of all materials, transportation, safe storage, fabrication, cutting, welding, grinding, bolting, riveting, erection, scaffolding, staging, lifting, tools and plant, wastage, taxes, and all incidental works. It shall also include the cost of all accessories such as gusset plates, stiffeners, base plates, cleats, brackets, connections, anchor fasteners of approved make, and complete finishing with primer and paint. No extra payment shall be made on any such account.

v) Mode of Measurement:

The mode of measurement shall be in **metric tonnes (MT)** of the actual structural steel work executed, based on standard rolled weights of sections as per IS: 808 and IS: 1730. No separate measurement shall be made for gusset plates, cleats, stiffeners, bolts, nuts, washers, anchor fasteners, welding, grinding, painting, scaffolding, or finishing, as all these are deemed to be included in the quoted rate.

Item No-35 structural steel work in rolled sections like joists, channels, angles, tees, tees, Sections trusses

All above general specifications to be followed, for all types of structural fabrication works at all levels like connecting bridge, any other supporting fabrication work.

Item No-36-Galvanized Steel Deck Sheet**i) Applicable Codes:**

The galvanized steel deck sheet shall conform to IS: 277:1992 (Galvanized Steel Sheets – Zinc Coating) and relevant IS/ASTM standards for steel decking and shuttering. Execution shall follow the approved structural drawings, design requirements, and instructions of the Engineer-in-Charge.

ii) Materials:

The deck sheet shall be of **minimum 1.00 mm thick galvanized steel**, manufactured from high tensile steel with minimum yield strength of 240 MPa, free from rust, cracks, waviness, and other defects. Galvanization shall be hot dip with a uniform zinc coating as per IS: 277:1992. The sheet shall be trapezoidal/corrugated profile as per manufacturer's specifications, with suitable embossments for mechanical interlock with concrete. MS wire mesh of **3 mm diameter** shall be laid in a **100 × 100 mm grid** over the deck sheet before concreting. Edge trims should be provided and securely fixed. Approved makes include **Jindal, JSW, TATA, RINL, or equivalent**.

iii) Execution:

The galvanized steel deck sheets shall be placed accurately on structural steel beams, columns, and joists, and supported with shear studs for composite action with concrete. Sheets shall be cut, aligned, and fixed in position as per detailed drawings, ensuring overlaps are as per manufacturer's recommendation. Mesh reinforcement shall be laid, properly tied, and aligned before concreting. All edge trims and side closures shall be fixed to prevent leakage of slurry. Concreting shall be carried out as per design specifications, ensuring full compaction and bonding with the deck sheet.

iv) Rate Inclusions:

The quoted rate shall include the cost of galvanized deck sheet, transportation, loading, unloading, cutting, fabrication at site, fixing in position, providing and tying of MS wire mesh, fixing of edge trims, wastage, taxes, and all incidental works to complete the item in all respects. Structural steel members (beams, columns, joists) and concrete of different grades will be measured and paid separately under respective items.

v) Mode of Measurement:

Measurement shall be taken in **square meters (Sq m)** of the finished surface area of deck sheet provided and fixed in position, measured from the net covered area. No separate measurement shall be made for laps, overlaps, cut-outs, edge trims, shear studs, or MS wire mesh, as these are deemed to be included in the quoted rate.

Item No-37 MS tube handrail, Ladder.

All above general specs to be followed of Structural steel works but for MS rail, Ladder works as per design and drawing etc.

Stainless Steel Works – General Specification (Railings & SS-Glass Railings)**i) Applicable Codes:**

All stainless-steel works shall conform to IS: 6911 (Stainless Steel Plate, Sheet, and Strip), IS: 6521 (Stainless Steel Wire), IS: 15997 (Stainless Steel Bars and Rods), ASTM A240 / A312 (Stainless Steel Plates and Tubes), IS: 2553 (Part 1) for safety glass, and IS: 4000 for high-strength bolts. Work shall be executed as approved architectural drawings, design requirements, and manufacturer's specifications, under the instructions of the Engineer-in-Charge.

ii) Materials:

Stainless steel sections shall be of **Grade SS 304** for interior works and **Grade SS 316** for external/marine environment works, with satin or mirror finish as specified. Sections shall include pipes, tubes, flats, rods, and plates of approved thickness, free from dents, rust, or defects. For SS-glass railings, **toughened glass panels of 10–12 mm thickness** conforming to IS: 2553 (Part 1) shall be used. Rubber gaskets, spacers, clamps, and U-channels shall be of suitable quality to prevent direct metal-to-glass contact. Anchor fasteners shall be of **Hilti, Fischer, or approved equivalent make**. All welding consumables shall be stainless steel grade conforming to IS: 814.

iii) Execution:

Fabrication shall be carried out as per approved shop drawings with accurate cutting, bending, welding, and finishing. Exposed welds shall be ground smooth and polished to match the surface finish. Stainless steel railings shall include vertical balusters, posts, handrails, and horizontal members, aligned in true line, level, and plumb. Railings shall be securely anchored with base plates and anchor fasteners. For SS-glass railings, glass panels shall be installed in SS clamps, point-fixing spider fittings, or U-channels with rubber gaskets, ensuring rigidity, vibration resistance, and safety. All members shall be polished with uniform satin/mirror finish as specified. Proper scaffolding and safety measures shall be adopted during erection.

iv) Rate Inclusions:

The quoted rate shall be inclusive of the cost of stainless-steel sections, glass panels (where applicable), consumables, polishing, buffing, anchor fasteners, adhesives, gaskets, screws, bolts, and all accessories. It shall also include labour, scaffolding, tools and plants, transportation, wastage, taxes, and all incidental work required for completion. No extra payment shall be made for anchoring, finishing, or fixing hardware items.

v) Mode of Measurement:

For **stainless steel/Glass railings**, measurement shall be taken in **running meters (R mt) unless otherwise specified** of completed railing, including handrails, balusters, posts, and supports. No separate measurement shall be made for base plates, polishing, welding, anchor fasteners, or fittings, as these are deemed included in the quoted rate.

Item No-38 Glossy/mat finish stainless steel (Grade 304) railing

All above general specifications to be followed for SS 304 Railing at specified locations.

Item No-39. 12 mm thick Toughened glass S S railing

All above general specifications to be followed for SS 304 Railing at specified locations.

Item No- 40. Multicell polycarbonate panel

i) Applicable Codes

The supply and installation of the translucent roof with DPI Flux standing seam multicell polycarbonate panel system shall conform to relevant provisions of IS codes and manufacturer's specifications. Panels and fixing accessories shall be designed to withstand wind uplift, vibration, oil canning, and adverse weather effects while ensuring durability and aesthetics. Fire performance, light transmission, and impact resistance shall comply with IS/ASTM/EN standards as per approved make.

ii) Materials

The system shall consist of co-extruded UV protected multicell polycarbonate panels of minimum 8 mm thickness and 900 mm minimum width, incorporating an angular daylighting concept. Each panel should have vertical standing seams on both sides. Panels shall be provided with UV protection, factory-manufactured end caps, aluminum U/F profiles, and glazing bars as required for proper termination. Fixing accessories shall include snap-on connectors with double tooth grip lock mechanism, minimum 3 numbers of self-drilling screws per panel, and trapezoid stainless-steel fasteners. The supporting MS structural framework shall be measured and paid separately. Approved makes shall be FLUX, Lexan, Sunlite, Sunpal, or equivalent as approved by the Engineer. Colour of panels shall be as per approval.

iii) Execution

Panels shall be fixed on purlins with snap connectors and secured on MS structures as per drawings and manufacturer's guidelines. Installation shall be carried out using trained and factory-authorized labour under supervision of the Engineer-in-Charge. All joints and terminations shall be sealed with approved gaskets and sealants to ensure weather tightness. Cutting, notching, and drilling shall only be done as per manufacturers' instructions to maintain structural integrity. A mock-up of minimum 1 m × 1 m panel shall be prepared and approved prior to full-scale execution.

iv) Rate Inclusion

The quoted rate shall include the cost of supply, transportation, handling, and installation of polycarbonate panels, snap-on connectors, screws, fasteners, aluminum U/F profiles, end caps, and all necessary accessories to complete the system in all respects. The rate shall also include labour, supervision, equipment, wastage, and compliance with approved drawings and specifications. The rate excludes the cost of MS structural framework, which shall be paid separately.

v) Mode of Measurement

Measurement shall be taken in square metres (sqm) of the actual covered surface area of the polycarbonate panels fixed in position, excluding MS structural members. The measurement shall include overlaps, seams, cut-outs, and wastages necessary to complete the work in accordance with drawings and instructions of the Engineer-in-Charge.

Item No 41- Rolling shutters with partly grill**i) Applicable Codes**

The rolling shutters with partly grill portion shall conform to IS: 6248 (latest) for design, materials, fabrication, and installation. All materials and workmanship shall comply with relevant IS standards and manufacturer's recommendations.

ii) Materials

The shutter shall be fabricated from cold rolled, continuously formed, interlocked MS laths of minimum 1.00 mm thickness, not less than 75 mm in width, and machine rolled for accurate curvature. The lower portion of the shutter shall be made of solid MS laths, while the upper portion shall consist of fabricated grill made of MS round rods of **minimum 8 mm diameter** arranged in a rectangular/diamond mesh pattern. The shutter shall be mounted on heavy-duty **MS side guides of minimum 3.15 mm thickness** with proper fixing arrangements. The barrel shall

be made of heavy-duty seamless MS pipe of adequate size to withstand torsional stresses, fitted with high tension coiled springs and ball bearings for smooth operation. MS hood cover of minimum 1.00 mm thick sheet shall be provided to cover the roller drum.

iii) Execution

The shutter shall be erected true to line, level, and plumb as per drawings and Engineer's instructions. The laths shall interlock perfectly and allow smooth rolling action without jamming. The grill portion shall be positioned in the upper half (or as specified in drawings) to permit ventilation and visibility, with the lower half solid to ensure security. The shutter shall be provided with locking arrangements on both ends at the bottom, including hasp and staple suitable for padlocking from inside and outside. Proper stoppers shall be welded at top and bottom. The operation shall be push and pull type up to 10 m² area; for larger sizes, ball bearing arrangements and gear-operated chain pulley shall be provided. All exposed metal parts shall be given a coat of red oxide zinc chromate primer and two coats of synthetic enamel paint of approved shade.

iv) Rate Inclusion

The quoted rate shall include cost of materials (MS laths, grill portion with 8 mm dia rods, side guides, rollers, springs, hood covers, stoppers, locking arrangements, ball bearings/gear system), fabrication, transportation, handling, erection, painting, labour, and all incidentals required to complete the work. It shall also include fixing bolts, nuts, welding, and alignment as per approved drawings.

v) Mode of Measurement

Measurement shall be taken as the clear opening width × clear opening height (sq.m) of the rolling shutter. The grill portion and solid portion shall not be measured separately. No extra payment shall be made for overlaps, cover plates, hood covers, ball bearings, painting, or accessories.

Item No- 42. M.S. grills of required pattern in frames of windows

All above general specifications to be followed of Structural Steel works but for MS Grills for Windows and wherever specified including, MS Flats, Round, Square MS Bars as per design. Mode of measurement shall be actual visible area of grill.

SECTION – J: FLOORING

General Specifications

i) Applicable Codes

All flooring, dado, and cladding works shall be carried out in accordance with relevant IS codes, manufacturer's specifications, and as directed by the Engineer-in-Charge. Workmanship shall be neat, durable, and aesthetically finished to the required line, level, and surface appearance.

ii) Materials

All materials such as tiles, stones, adhesives, grouts, polishing compounds, edge trims, and protective coverings shall be of approved quality and free from cracks, warping, or shade variations. All dado tiles shall be fixed using eco-friendly polymer-based tile adhesive conforming to IS 15477 or equivalent international standards to ensure durability, bonding strength, and sustainability. Protective covering for finished works shall be provided with POP / PVC sheets or other approved materials.

iii) Execution

Measurements shall be taken for the exposed and visible finished surface area of application only. No extra or separate payment shall be made for grooves, chamfered edges, polishing, moulding, rounding, nosing, overlapping portions, or chiselling in walls or tiles. Laying shall include work at all heights and levels in both sub-structure and superstructure. Proper alignment, straightness, joints, slopes, and overall finishing shall be ensured. **If instructed/required, spacer joints shall be provided during installation, and all tile joints shall be filled and finished neatly with approved quality epoxy grout of specified shade to ensure durability, stain resistance, and uniform finish.**

iv) Rate Inclusion

The quoted rate shall include the cost of all materials, labour, tools, tackles, lifts, and leads required for execution. It shall also cover finishing works such as grooves, chamfering, nosing, rounding, polishing, edge moulding, cut-outs, and provision of spacer joints with epoxy grouting wherever instructed. The use of polymer-based eco-friendly tile adhesive for dado works shall be deemed included in the rate. The rate shall further include covering and protecting completed flooring, dado, and kitchen otta with POP / PVC or other protective coverings. The contractor shall be responsible for replacing, at his own cost, any flooring or dado work found defective, broken, cracked, or with shade variation.

v) Mode of Measurement

Payment shall be made based on the actual exposed finished surface area measured in square metres (sqm) at site. Overlaps, grooves, cut-outs, edges, wastages, adhesives, epoxy grouting, and protective covering shall not be measured separately and shall be deemed to be included in the quoted rate.

Item No.-43-ceramic glazed wall tiles of 300 x 600 mm/ approved size (Kitchen dado)

All above general specifications to be followed but for ceramic/vitrified glazed wall tiles of 300 x

600 mm / approved size including providing spacers, joint /groove filling with epoxy grout. Mode of measurement shall be in Sq. m of actual exposed visible area

Item No.-44-ceramic glazed wall tiles of 300 x 600 mm /approved size (Dry Balcony, Toilet Dado, Wash basin area & wherever specified.)

All above general specifications to be followed but for ceramic/vitrified glazed wall tiles of 300 x 600 mm / approved size including providing spacers, joint /groove filling with epoxy grout. Mode of measurement shall be in Sq. m of actual exposed visible area

Item No.-45-ceramic floor tiles of 300 x 300 mm / approved size (Garbage Room, inside water tank Below Rubberised Floor & wherever specified.)

All above general specifications to be followed but for ceramic/vitrified floor tiles 300 x 300 mm / approved size. Mode of measurement shall be in Sq. m of actual exposed visible area

Item No.46a to 46c – Double Charged vitrified tile Flooring of Specified sizes as per design and drawing.

All above general specifications are to be followed but the Double charged vitrified tile flooring of specified sizes. **Mode of measurement shall be in Sq. m of actual exposed visible area**

Item No. 46d- Double charged Vitrified Tiles of Size 800 x 1600mm flooring and Skirting

All above general specifications to be followed but the Double charged vitrified tile flooring/skirting of specified sizes to be fixed on average 50 mm thk. IPS concrete floor with average 5 mm thk polymer tile adhesive. Rate shall be inclusive IPS floor and polymer adhesive. **Mode of measurement shall be in Sq. m of actual exposed visible area.**

Item No.47a to 47b vitrified anti-skid and rustic tile of Specified sizes for Skirting as per design and drawing.

All above general specifications are to be followed but the vitrified tile skirting of specified sizes. **Mode of measurement shall be in Sq. m of actual exposed visible area**

Item No.47c Italian Marble Stone Flooring & Skirting

Above general specifications as well as Section G - Marble & Granite Work specifications to be followed for minimum 15 mm thk. Italian marble flooring (Not less Than 1 X 1 m size) and skirting as per design and drawing. Mode of measurement shall be Sq m area of exposed visible area.

Item No.48 & 49 Italian Marble Stone Treads & Risers

Above general specifications as well as Section G - Marble & Granite Work specifications to be followed for minimum 15 mm thk. Italian marble stone treads & risers as per design and drawing. Rate includes mirror polishing, making grooves, nosing, chamfering, edge polishing. Mode of measurement shall be Sq m area of exposed visible area.

Item No. 50- Cement concrete Flooring of M-30 grade with vacuum dewatering**i) Applicable Codes**

The work of providing and laying cement concrete flooring of M-30 grade with vacuum dewatering shall be carried out in accordance with IS 456:2000 (Code of Practice for Plain and Reinforced Concrete), IS 383:1970 (Specification for Coarse and Fine Aggregates), IS 10262:2019 (Concrete Mix Design Guidelines), IS 4926:2003 (Ready Mixed Concrete Specifications), IS 9103:1999 (Admixtures for Concrete), IS 1199:1959 (Sampling and Analysis of Concrete) and IS 13111:1991 (Guidelines for laying Vacuum Dewatered Concrete Floors), along with manufacturer's specifications for joint fillers, sealants and curing compounds and as directed by the Engineer-in-Charge.

ii) Materials

The materials shall comprise Ordinary Portland Cement (OPC) 43/53 grade or equivalent approved make conforming to IS standards, coarse sand as fine aggregate, and graded crushed stone aggregate of 40 mm nominal size conforming to IS 383. Water shall be clean, potable, and free from deleterious materials. Ready Mix Concrete of M-30 grade shall be prepared in a fully automatic batching plant and transported to the site in transit mixers. Required reinforcement in the form of dowel bars with sleeves, tie bars, and MS channel sections for formwork shall be provided. Expansion and construction joint treatment materials shall include approved silicon sealant or bitumen, Baker rods, epoxy grouts, and approved fillers. Necessary admixtures conforming to IS 9103 shall be used to improve workability, durability, and setting properties of the concrete.

iii) Execution

The work shall start with proper preparation of the base, ensuring compaction, levelling, slope, and camber as specified. Steel formwork made of sturdy MS channel sections shall be fixed securely to line and level. Concrete from the batching plant shall be laid in position using transit mixers, spread and compacted with the help of needle vibrators and surface vibrators to ensure full compaction. Immediately after laying and compaction, vacuum dewatering shall be carried out to achieve a dense, wear-resistant, and durable surface. The finished surface shall be levelled to the required slope and texture using mechanical floaters and trowels. Contraction, expansion, and longitudinal joints of size 10 mm wide × 50 mm deep shall be made using groove cutting machines and subsequently filled with approved joint fillers and sealed with silicon sealant/bitumen. Dowel bars and tie bars shall be provided at specified intervals. Proper curing shall be ensured for at least 14 days either by wet curing or by using approved curing compounds. Completed flooring shall be protected, cleaned, and handed over in perfect condition.

iv) Rate Inclusion

The quoted rate shall be inclusive of the cost of cement, sand, coarse aggregates, admixtures, and water; design mix concrete manufactured in an RMC plant and transported to site in transit mixers; supply and fixing of dowel bars, sleeves, tie bars, joint fillers, Baker rods, sealants and expansion joint treatments; providing, fixing and removing steel formwork, necessary scaffolding and shuttering; laying, compacting, vacuum dewatering, levelling, finishing and curing; labour charges, hire and operation of machinery and tools; cleaning and making good all defects as per

directions of the Engineer-in-Charge; and carrying out the work complete in all respects to the approved design, drawings and specifications.

v) Mode of Measurement

The mode of measurement shall be in cubic meters (Cum) of finished concrete work executed in place. The length, breadth, and thickness of the finished concrete shall be measured net to the nearest centimeter. No deductions shall be made for joints, dowel bars, tie bars, sleeves, or other embedded items. Measurement shall be based on the exposed finished surface volume as per approved drawings and as certified by the Engineer-in-Charge.

Item No. 51- 80 mm thick C.C. paver block of M-30 grade

i) Applicable Codes

The work shall be executed in accordance with IS 15658:2006 (Precast Concrete Blocks for Paving – Specification), IS 383:2016 (Specification for Coarse and Fine Aggregates), IS 10262:2019 (Concrete Mix Design Guidelines), IS 456:2000 (Code of Practice for Plain and Reinforced Concrete), IS 2386 (Testing of Aggregates), and IS 9103:1999 (Concrete Admixtures). All works shall conform to the latest specifications, manufacturer's instructions, and as directed by the Engineer-in-Charge.

ii) Materials

Paver blocks shall be factory-made chamfered edge cement concrete blocks of **80 mm thickness and M-30 grade** strength, manufactured using a vibro-compaction process with PU moulds to achieve uniform strength, size, and durability. The blocks shall be of approved colour, design, and pattern, conforming to IS 15658:2006. The bedding layer shall consist of **50 mm thick compacted coarse sand**. Jointing material shall be clean, dry sand of approved quality for filling the inter-block joints. Approved make such as Vyara Tiles, Shivalik Pavers, JP Blocks, or equivalent shall be used. Water shall be potable, free from harmful salts or impurities.

iii) Execution

The area to be paved shall be prepared to the required levels, slopes, and camber. A **50 mm thick compacted bed of coarse sand** shall be spread uniformly and levelled. Paver blocks shall be laid in the required colour and pattern as per approved design over the sand bed, ensuring close interlocking and proper alignment. Blocks shall be embedded by gentle tapping and compacted using a plate vibrator to achieve stability. After laying, joints shall be filled with clean, dry sand by brooming and further compacted by vibration. All edges and corners shall be cut neatly to match the pattern, and surplus sand shall be swept off. The finished surface shall be even, stable, and free from gaps or lippage.

iv) Rate Inclusion

The quoted rate shall include the cost of all paver blocks, sand bedding, joint filling sand, cutting and shaping of blocks as required, transportation to site, loading, unloading, laying in position, compaction using plate vibrator, sweeping of extra sand, finishing, and curing if required. It shall also cover all labour, tools, equipment, and incidental work required for completion of the item in accordance with drawings, specifications, and instructions of the Engineer-in-Charge.

v) Mode of Measurement

Measurement shall be done in **square meters (Sqm)** of finished work. The length and breadth of the paved area shall be measured correctly to the nearest centimeter. No deduction shall be made for gaps or joints filled with sand. The measurement shall be based on the net finished surface area laid with paver blocks, complete in all respects as per specification and direction of the Engineer-in-Charge.

Item No. 52- 35 mm thick Rubberise Flooring**i) Applicable Codes**

The work of providing and fixing rubberised flooring shall be carried out in conformity with relevant international and national standards, including **ASTM standards for rubber flooring**, IS 15622 (general flooring practices, where applicable), IS 9103 (admixtures for adhesion, if used), and other manufacturers' guidelines. The flooring shall also comply with non-hazardous and ecofriendly with Green Building Certification,

ii) Materials

The flooring shall consist of a **two-layer rubber flooring system** of total thickness 35 mm (\pm 2 mm). The base layer shall be **30 mm thick Black SBR rubber**, and the top layer shall be **6 mm thick EPDM coloured granules**, both mixed and bonded with polyurethane binder to provide durability and resilience. The flooring shall be installed on a **well-prepared, levelled, and finished PCC/concrete base** (not included in the scope of this item). Adhesives, if required, shall be of approved grade and suitable for rubber flooring applications. Patterns should be made using various colours such as red, green, grey, or blue as per design requirements. The flooring shall be supplied by approved makes such as **Asian, Sunflex, Ecoflex, Aditya** or equivalent, with a **minimum 5-year manufacturer's warranty**.

iii) Execution

The existing concrete surface shall be leveled, cleaned, and prepared as per manufacturer's specifications. The rubber flooring tiles/mats shall be cut to the required shape and laid as per approved drawings and patterns. The base 30 mm SBR rubber layer shall first be installed, followed by the 6 mm EPDM coloured top layer, using a full polyurethane binder or adhesive wherever required. Care shall be taken to ensure proper jointing, alignment, and colour patterning as per the design. The flooring shall be pressed and fixed firmly to avoid gaps, with all edges trimmed neatly. After laying, the surface shall be cleaned and finished to provide a smooth, resilient, and hygienic surface fit for use of indoor games, yoga, meditation, gymnasium, and similar applications.

iv) Rate Inclusion

The quoted rate shall be inclusive of the cost of all materials, adhesives, binders, wastage, cutting, pattern making, labour, loading, unloading, transportation, taxes, duties, cess, and all incidental works required for completion. The rate shall also include providing the rubberised flooring with approved colour, thickness, design, and finish, along with the manufacturer's 5-year warranty. However, **the cost of PCC/concrete base preparation is excluded** from the scope of this item.

v) Mode of Measurement

The work shall be measured in **square meters (Sqm)** of finished surface area. The length and breadth shall be measured correctly to the nearest centimeter. No extra payment shall be made for wastage, cutting, shaping, or finishing around edges, corners, and patterns. Measurement shall be taken only of the actual laid and accepted area of flooring, complete in all respects as per specification and direction of the Engineer-in-Charge.

SECTION -K: WATERPROOFING WORK**Item No. 53- Toilet Waterproofing****i) Applicable Codes**

All waterproofing works shall conform to IS 2645:2003 (Integral Waterproofing Compounds), IS 3067:1988 (Code of Practice for General Design Details and Preparatory Work for Damp-Proofing and Waterproofing of Roofs), IS 456:2000 (Code of Practice for Plain and Reinforced Concrete), and relevant ASTM standards for elastomeric coatings and membranes. The work shall also comply with manufacturer's specifications, tender requirements, and directions of SBI/APMCF.

ii) Materials

Approved waterproofing materials shall include Bathseal tape (non-reinforced twin-sided self-adhesive bituminous membrane), high-performance elastomeric 1K waterproof coating, non-shrink free-flow cementitious grout/micro-concrete for core cut treatment, URP (Polymer Modified Cementitious Bonding Agent), quartz sand, and geo-textile fabrics of 40–60 GSM and 45 GSM as specified. Additional materials include brickbat coba for horizontal protection, cement-sand mortar (1:4) with integral waterproofing compound, and spatter dash bond coat. Only improvements such as BASF, MYK, Dr. Fixit, Fosroc, Cico or equivalent shall be used. All materials shall be non-hazardous, hygienic, and supplied with necessary test certificates and manufacturer's warranty.

iii) Execution

The waterproofing work shall be carried out by an approved specialized agency only. The sequence of execution shall be as follows:

- Drainpipe & Core Cut Treatment: Surfaces shall be cleaned, pipes wrapped with Bathseal tape, and core cut junctions filled with non-shrink grout or micro-concrete, followed by moist curing. The treated area shall be dressed with geotextile and elastomeric coating.
- Angle Fillet Treatment: Junctions of wall and floor shall be cleaned, URP and cement bond coat applied, and 50 × 50 mm angle fillets prepared using PMM (polymer modified mortar). Smooth finishing and curing for 3–4 days shall be ensured.
- Waterproof Coating: Surfaces shall be brought to saturated dry condition (SSD). A self-priming coat of Bathseal tape with water dilution shall be applied, followed by sealing of joints, corners, and penetrations with additional coats reinforced with geotextile fabric. A minimum dry film thickness (DFT) of 500–600 microns shall be achieved. Special attention shall be given to splash zones, shower walls, and pipe junctions.
- Horizontal Protection (Brickbat Coba): A 120 mm thick brickbat coba shall be laid in cement mortar (1:4) with waterproofing compound, finished with a trowel, and cured for 2 weeks.
- Vertical Wall Protection (Plaster): Spatter dash bond coat shall be applied, followed by 12 mm plaster in cement mortar (1:4) admixed with waterproofing compound, finished smoothly, and cured for at least 7 days.

All treatments shall be tested for water tightness by ponding test for 10 days, and any leakage shall be rectified by the contractor free of cost during the 10-year guarantee period.

iv) Rate Inclusion

The quoted rate shall be inclusive of all materials, labour, equipment, tools, scaffolding, surface

preparation, application of coatings, treatment of joints, angles, core cuts, curing, testing, rectification of defects, taxes, transportation, and incidental works complete as per specifications. The rate shall also include furnishing of a guarantee undertaking on Rs. 500/- stamp paper for 10 years against leakage and seepage. Only plan area shall be measured for payment.

v) Mode of Measurement

The mode of measurement shall be based on the plan area in square meters (Sq.m) of the waterproofed surface. No extra measurement shall be considered for overlaps, returns, junctions, upturns on vertical faces, or thickness variations. Only the net plan area treated and accepted shall be paid.

Item No.54- Attached Terrace + Dry balcony Waterproofing

i) Applicable Codes

The work shall be carried out in line with IS 2645:2003 for integral waterproofing compounds, IS 456:2000 for plain and reinforced concrete, and relevant IS codes for cement, sand, brick, and admixtures. In addition, manufacturer's specifications for URP, polymer modified mortar, acrylic cementitious coating, epoxy bonding agents, and other proprietary waterproofing materials shall be strictly followed to ensure performance and durability of the system.

ii) Materials

The materials to be used shall include polymer modified mortar (PMM) prepared using 1 kg URP of approved make, 5 kg fresh cement, and 15 kg graded quartz sand in the ratio of 1:5:15 or dual shrinkage compensated mortar as specified; URP or epoxy bonding agents of approved make to be applied as slurry with cement in 1:1 ratio by volume; integral waterproofing compound conforming to IS 2645:2003 to be dosed @ 200–220 ml per bag of cement; high performance two-component acrylic polymer based cementitious waterproof coating (liquid: powder = 1:2 by weight) to be applied in two coats achieving minimum 1.2 mm DFT; well burnt clean brick bats for coba of minimum 120 mm thickness; and cement sand mortar of proportions 1:4 for bedding, 1:3 for finishing, and 1:4 plaster with waterproofing admixture.

iii) Execution

The surface shall be prepared by cleaning with wire brush or grinder and water jet, removing laitance, loose concrete, grease, and dust, and chiseling undulations, honeycombs, and pinholes. The prepared surface shall be repaired using PMM or shrinkage compensated for mortar, and all pipe junctions/core cuts shall be sealed with URP slurry, quartz sand, and non-shrink grout. At all slab-wall junctions, a 75 × 75 mm angle fillet (gola) shall be provided using PMM applied over URP slurry, finished smooth and water cured for 3–4 days. The surface shall then be brought to SSD condition, and two coats of cementitious waterproofing coating shall be applied with brush/roller at right angles to each other, extending up to 450 mm height on vertical walls, with air curing for 3–5 days followed by a 24-hour ponding test. For horizontal protection, a 120 mm thick brick bat coba laid over CM 1:4 bedding with waterproofing compound shall be provided with adequate slope for drainage, finished with neat CM, adjoining walls treated up to 300 mm height with rounded junctions, and water cured for minimum 14 days. For vertical wall protection, one coat of spatter dash slurry of URP and coarse sand shall be applied, followed by 12 mm thick

CM 1:4 plaster admixed with waterproofing compound, finished smooth and cured for at least 7 days.

iv) Rate Inclusion

The rate shall be inclusive of supply and application of all materials, surface preparation, mixing, labour, tools, tackles, scaffolding, curing, protection of finished work, disposal of debris, and all necessary accessories required to complete the work in all respects. No extra payment shall be made for treatment around pipes, sleeves, overlaps, grooves, chamfers, coves, angle fillets, or work at any heights and leads, as these are deemed included in the quoted rates.

v) Mode of Measurement

Measurement for payment shall be taken on the net finished area of waterproof surfaces only. Horizontal surfaces such as terrace slabs and dry balconies shall be measured in square metres of the finished top surface, in square meters while vertical surfaces shall not be measured separately. coves, angle gola, rounding of junctions, and pipe treatments shall not be measured separately and are deemed included in the overall item rate.

Item No. 55-Water tank waterproofing

i) Applicable Codes

The work shall be carried out in accordance with IS 2645:2003 for integral waterproofing compounds, IS 456:2000 for concrete works, IS 9103 for admixtures, IS 7809 (Part 2/1977) for vapour permeance, ASTM D4541:02 for adhesion strength, and all relevant IS standards for cement, mortar, and coatings. Manufacturers' specifications for polymer modified mortar, epoxy coatings, non-shrink grouts, elastomeric coatings, and food-grade epoxy coatings shall be strictly followed. The epoxy system must be CFTRI certified and compliant with US-FDA 21 CFR 175-300 requirements for non-toxic, anti-algae, anti-fungal, food-safe coatings.

ii) Materials

The materials shall include polymer modified mortar prepared with URP of approved make, fresh cement, and sand for chamfering and vatta formation; non-shrink free-flow grout for construction joint treatment, dosed at 10 litres per 50 kg bag of cement with 150 kg zone II sand; Bathseal tape or equivalent twin-sided self-adhesive bituminous membrane for pipe wrapping; micro concrete of approved make for pipe bore packing; high-performance elastomeric waterproof coating with GSM geotextile for wet-on-wet application; two-component cementitious waterproof coating with liquid: powder ratio 1:1.4 to be applied in two coats achieving 1.2 mm DFT; integral waterproofing compound conforming to IS 2645:2003 for use in 15 mm thick cement plaster (1:3); and two-component, water-based, food-grade epoxy resin system mixed in ratio 1:1:1 (base: hardener: water) with properties of specific gravity 1.2, vapour permeance 244.48 g/m²/24 hrs, and adhesion strength 2 N/mm². All materials shall be from approved makes such as BASF, MYK, Dr. Fixit, Fosroc, CICO, or equivalent.

iii) Execution

The surface shall be prepared by wire brushing, cleaning, and washing with water to remove laitance, dust, oil, or contaminants. All cracks, joints, and honeycombs shall be repaired with non-shrink grout. Chamfers or vatta of minimum 50×50 mm shall be provided at raft and wall

junctions using PMM. Tie rod holes and construction joints shall be filled with non-shrink grout as specified. For overflow pipes, the core cut shall be packed with pipe wrapped in Bathseal tape and supported with shuttering, then grouted with micro concrete mixed with w/p ratio of 0.13–0.15, cured for 5 days, and finished with elastomeric waterproof coating over GSM geotextile. The positive side waterproofing shall consist of two coats of high-performance cementitious acrylic polymer-based coating applied perpendicular to each other, with curing for 4–6 hours between coats to achieve 1.2 mm DFT. Over the cured coating, a 15 mm thick plaster in CM 1:3 admixed with waterproofing compound shall be applied to protect the waterproofing membrane. Finally, the inner side of the water tank shall be coated with two coats of food-grade epoxy coating, applied at 4 sqm/kg, forming a damp-proof, non-toxic, anti-microbial barrier in compliance with food safety standards.

iv) Rate Inclusion

The quoted rate shall include all labour, materials, equipment, mixing, surface preparation, scaffolding, curing, testing, and application as per specification. It shall also include the cost of chamfering, vatta, bore packing around pipes, treatment of construction joints, application of GSM geotextile, elastomeric waterproof coating, positive side cementitious coating, protective plaster, and two coats of food-grade epoxy.

v) Mode of Measurement

Item No. 55a - Preparation of chamfer or vatta at wall & raft junction shall be measured in Sq m of applicable areas of wata.

Item No. 55b- Bore Packing for Overflow Pipes shall be measured in numbers of Pipes treated.

Item No 55c- Waterproofing application on positive side shall be measured in Sq m of treatment applied area.

Item No. 55d- Protective Plaster application area shall be measured as per applicable area.

Item No. 55e- Application of food grade epoxy (Anti-microbial Coating) Inner side of tank shall be measured applicable area of treatment.

Item No 55c. Top Terrace Brick Bat Waterproofing with China Mosaic Tiles

i) Applicable Codes

The work shall be executed in conformity with IS 2645:2003 for integral waterproofing compounds, IS 456:2000 for reinforced concrete works, and relevant IS codes for cement, sand, and aggregates. Manufacturer's specifications for waterproofing compounds shall be strictly adhered to, along with APMCF/SBI instructions for quality and performance.

ii) Materials

The materials shall include Ordinary Portland Cement, coarse sand, and broken bricks/brick bats ranging from 25 mm to 115 mm in thickness. The mortar shall be prepared in mixes of 1:5 and 1:4 (cement: sand) as specified, admixed with integral waterproofing compound conforming to IS 2645 at the rate of 1 kg per bag of cement. Broken China mosaic tiles (China chips) of approved

colour, pattern, and quality shall be used for final finishing. Additionally, neat cement slurry prepared using 2.75 kg cement per sqm with waterproofing compound shall be applied in two coats.

iii) Execution

The RCC slab surface shall be cleaned thoroughly before treatment, including adjoining walls up to 300 mm height. A first coat of neat cement slurry using 2.75 kg/sqm of cement with waterproofing compound shall be applied. Over this, brick bats shall be laid in mortar 1:5 admixed with waterproofing compound, over a 20 mm thick bedding mortar of 1:5 mix with waterproofing compound, laid to the required slope. Junctions of walls and slabs shall be rounded and finished neatly. After proper curing of two days, a second coat of cement slurry at 2.75 kg/sqm shall be applied. Thereafter, the surface shall be finished with 20 mm thick cement mortar 1:4 admixed with waterproofing compound at the rate of 1 kg per bag, and broken China mosaic chips of approved shade and pattern shall be pressed into the surface with neat cement float to achieve the required slope and finish. Bell mouth and rounding (Vatta) portions shall be finished with kani plaster. The entire treated terrace shall be cured by ponding water for a minimum of two weeks and tested for water tightness.

iv) Rate Inclusion

The quoted rate shall include all labour, materials, equipment, surface preparation, mixing, laying, compaction, curing, finishing, scaffolding, disposal of debris, and protection of finished work. It shall also cover treatment of adjoining walls up to 300 mm height, rounding of junctions, preparation of bell mouth and vatta, laying of China mosaic chips in neat cement float, and water ponding test. No extra payment shall be made for grooves, overlaps, corners, or treatment around junctions and pipes.

v) Mode of Measurement

Measurement shall be taken on the **net finished horizontal surface area (in sqm)** of terrace waterproofed with China mosaic finish. Treatment of adjoining walls up to 300 mm height, rounding of junctions, angle fillets, vattas, and water testing shall not be measured separately and are deemed included in the overall item rate.

Item No. 57- Terrace garden Waterproofing

i) Applicable Codes

All works shall be carried out in accordance with IS 2645:2003 for integral waterproofing compounds, IS 456:2000 for reinforced concrete structures, ASTM C898 for elastomeric waterproofing membranes, ASTM D412 for tensile strength, ASTM C1305 for crack bridging, ASTM D2240 for Shore A hardness, ASTM D903 for adhesion to concrete, ASTM D5147 for puncture resistance of membranes, ASTM D4073 for tear resistance, ASTM D543 for chemical resistance, and DIN 1048 for hydrostatic pressure. Manufacturer's specifications for PU sealants, epoxy adhesives, geotextile layers, drain board systems, and membranes shall be strictly followed, along with instructions from SBI/APMCF.

ii) Materials

The materials shall include cement-sand polymer modified mortar for angle fillets and coving; PU sealants or hybrid sealants with Shore A hardness 25, elongation >400%, and movement accommodation factor 25% for butt joints and 50% for lap joints; non-shrink grout and leak-plug compounds for crack injection; epoxy adhesives for bonding waterproofing tape; high solid content cold liquid-applied elastomeric waterproofing membrane with >85% solids, tensile strength >2 MPa, elongation >400%, adhesion >1.5 MPa, and vapor permeability <14 g/m²/day; non-woven geotextile of minimum 100 GSM for separation layers; M20 grade screed concrete admixed with virgin polypropylene fibres (0.9 kg/m³) for slope and protection; integral waterproofing compound conforming to IS 2645 for protective plaster; 1.5 mm thick SBS modified self-adhesive HDPE laminated membrane conforming to IS 16471:2017 Type A with puncture resistance >200 N, tensile strength >4 MPa, elongation >180%, softening point ≥105°C, hydrostatic resistance >50M; and rolled matrix soil filter drain board system of dimpled polypropylene sheet bonded to geotextile fabric with compressive strength ≥600 kg/sqm.

iii) Execution

The surface shall be cleaned by vacuum to remove laitance, debris, and friable material, ensuring the substrate is sound, cured, and profile-free. Any pinholes or honeycombs shall be repaired with scratch coat mortar. Angle fillets or vatta of 50×50 mm shall be provided at all vertical junctions with polymer modified mortar or joint tape of approved make. Non-leaking cracks >1 mm shall be cut into V-grooves and sealed with PU sealant, cured for 7 days. Expansion joints <30 mm shall be sealed with PU/Hybrid sealant and geotextile strip saturated with PU coating, while joints >30 mm shall be treated with flexible waterproofing tape bonded with epoxy adhesive, with overlaps heat welded. Leaking cracks shall be injected with cement slurry admixed with plasticizing admixture using grout pump. Over the prepared substrate, a cold liquid-applied elastomeric waterproofing membrane shall be applied in three coats to achieve 1.5 mm DFT, followed by air curing for 7 days. A separation layer of 100 GSM geotextile shall be laid loosely over the membrane. A protective M20 screed of 100 mm average thickness, with slope 1:100 and fibre reinforcement, shall be laid and cured for 7 days, including vatta at wall junctions. A 15 mm protective plaster (1:4) with waterproofing compound shall be applied on vertical faces after bonding with epoxy primer and quartz sand. For anti-root protection, 1.5 mm SBS modified HDPE laminated membrane shall be laid over torch-applied primer with 100 mm laps sealed with double-sided tape. Over sloped screeds, drain board filter media of dimpled polypropylene with bonded geotextile shall be laid prior to soil filling.

iv) Rate Inclusion

The quoted rate shall include surface cleaning, preparation, angle fillets, sealant application, crack injection, joint treatment, supply and laying of all waterproofing membranes, geotextiles, PU membranes, HDPE laminated sheets, protective screeds, plaster, and drainage boards. It shall also cover scaffolding, curing, water testing, ponding test, disposal of waste, and protection of finished waterproofing until final acceptance. No extra payment shall be made for treatment around pipes, overlaps, junctions, parapets, grooves, or vatta.

v) Mode of Measurement

Measurement for payment shall be taken on the net finished horizontal surface area in square meters of waterproofed surface, inclusive of vertical up stands up to 300 mm height on parapet walls or as per drawings. Treatments at junctions, overlaps, fillets, coating, vatta, pipe detailing, water testing, curing, and protection works shall not be measured separately and shall be deemed to be included in the item rate.

Item No. 58a & 58b- Waterproofing of Basement – HDPE Membrane System**i) Applicable Codes**

The waterproofing system shall comply with BS 8102 for underground structures, IS 16471:2017 for waterproofing membranes, ISO 25619-2 for compressive strength of dimpled drain boards, ISO 12236 for puncture resistance, and relevant IS standards for polymer modified mortar and cementitious grouts. Manufacturer's specifications for HDPE membranes, SBS modified membranes, primers, adhesives, sealants, and drain boards shall be strictly followed.

ii) Materials

The materials shall include a 1.5 mm thick composite pre-applied fully bonded HDPE weldable membrane consisting of resilient HDPE film, pressure-sensitive adhesive, and weather-protective layer; SBS modified 1.6 mm thick self-adhesive cross-laminated HDPE valeron lining waterproofing membrane; solvent-based bituminous primer applied at 4 sqm/liter; polymer modified mortar and dual shrinkage cementitious grout for treatment of tie rod holes and cracks; polyethylene dimpled drain board of 8–10 mm thickness with compressive strength >400 kN/m² and puncture resistance of 1250 N; aluminum termination bars fixed with non-corrosive fasteners; and PU sealant/epoxy mortar for sealing termination bars. All materials shall be of approved by makes such as MYK, Dr. Fixit, Fosroc, CICO, BASF, or equivalent.

iii) Execution

For the horizontal surface below raft, the PCC surface shall be cleaned of loose aggregates, laitance, and foreign material. The HDPE membrane shall be cut to convenient lengths, aligned carefully, and rolled with the sand-coated side facing upwards. Adjacent sheets shall have 75 mm overlaps, welded using hot air fusion welding equipment after removing sand and adhesive. The membrane shall be extended vertically, terminating 50 mm below the raft top, and fixed to shuttering with double-sided adhesive tape.

For retaining wall waterproofing, after de-shuttering and curing, the vertical surface shall be cleaned of dust and loose mortar, cracks filled with polymer modified mortar, and tie rod holes plugged with shrinkage compensated for cementitious grout. A coat of approved primer shall be applied at 4 sqm/liter, over which 1.6 mm SBS modified membrane shall be laid with 100 mm overlaps bonded using double-sided tape. Over this, an 8–10 mm thick polyethylene dimpled drain board shall be installed by spot bonding, ensuring protection against backfilling loads. The membrane shall be terminated at least 200 mm above FGL, secured with aluminum termination bars at 4 nos./RM, and sealed with PU sealant or epoxy putty.

iv) Rate Inclusion

The quoted rate shall include supply and installation of HDPE membranes, SBS modified membranes, primers, adhesives, polymer modified mortar, grout, drain boards, aluminum termination bars, PU sealants, scaffolding, labour, tools, and equipment. It shall also include surface preparation, cutting, welding, overlaps, spot bonding, sealing, protection against backfilling, curing, transportation, and all incidental works to complete the waterproofing system as per specification. No extra payment shall be made for overlaps, joints, terminations, pipe cut-outs, or detailing work, as these are deemed included.

v) Mode of Measurement

Measurement shall be taken in square meters of the net finished waterproof surface area of horizontal and vertical surfaces. Overlaps, joints, terminations, protection layers, drain boards, and sealing works shall not be measured separately and are deemed included in the overall item rate.

Item No. 59a- Crystalline Waterproofing System**i) Applicable Codes**

The crystalline waterproofing admixture shall comply with IS 456:2000 for reinforced concrete, IS 2645:2003 for integral waterproofing compounds, and relevant ASTM/EN standards for crystalline technology. All materials and workmanship shall strictly follow the manufacturer's specifications and instructions, as well as directions from SBI/APMCF.

ii) Materials

The material shall be an integral crystalline concrete waterproofing admixture of approved make, supplied in powder form to be dosed at **1% by weight of cement content** in the concrete. The admixture shall be prepared as a thin slurry by mixing with clean water as per manufacturer's specification. Only makes such as **MYK, Dr. Fixit, Fosroc, CICO, BASF, or equivalent** approved by the Engineer-in-Charge shall be used.

iii) Execution

The crystalline waterproofing admixture slurry shall be prepared by mixing the powder with clean water in recommended proportions. This slurry should be added directly into the RMC transit mixer at site before pumping. After addition, the mixer shall be rotated at full speed for around **5 minutes** to ensure uniform dispersion of the admixture throughout the concrete. This procedure shall be followed for all base slab, raft concrete up to 300 mm thickness, and retaining/diaphragm wall concreting works, ensuring a continuous full-section waterproofing barrier.

iv) Rate Inclusion

The quoted rate shall be inclusive of supplying the admixture, slurry preparation, addition into transit mixer, labour, mixing, equipment, water, supervision, and all incidental works. No separate payment shall be made for handling, dosing, or mixing operations. The admixture is considered included in the item rate of concrete.

v) Mode of Measurement

Measurement shall be based on the **net volume of concrete (in cubic metres)** in which crystalline admixture is dosed at the specified rate. Slurry preparation, mixer rotation, and other incidental operations shall not be measured separately and shall be deemed included in the item rate.

Item No. 59b Construction Joint Treatment**i) Applicable Codes**

The construction joint waterproofing system shall comply with IS 456:2000 for concrete construction, IS 3370 for water retaining structures, and relevant ASTM/EN standards for hydrophilic waterbars. Manufacturer's specifications for expansion capacity, adhesive application, and fixing methods shall be strictly followed, along with instructions from SBI/APMCF.

ii) Materials

The material shall be a re-swellable SealArm type waterbar of approved make, designed for use in starter joints and all construction joints. The waterbar shall have **unrestrained volumetric expansion >800% after 14 days** in contact with water. Fixing accessories shall include gun-grade hydrophilic adhesive of approved make and/or non-corrosive mechanical fasteners as specified. Approved makes include **MYK, Dr. Fixit, Fosroc, CICO, BASF, or equivalent**.

iii) Execution

Before installation, the concrete surface on which the waterbar is to be fixed shall be levelled and cleaned. The waterbar should be placed centrally within the section, fixed either with adhesive or by mechanical fastening using non-corrosive nails as per manufacturer's recommendations. Cross nailing in alternate manner shall be adopted to prevent displacement during concrete. Care shall be taken to maintain continuity at overlaps and corners. After fixing, concreting shall be carried out ensuring full embedment of the waterbar without displacement.

iv) Rate Inclusion

The quoted rate shall be inclusive of supply of waterbar, adhesive, fixing accessories, labour, scaffolding, surface preparation, overlaps, and installation as directed. No separate payment shall be made for overlaps, alignment adjustments, or nailing.

Note: The diaphragm wall concrete rate already includes waterbar installation, and hence separate payment shall not be made for diaphragm wall waterbars.

v) Mode of Measurement

Measurement shall be taken in **running meters (R mt)** of waterbar fixed in position at construction joints. Overlaps, adhesives, nails, and incidental works shall not be measured separately and are deemed included in the rate.

Section- L : PAINTING WORKS

General Specifications for Painting Works

i) Applicable Codes

All painting works shall conform to IS 2395 (Part I & II) for painting of concrete, masonry and plaster surfaces, IS 1477 for painting of ferrous metals, IS 2339 for aluminium painting, and IS 5411 for cement paint, as applicable. Low VOC paints shall be used in accordance with IGBC/GRIHA/Green Building certification norms or other required environmental certifications. Manufacturer's specifications for mixing, application, and curing shall be strictly adhered to, and all works shall be executed under the directions of SBI/APMCF.

ii) Materials

All paints shall be of **approved make, low VOC, lead-free, and eco-friendly** conforming to Green Building requirements. Materials shall include primer, putty, synthetic enamel, acrylic emulsion, cement-based paint, texture coat, or any other specified type as approved. Only fresh materials in sealed containers bearing manufacturer's label shall be used. Water, thinners, brushes, rollers, scaffolding, and other ancillary materials shall be provided by the contractor at his cost. Only **MS scaffolding** shall be permitted for all plastering and painting works.

iii) Execution

All plastered surfaces shall be cured, dried, and cleaned thoroughly before application of any paint. Dust, grease, loose particles, or laitance shall be removed by brushing, sandpapering, or washing. Unevenness shall be corrected with approved wall putty. A primer coat shall be applied as per manufacturer's specifications, followed by a minimum of two finishing coats of approved paint, applied uniformly with brush/roller/spray to achieve an even shade and finish. For metallic surfaces, surface preparation shall include rust removal, sandpapering, priming with red oxide zinc chromate, and application of enamel paint. Painting works shall be carried out only by **authorized applicators**, and certificate/registration of the applicator shall be submitted to SBI/APMCF before commencement. Work shall be executed at all heights, substructure and superstructure levels, including lifts, leads, levelling, finishing, and curing as required.

iv) Rate Inclusion

The quoted rate shall be inclusive of supply and application of paint, primer, putty, scaffolding, labour, tools, equipment, surface preparation, levelling, finishing, curing, and all incidental works at all levels and heights. No extra payment shall be made for dhar, kani, grooves, strips, bands, junctions, or any other architectural features, as these are deemed included in the overall item rate.

v) Mode of Measurement

Measurement shall be taken as the **net surface area of finished plaster/painted work in sqm**, measured over plain surfaces only. No extra or separate measurement shall be allowed for bands, grooves, moulds, cornices, junctions, or similar features. Deductions for openings shall be as per IS code provisions.

Item No.60- Synthetic Enamel Paint

All above general Specifications to be followed in addition to the particular specification, mode of measurement shall be in Sq m of applicable area.

Item No.61- White Cement Base Putty

All above general Specifications to be followed in addition to the particular specification, mode of measurement shall be in Sq m of applicable area.

Item No.62- Acrylic emulsion paint with low VOC content to internal walls/ceiling

All above general Specifications to be followed in addition to the particular specification, mode of measurement shall be in Sq m of applicable area.

Item No. 63- Exterior Grade Acrylic Emulsion Paint with low VOC content

All above general Specifications to be followed in addition to the particular specification, mode of measurement shall be in Sq m of applicable area.

**Item No. 64- External Painting with Texture Plaster & Higher Graded Elastomeric Paint (Low VOC)
i) Applicable Codes**

All external painting works shall conform to IS 2395 (Part I & II) for painting on plaster surfaces, IS 1477 for painting on ferrous surfaces, IS 5411 for cement paints, and IS 15489 for elastomeric exterior coatings. In addition, low VOC paints shall comply with IGBC/GRIHA green building requirements and relevant BIS standards. Manufacturer's specifications for application thickness, coverage, drying time, and curing shall be strictly followed, with approval of SBI/APMCF.

ii) Materials

The materials shall include texture plaster material of approved make applied in 3–4 mm thickness, with grooves of 6 mm thickness or 35–45 mm width as required. Water-based acrylic anti-fungal primer of approved quality shall be used, followed by fibre-reinforced membrane paint waterproofing coat (e.g., Asian Protek Basecoat, Berger Weathercoat Roof Guard, Dulux Aqua Touch, or equivalent) having crack-bridging ability up to 2.0 mm, anti-carbonation, and waterproofing properties. The finishing coats shall be low VOC higher-graded external acrylic emulsion paints (e.g., Asian Apex Ultima Protek, Berger Weathercoat All Guard, or Dulux Weather Shield Max) in approved shade, having anti-fungal, dust and dirt resistant, and colour-fade resistant properties. All materials shall be of fresh supply in sealed containers.

iii) Execution

The surface shall be prepared by scrapping, rubbing with sandpaper, and thoroughly cleaning with wire brushes and water to remove dust, laitance, and loose particles. Over prepared plastered surfaces, 3–4 mm thick texture plaster shall be applied uniformly, including grooves as specified, with proper scaffolding and finishing. One coat of water-based acrylic anti-fungal primer shall be applied uniformly, followed by one coat of fibre-reinforced elastomeric membrane paint with crack-bridging ability up to 2.0 mm. Finally, two or more coats of higher-graded low VOC exterior acrylic emulsion paint shall be applied in approved shade and finish, ensuring even coverage and durability. Application shall be carried out using brush, roller, or spray as per manufacturer's recommendation. Scaffolding, cradles, safety nets, and protective measures shall be

provided to ensure safety and quality of work.

iv) Rate Inclusion

The quoted rate shall include supply of all materials, scaffolding, cradles, debris safety netting, surface preparation, texture plaster, primer, basecoat, finishing coats, labour, cleaning after completion, and all incidental items required for proper execution. No extra payment shall be made for bands, grooves, strips, or architectural detailing. For grills, MS jali, or gates, if not specifically mentioned, painting shall be deemed included in overall item rate.

v) Mode of Measurement

Measurement shall be taken on the net surface area of finished external plastered surfaces (in sqm) treated with texture plaster and painting system. No extra or separate measurement shall be taken for grooves, bands, or strips. For grills, jali, or MS gates, if specified separately, payment shall be made as per mode of measurement given in BIS/technical bid documents.

Item No .65-Oil Bound Distemper/Acrylic Distemper (Low VOC)

All above general Specifications to be followed in addition to the particular specification, mode of measurement shall be in Sq m of applicable area.

Item No .66-Cement Paint (Low VOC)

All above general Specifications to be followed in addition to the particular specification, mode of measurement shall be in Sq m of applicable area.

SECTION – M: WINDOWS, VENTILATORS, SLIDING DOORS ETC.

General Specification for uPVC Windows, Sliding Windows & Ventilators

i) Applicable Codes

All uPVC windows, doors, and ventilators shall conform to IS 4020 for performance tests on doors/windows, IS 7452 for uPVC profiles, IS 1038 for glazing, and IS 1361 for fasteners. Glass shall comply with IS 2553 (Part 1) for toughened safety glass, and hardware shall be stainless steel grade 304 or equivalent. Workmanship shall follow manufacturer's specifications and instructions of SBI/APMCF.

ii) Materials

The windows shall be factory-made white colour uPVC units with multi-chambered extruded profiles duly reinforced with galvanized mild steel sections of 1.5 mm to 2.52 mm thickness (depending on system requirement). Profiles shall include integral roller tracks, glazing beads, interlocks, EPDM gaskets, and wool pile. Hardware shall comprise stainless steel 304 grade friction hinges, zinc alloy powder-coated casement handles, touch locks with hooks, flush handles, C/D handles with locking systems, and nylon rollers of 80–150 kg load capacity. Glazing shall consist of **6 mm thick toughened glass of required U value, SR value as per IGBC Platinum Rating Project requirement** for windows, **5 mm frosted glass** for ventilators in toilets as specified. All joints shall be mitred and fusion welded, mullions if required also fusion welded. Fasteners shall be SS screws (100 × 8 mm). After installation, all joints between frame and wall shall be sealed with approved weatherproof silicone sealant. Mosquito mesh shutters shall be provided where specified. Makes: Fenesta, Deceuninck, Saint-Gobain, Tostem, Koemmerling, Prominence, or approved equivalent.

iii) Execution

Frames shall be cut to required size, assembled, and fusion welded at corners. Holes shall be drilled for fixing hardware and for water drainage. Frames shall be installed plumb, level, and true in prepared openings, anchored with SS fasteners to the finished wall. A 5° slope shall be provided in the drainage track. After fixing, weatherproof silicone sealant shall be applied between frame and wall junction. Glass panes shall be fixed with uPVC glazing beads and EPDM gaskets. Variations in profile dimensions on higher side shall be acceptable, but no extra payment shall be made.

- **Item No. 67a- 3-Track 3-Panel Sliding Window with Fly Proof Mesh:** Made of big series frame 116 × 45 mm and sash 46 × 62 mm, wall thickness 2.3 ± 0.2 mm, two glazed panels and one stainless steel wire mesh panel.
- **Item No. 67b- 2-Track 2-Panel Sliding Window:** Made of big series frame 67 × 50 mm and sash 46 × 62 mm, wall thickness 2.3 ± 0.2 mm.
- **Item No. 67c- uPVC Ventilators:** As per design, fitted with 8 mm toughened glass in casement shutter, profile wall thickness 2.3 ± 0.2 mm, with single/double glazing bead, partly fixed with provision for exhaust fan, for toilet or service areas (0.5–1 sqm).

iv) Rate Inclusion

The rate shall be inclusive of supply, fabrication, transportation, delivery, installation, glazing, mosquito net shutters (if specified), weatherproof silicone sealant, scaffolding, anchoring, fasteners, labour, and finishing complete as per drawings and instructions. No extra payment shall

be made for profile variation, fusion welding, mitring, drainage provision, or groove finishing.

v) Mode of Measurement

Measurement shall be taken in **square meters of the net finished area of installed windows, doors, and ventilators**, including frames, sashes, glazing, hardware, and mesh shutters where provided. No separate payment shall be made for silicon sealing, fixing accessories, drainage tracks, or mosquito mesh.

Item No.68- 3 Track, 3 Panel Sliding Door with Fly Proof Mesh:

All above general specifications to be followed for **3 Track, 3 Panel Sliding Door with Fly Proof Mesh** Made of big series frame 116 × 45 mm and sash 46 × 82 mm, wall thickness 2.3 ± 0.2 mm, with two glazed shutters and one stainless steel wire mesh shutter: suitable for openings 2.00–5.00 sqm.

Item No. 69- Powder Coated Aluminum Vertical Fins with Openable Doors

i) Applicable Codes

All aluminum works shall conform to IS 733 and IS 1285 for aluminum extruded sections, IS 1868 for anodic/powder coating, IS 5523 for hinges, IS 7088 for fasteners, and IS 1038 for glazing where applicable. Welding, fabrication, and surface finishing shall be carried out as per IS 814 and manufacturer's specifications. Workmanship shall follow the design/drawing requirements and directions of SBI/APMCF.

ii) Materials

The system shall consist of:

- **Outer Frame:** Aluminum box section of 75 × 40 × 1.5 mm thickness.
- **Inner Frame:** Aluminum box section of 75 × 40 × 1.5 mm thickness.
- **Vertical Fins:** Aluminum box sections of 75 × 40 × 1.5 mm thickness, spaced at 75 mm clear opening.
- **Hinges & Locks:** Aluminum butt hinges of heavy-duty, stainless-steel screws, locking arrangement as per approved design.
- **Coating:** All aluminum members shall be powder coated (minimum 50–60 microns thickness) of approved colour and shade as per IS 1868.
- **Fasteners:** SS 304 grade anchors, bolts, and screws for fixing the frame to wall.

iii) Execution

Frames and fins shall be fabricated from extruded aluminum box sections, cut to required length, mitred, and welded at all corners. Welded joints shall be ground, rubbed smooth, and polished before powder coating. Vertical fins shall be fixed to inner frames with 75 mm spacing, ensuring uniform alignment. The entire frame, including openable shutters, shall be provided with aluminum butt hinges and locking arrangement as per approved design. After fabrication, all members shall be powder coated on all sides with a uniform finish. The complete frame shall be fixed in position into the wall using stainless steel fasteners, ensuring plumb, level, and secure installation.

iv) Rate Inclusion

The quoted rate shall be inclusive of supply, fabrication, welding, grinding/rubbing, powder coating, transportation, labour, fasteners, anchors, scaffolding, and installation complete as per design, drawing, and direction of SBI/APMCF. No extra payment shall be made for cutting, jointing, alignment, hardware, or surface finishing.

v) Mode of Measurement

Measurement shall be taken in **square metres of finished installed area of aluminum vertical fins including openable doors**, covering the entire framed system with outer frame, inner frame, vertical fins, hinges, locks, and powder coating. No separate measurements shall be made for joints, fasteners, or surface preparation.

Item No.-70 Toughened Glass Door

i) Applicable Codes

All frameless toughened glass doors shall conform to IS 2553 (Part I) for safety glass, IS 6315 for hydraulic floor springs, and relevant IS/ASTM standards for patch fittings, pivots, and handles. All fittings and fixtures shall be of approved make and as per manufacturer's specifications, with installation following design drawings and instructions of SBI/APMCF.

ii) Materials

- **Glass Shutter:** 12 mm thick frameless toughened glass shutter of approved make, capable of withstanding impact and thermal stresses.
- **Hydraulic Floor Spring:** Double spring mechanism, minimum **120 kg capacity**, conforming to IS 6315, with brand logo embossed, suitable for door weight up to 125 kg.
- **Fittings:** Top and bottom pivots, brass pivot cover plates, single piece MS outer box with slide plate, CP (chrome plated) handles, locks, patch fittings, stoppers, and other required door hardware.
- **Approved Makes:** Dorma, Hettich, Dorset, or other equivalent approved brands.

iii) Execution

The floor shall be cut and embedded for fixing the hydraulic floor spring as per manufacturer's recommendations. All edges of glass shutters shall be polished for smooth finish, and fittings such as pivots, handles, locks, and patch fittings shall be installed as per approved drawings. The floor spring cover plate shall be flush with the finished flooring, ensuring neat appearance. Glass shutters shall be aligned true and plumb, with proper clearances maintained. After installation, all disturbed floor areas shall be restored to match existing finishes.

iv) Rate Inclusion

The quoted rate shall include supply and installation of glass shutter, hydraulic floor spring, pivots, handles, patch fittings, locks, stoppers, all required accessories, cost of cutting and embedding into floors, making good the floor finishes, labour, scaffolding, transportation, and all incidentals to complete the work in accordance with manufacturer's specification and direction of SBI/APMCF.

v) Mode of Measurement

Measurement shall be taken as the **net finished area in square meters of the toughened glass**

shutter, inclusive of all fittings, fixtures, hardware, and installation works. No separate measurements shall be taken for cutting, embedding, or floor finishing repairs.

SECTION N: MISCELLANEOUS WORKS

Item No.70- Providing, Fixing, and Maintaining Nylon Safety Nets

i) Applicable Codes

The safety net system shall conform to IS 5175 for safety nets, IS 3521 for industrial safety belts and fall protection equipment, and relevant OSHA/European EN standards for load capacity and durability. Installation and maintenance shall strictly follow manufacturer's recommendations and safety guidelines issued by SBI/APMCF.

ii) Materials

- **Nylon Safety Net:** 35 mm × 35 mm square mesh made from **5 mm thick nylon rope**, UV-stabilized and weather resistant.
- **Support Structure:** 50 mm dia MS hollow pipe (40 NB), anchored to the slab with 10 mm thick base plates and anchor fasteners (Hilti type or equivalent) – 4 nos. at all corners.
- **Fixing Accessories:** Nylon rope of 16 mm dia for tying to upper floor columns, additional clamps, shackles, and anchoring devices as required.
- **Arrangement:** Nets shall be provided with a minimum **4.5 m horizontal projection** beyond the building periphery, with proper slope for effective fall protection.

iii) Execution

The safety net shall be fixed at each level of work progress with MS hollow pipes firmly anchored to slabs using approved fasteners. Free pipe ends shall be tied to columns with 16 mm nylon rope for stability. The system shall be installed at every 4.5 m vertical interval, covering at least four working levels (2nd slab above podium, followed by 7th, 14th, and 21st slabs or as directed). Nets shall be removed and refixed as construction progresses, ensuring continuous protection. Cleanliness and proper slope of nets shall be maintained at all times.

iv) Rate Inclusion

The quoted rate shall include supply of nylon safety nets, MS hollow pipes, base plates, anchor fasteners, ropes, clamps, scaffolding, labour, installation, removal, refixing, maintenance, and cleaning throughout the work duration. It also includes shifting of nets at various slab levels as required. The safety nets shall remain the property of the contractor after completion of work.

v) Mode of Measurement

Measurement shall be taken as the **projected horizontal area (sqm) beyond the building outline** covered by the nets, in accordance with approved drawings. One-time payment shall be made for complete installation, maintenance, and shifting till the completion of works.

Item No. 71-M.S. Rungs in Overhead & Underground Water Tanks or at specified areas

i) Applicable Codes

The MS rungs shall conform to IS 1786 (for steel reinforcement bars), IS 800 (general construction

in steel), and IS 1239 (steel tubes where applicable). Epoxy painting shall be as per IS 1477/IS 13213. Installation shall be carried out as per drawings and instructions of SBI/APMCF.

ii) Materials

M.S. rungs of size **600 × 300 mm**, with **25 mm thick mild steel bars**, shall be used. Each rung shall weigh approximately **2.5 kg**. Rungs shall be provided with a protective epoxy paint coating of approved make to ensure corrosion resistance, particularly in water retaining structures.

iii) Execution

Rungs shall be fixed in position at the time of **casting RCC walls** of overhead and underground water tanks. Proper slots shall be left in shuttering to embed the rungs securely into the RCC wall, ensuring alignment and equal spacing as per design drawings. No extra cost shall be payable for modification of shuttering or fixing arrangements. Rungs shall be embedded in such a way that adequate anchorage is achieved for safety and durability.

iv) Rate Inclusion

The quoted rate shall include supply of MS bars, cutting, bending, fabrication of rungs, application of epoxy paint, fixing during RCC casting, necessary alterations in shuttering, labour, tools, and all incidental items. No extra payment shall be made for modifications required in shuttering for proper fixing.

v) Mode of Measurement

Measurement shall be taken in **Kilo Gram (KG) of MS Rugs** fixed in position, complete with epoxy coating and embedding. Weight per rung shall be considered as 2.5 kg for reference purposes.

Item No. 73- 73a to 73g - Rebaring Reinforcement Bar Dowel

i) Applicable Codes

Rebar dowel fixing shall conform to IS 456 for reinforced concrete works, IS 1786 for reinforcement steel, and relevant provisions of ACI/ASTM standards for anchorage and chemical grouting (ASTM C881 for epoxy-resin-based grout). Manufacturer's specifications for drilling, embedment depth, and grout application shall be strictly followed. Work shall be carried out as per SBI/APMCF instructions.

ii) Materials

- **Reinforcement Bars:** High-yield strength deformed (HYSD) bars conforming to IS 1786 of approved diameter and grade (Fe-500/Fe-550 as specified).
- **Chemical/ Epoxy Grout:** Hilti, Fischer, Fosroc, or other approved equivalent make epoxy/chemical anchoring grout, conforming to manufacturer's technical datasheet, with high bond strength and non-shrink properties.
- **Accessories:** Approved drilling equipment, anchoring guns, applicators, and scaffolding as required.

iii) Execution

Holes shall be drilled in RCC members (slabs, beams, columns, or walls) at specified locations

and diameters, ensuring correct embedment depth as per design. Dust and debris shall be thoroughly cleaned from drilled holes using air blower and brush. The specified epoxy/chemical grout shall be injected into the drilled hole as per manufacturer's instructions. Reinforcement bars shall then be placed into position, ensuring proper alignment and cover. The grout shall be allowed to cure as recommended before further loading or concreting. All works shall be executed at all levels with proper scaffolding and safety arrangements.

iv) Rate Inclusion

The quoted rate shall include cost of reinforcement bars, drilling, cleaning, supply and application of chemical/epoxy grout, scaffolding, equipment, labour, and all incidental works complete as directed by SBI/APMCF. No extra payment shall be made for working at heights, multiple drilling attempts, or curing arrangements.

v) Mode of Measurement

Measurement shall be taken in **number of dowel bars (Nos.)** successfully fixed in position with chemical anchorage, complete as per specification. The unit rate shall be inclusive of all materials, consumables, and labour.

Item No. 74a to 74d: - MS Sleeves

Here's the **General Specification for M.S. Sleeves** rewritten in **para format under the five standard heads** for tender/BOQ documentation:

i) Applicable Codes

Mild Steel (M.S.) sleeves shall conform to **IS 1239 (Part I) – Class C (Heavy Duty)** for mild steel tubes, IS 1367 for fasteners, and IS 4014 for fabrication and welding works. Water and fire-resistant sealant shall conform to relevant IS/ASTM standards. Installation shall be as per approved design, drawings, and instructions of SBI/APMCF.

ii) Materials

- **M.S. Sleeves:** Heavy duty Class C mild steel pipes as per IS 1239, of required diameter and thickness as specified in drawings.
- **Packing Material:** Glass wool or equivalent approved insulating material for filling annular gaps around the sleeve.
- **Sealant:** Water-proof and fire-proof sealant of approved make for sealing both ends of the sleeve.
- **Other Accessories:** Necessary clamps, supports, welding electrodes, and consumables as required for fixing.

iii) Execution

The M.S. sleeves shall be positioned in RCC walls, brick walls, beams, or other RCC members at the specified locations **prior to casting** or by core cutting if unavoidable. Proper alignment shall be ensured for free passage of service pipes. After installation of service pipes, the annular space between pipe and sleeve shall be packed with glass wool and sealed on both ends with approved water-proof and fire-retardant sealant. All welding joints shall be neat, ground smooth, and rust protected. Any displacement of sleeves during construction shall be rectified by the contractor

at his own cost, without any claim.

iv) Rate Inclusion

The quoted rate shall include supply of M.S. sleeves, cutting, welding, anchoring, filling with glass wool, sealing with fire/water-proof sealant, labour, tools, scaffolding, curing, and all incidental works complete as per specification and direction of SBI/APMCF. Rectification of displaced or misaligned sleeves shall also be deemed included in the rate.

v) Mode of Measurement

Measurement shall be taken **in R mt of installed in pipe/sleeve in position**, complete with packing and sealing. No extra payment shall be made for rectification, cutting, scaffolding, or wastage.

Item No.75 a to 75d: -**PVC Sleeves**

i) Applicable Codes

PVC sleeves shall conform to **IS 4985** for unplasticized PVC pipes, IS 12235 for installation practices, and other relevant IS standards for pipe fittings. Workmanship and installation shall follow manufacturer's guidelines and instructions of SBI/APMCF.

ii) Materials

- **PVC Sleeves:** Rigid unplasticized PVC sleeves of class rating **6 kg/sq.cm pressure** with diameters as per drawing requirements.
- **Sealing Material:** Plastic adhesive tape of approved quality for sealing both ends of the sleeves.
- **Accessories:** Any fixing clamps, supports, or ties required during installation.

iii) Execution

PVC sleeves shall be fixed in position in walls, columns, beams, floors, and top slabs at locations shown in the drawings or as directed. Sleeves shall be secured properly to prevent movement or displacement during concreting. After positioning, both ends of the sleeve shall be sealed with approved plastic tape to prevent entry of debris, mortar, or slurry. Care shall be taken to maintain alignment, size, and location to suit the passage of service pipes. Any displaced or misaligned sleeves shall be rectified by the contractor at his own cost without additional claims.

iv) Rate Inclusion

The quoted rate shall include the supply of PVC sleeves, cutting, fixing, sealing ends with tape, providing necessary supports/clamps, scaffolding, labour, and rectification of displaced sleeves as required. No extra claim shall be entertained for correction of misalignments.

v) Mode of Measurement

Measurement shall be taken **in R mt of installed in pipe/sleeve in position**, complete with packing and sealing. No extra payment shall be made for rectification, cutting, scaffolding, or wastage.

Item No.76- Corner Guards

i) Applicable Codes

Corner guards shall conform to international safety and impact resistance standards for parking

and building protection. Reflective strips shall comply with IS 164 or equivalent for retro-reflective materials. Workmanship and installation shall be as per manufacturer's specifications and directions of SBI/APMCF.

ii) Materials

- **Corner Guards:** 1 m height, 75 mm × 75 mm × 10 mm thick, made of high-strength, tamper-proof, flexible rubber of approved make.
- **Finish:** Black base with **reflective yellow colour strips** for visibility, resistant to abrasion, UV rays, and weathering.
- **Fixing Material:** Approved adhesive/anchor fasteners as required to securely fix on RCC or brick surfaces.

iii) Execution

Corner guards shall be fixed on sharp building corners (especially in parking areas, driveways, and basement walls) at specified locations and heights. The surface shall be cleaned and prepared before fixing. Guards shall be installed plumb and aligned properly to provide protection against vehicle impacts. Reflective yellow strips shall be positioned facing traffic movement for maximum visibility under both day and night conditions.

iv) Rate Inclusion

The quoted rate shall include supply, transportation, and fixing of corner guards with reflective strips, including adhesives/fasteners, surface preparation, labour, scaffolding (if required), and all incidental works complete as per approved design and direction of SBI/APMCF.

v) Mode of Measurement

Measurement shall be taken in **number of corner guards (Nos.)** fixed in position, complete with reflective strips and all accessories.

Item No.77- Thermoplastic Road Marking Paint

i) Applicable Codes

Thermoplastic road marking works shall conform to **MoRTH Clause 803, IRC:35 – Code of Practice for Road Markings**, and relevant ASTM standards for retro-reflectivity and skid resistance. Glass beads shall conform to BS 6088/IS 4606.

ii) Materials

- **Thermoplastic Paint:** Hot-applied Road marking material of approved make, capable of forming 2.5 mm thick film.
- **Glass Beads:** Spherical, clear, and transparent glass beads, 30% by weight, confirming to IS/BS standards for retro-reflectivity.
- **Shades/Colours:** As specified in drawings (white, yellow, or others), with retro-reflective properties.
- **Applicator Machine:** Fully/semi-automatic thermoplastic paint applicator machine fitted with profile shoe, glass beads dispenser, propane tank heater, and profile shoe heater.

iii) Execution

The road surface shall be cleaned thoroughly of dust, dirt, oil, grease, and other foreign materials. Thermoplastic paint shall be heated to the specified temperature and applied evenly in **2.5 mm thickness** using an approved applicator machine. Glass beads shall be applied simultaneously at uniform density for retro-reflectivity. All works shall be executed by trained operators to ensure uniform width, thickness, and finish. Road marking shall be carried out only in dry weather conditions, and traffic shall be allowed only after sufficient cooling and hardening of the applied paint.

iv) Rate Inclusion

The quoted rate shall include cost of thermoplastic paint, glass beads, heating, labour, transportation, tools, plant & machinery, cleaning of road surface, application, and all incidentals to complete the work in accordance with specifications and directions of SBI/APMCF.

v) Mode of Measurement

Measurement shall be taken in **square meters (sqm) of finished marking surface** as indicated in BOQ/drawings. Thickness shall be uniform at 2.5 mm excluding glass beads.

Item No.78- Rubberised Speed Breakers

i) Applicable Codes

Rubberised speed breakers shall conform to ASTM standards for EPDM rubber materials, specifically ASTM D2240 (Hardness), ASTM D412 (Tensile Properties), ASTM D395 (Compression Set), ASTM D573 (Heat Resistance), ASTM D624 (Tear Strength) or equivalent IS standards. Installation shall be as per IRC:99 – 2018 (Guidelines for Speed Breakers) and instructions of SBI/APMCF.

ii) Materials

- **Speed Breaker Units:** Weather-resistant and water-resistant EPDM rubber modules, size **500 × 350 × 50 mm**, with interlocking features, provided in black and yellow colour combination.
- **Fastening Hardware:** Necessary anchor bolts, nuts, washers, and adhesives of approved make for fixing on concrete/asphalt surfaces.
- **Approved Makes:** Deesawala Rubber Industries, Acutel Solutions, Axnoy Industries, Realtek, or equivalent approved by SBI/APMCF.

iii) Execution

The road surface shall be cleaned and prepared before installation. Rubber speed breaker units shall be laid across the full width of the road/driveway at designated locations as instructed by SBI/APMCF. Modules shall be securely fixed to the pavement using approved anchor bolts and hardware, ensuring alignment and uniformity in height. End caps and reflectors shall be provided for better visibility. All installation shall be carried out without damaging the road surface and in accordance with approved profiles and drawings.

iv) Rate Inclusion

The quoted rate shall include the cost of EPDM rubber speed breaker modules, anchor bolts, fasteners, transportation, handling, cutting, wastage, laying, fixing, and labour complete in all respects as per approved specifications and directions of SBI/APMCF.

v) Mode of Measurement

Measurement shall be taken in **running meters (R mt)** of speed breaker provided and fixed in position, complete with black and yellow modules and fastening hardware.

Item No. 79- Glow Studs (100 × 20 mm heavy duty)**i) Applicable Codes**

Glow studs shall conform to **ASTM D4280** for load-bearing capacity, **ASTM I:809** for luminance intensity, and **BS 873 Part 4:1973** for reflective performance. Adhesive shall conform to relevant IS standards for road studs. Installation shall be as per manufacturer's recommendations and directions of SBI/APMCF.

ii) Materials

- **Body:** Heavy duty ASA (Acrylic Styrene Acrylonitrile), HIP (High Impact Polystyrene), or ABS, moulded to size 100 × 20 mm.
- **Reflective Lens:** Electronically welded micro-prismatic lens with abrasion-resistant coating.
- **Performance Requirements:** Stud to support a load of **13,635 kg** as per ASTM D4280. Reflective surface slope shall be **35° ± 5°** to base. Each side shall have a reflective area of at least **12 cm²**.
- **Adhesive:** Conforming to IS standards and manufacturer's specification for road surface bonding.

iii) Execution

Glow studs shall be fixed on cleaned road surfaces at approved locations and spacing. The surface shall be free from dust, oil, grease, and loose material before fixing. Approved adhesive shall be applied as per manufacturer's procedure, and studs shall be pressed firmly into position ensuring proper bonding. Care shall be taken to maintain alignment and orientation of reflective panels for optimum visibility.

iv) Rate Inclusion

The quoted rate shall include the cost of glow studs, adhesive, labour, surface preparation, placement, wastage, transport, handling, and all incidental works complete in accordance with specifications and instructions of SBI/APMCF.

v) Mode of Measurement

Measurement shall be taken in **number of glow studs (Nos.)** fixed in position, complete with adhesive and all accessories as specified.

Item No.80-Expansion Joint System (Floor Location) 50 mm Width**i) Applicable Codes & Standards**

The expansion joint system shall be designed, manufactured, and installed in accordance with ASTM B221-02 and ASTM 6063. All works shall be carried out strictly as per the approved design, drawings, and directions of APMCF / SBI.

ii) Materials

The system shall consist of extruded aluminum base members with universal aluminum profiles

designed to accommodate various project conditions and finish floor treatments. A pre-engineered self-centering and self-aligning mechanism shall be provided, incorporating circular sphere ends locking inside the corresponding aluminum extrusion cavity to allow free rotation, freedom of movement, and flexure in all directions including vertical displacement. The cover plate shall be of adequate width and thickness to meet project movement and loading requirements, and it shall be secured to the base members using the manufacturer's recommended arrangement. A moisture barrier membrane shall be mandatorily provided within the joint system to ensure watertightness, in full conformity with the manufacturer's design.

iii) Execution

The expansion joint system shall provide floor-to-floor and floor-to-wall expansion control at various vertical locations in load application areas. The system shall be capable of accommodating multi-directional seismic movement without transmitting stress to its components. Fixing of cover plates to base members shall be carried out using the manufacturer's recommended arrangements. The installation shall be done in strict compliance with approved drawings and instructions of APMCF / SBI.

iv) Rate Inclusion

The rate shall be inclusive of supply, delivery, and installation of the complete system comprising aluminum base members, cover plates, self-centering mechanism, support plates, moisture barrier membrane, fasteners, and all associated accessories. The rate shall also include the cost of all labour, tools, tackles, scaffolding, handling, and transportation at all heights and leads. The watertight performance of the system shall be ensured and is deemed to be included in the quoted rate.

v) Mode of Measurement

The measurement for payment shall be made in running meters (RM) of the installed expansion joint system. The standard requirement shall be considered for a floor joint with a 50 mm gap, unless otherwise specified in drawings.

Item No. 81-Expansion Joint System related with Wall Joint 50 mm Joint Width

i) Applicable Codes & Standards

The expansion joint system shall be designed, manufactured, and installed in accordance with **ASTM B221-02** and **ASTM 6063**. All works shall be executed as per the approved drawings and directions of **APMCF / SBI**.

ii) Materials

The joint system shall consist of extruded aluminum base members, self-aligning/self-centering arrangements, and support plates. The material shall be suitable for vertical wall-to-wall and wall-to-corner applications in both new and existing constructions, including office buildings and complexes. The system shall utilize lightweight aluminum profiles with minimal exposed aluminum surfaces. The aluminum profiles shall be designed to mechanically snap lock into multicellular cavities to allow and facilitate free movement.

iii) Execution

The expansion joint system shall be fixed in **internal and external wall locations** as per design and site requirements. It shall be ensured that there is no slipping tendency amongst the system components during service life. The system shall be capable of accommodating vertical wall-to-wall and wall-to-corner movements effectively while maintaining structural integrity. Installation shall be carried out strictly in line with the manufacturer's recommendations and under the supervision of APMCF / SBI.

iv) Rate Inclusion

The rate shall be inclusive of all components, namely **aluminum base members, support plates, self-aligning/centering arrangements, snap-locking multicellular profiles, fasteners, and all necessary accessories**. It shall also cover labour, equipment, tools, scaffolding, and handling at all heights and leads. The watertight and movement-accommodating performance of the system is deemed included in the quoted rate.

v) Mode of Measurement

Measurement shall be taken in **running meters (R mt)** of the installed joint system. Standard provision shall be considered for a **wall joint of 50 mm gap** unless otherwise specified in drawings.

Item No.82- Roof Location Expansion Joint spec 50 mm joint Width

i) Applicable Codes & Standards

The expansion joint system shall conform to **ASTM B221-02** and **ASTM 6063**. All works shall be carried out strictly as per approved drawings, manufacturer's recommendations, and directions of **APMCF / SBI**.

ii) Materials

The joint system shall consist of extruded aluminum base members with self-aligning and self-centering arrangements, and support plates. The system shall provide a watertight roof-to-roof or roof-to-corner expansion control system. It shall incorporate a universal aluminum base member suitable for various project conditions and roof finishes. The cover plate shall be of adequate width and thickness to withstand project-specific movement and loading requirements, and it shall be secured to the base members using the manufacturer's pre-engineered self-centering arrangement. The arrangement shall utilize circular sphere ends that lock and slide into the corresponding aluminum extrusion cavity, ensuring freedom of movement and flexure in all directions including vertical displacement.

iii) Execution

The expansion joint system shall be capable of accommodating **multi-directional seismic movement** without transmitting stress to its components. It shall be designed to withstand environmental and service impacts such as **falling ice, UV exposure, airborne contaminants, and occasional foot traffic from maintenance personnel**. The cover plates and components shall be fixed securely in line with manufacturer's specifications and under the supervision of APMCF / SBI. Provision of a **Moisture Barrier Membrane** in the joint system to ensure a watertight joint is mandatory.

iv) Rate Inclusion

The rate shall include supply, delivery, and installation of the complete system comprising extruded aluminum base members, self-centering arrangement, support plates, cover plates, moisture barrier membrane, and all fasteners and accessories. It shall be inclusive of all labour, tools, scaffolding, and handling at all heights and leads. The watertight and durable performance of the system is deemed included in the quoted rate.

v) Mode of Measurement

Measurement shall be made in **running meters (RM)** of the installed joint system. Standard provision shall be considered for a **roof joint of 50 mm gap** unless otherwise directed in the drawings.

Item No. 83- Artificial Lawn**i) Applicable Codes & Standards**

The work shall be executed in accordance with approved design, drawings, and manufacturer's specifications, and under the direction of **APMCF / SBI**.

ii) Materials

The artificial lawn shall be **35 mm thick**, made of **polyethylene fibers with high UV protection** to ensure durability and resistance to fading. It shall have **PP woven fabric primary and secondary backing** for dimensional stability and long-term performance. The lawn shall be supplied in approved quality, make, and colour as per project design and manufacturer's recommendation.

iii) Execution

The artificial lawn shall be applied on a concrete or other finished surface using an **adhesive of approved quality**. The fixing shall be carried out neatly, ensuring proper bonding and alignment in accordance with the manufacturer's guidelines. The work shall strictly follow drawings, specifications, and site instructions issued by APMCF / SBI.

iv) Rate Inclusion

The quoted rate shall include supply and installation of artificial lawn, adhesive, consumables, and all accessories required to complete the work in all respects. It shall also cover labour, equipment, tools, and handling at all levels and leads. The rate shall be inclusive of a **5-year warranty** against manufacturing defects and performance failure.

v) Mode of Measurement

Measurement shall be taken in **square meters (sqm)** of the finished surface area of artificial lawn installed and accepted at site.

Item No.84- Kerb Stone Installation**i) Applicable Codes & Standards**

The kerb stone work shall be executed as per approved design, drawings, and manufacturer's recommendations, and under the direction of **APMCF / SBI**. Precast cement concrete kerb stones shall be factory-made and specifically approved by APMCF / SBI prior to use.

ii) Materials

Kerb stones shall be manufactured from **M-25 grade cement concrete** with proper compaction and curing. They shall be factory cast with smooth finish, free from cracks, honeycombing, or other defects. Cement mortar used for jointing shall be of mix proportion **1:3 (1 cement: 3 coarse sand)**.

iii) Execution

The kerb stones shall be laid at or near ground level in the required **line, level, and curvature** as shown in drawings and directed by the Engineer-in-Charge. Joints shall be made with or without grooves, with joint thickness not exceeding **5 mm** except at sharp curves. Provision for **drainage openings** shall be made wherever required. Proper bedding, alignment, and finishing shall be ensured.

iv) Rate Inclusion

The rate shall include cost of precast kerb stones, cement mortar, labour, equipment, scaffolding, and all materials required for laying, jointing, and finishing the kerb stone work in complete condition. It shall also include making drainage openings as directed at site.

v) Mode of Measurement

Measurement shall be made in **Cubic meters (Cum)** of the finished volume of kerb stone including edging, complete in position and accepted at site. No separate payment shall be done against cement mortar, PCC, excavation etc.

Item No. 85-Coloured thermoplastic Road marking paints for marking a 3ft x 3 ft universal accessibility symbol within the parking bay**i) Applicable Codes & Standards**

The work shall be carried out in accordance with approved drawings, manufacturer's instructions, and directions of **APMCF / SBI**. All materials used shall conform to relevant IS/ASTM standards for road marking paints.

ii) Materials

The road marking paint shall be **coloured thermoplastic paint** in blue and white (or as instructed), suitable for external use, with properties of high visibility, durability, and skid resistance. Paint shall be supplied from an approved make, ensuring compliance with performance and safety standards.

iii) Execution

The work shall consist of **providing and applying coloured thermoplastic road marking paints** for marking a **3 ft x 3 ft universal accessibility symbol** within the designated parking bay. Application shall be carried out using approved methods and equipment to ensure uniform thickness, sharp edges, and long-lasting visibility. The surface shall be cleaned, dried, and prepared properly before application. All work shall be executed strictly as per approved drawings and to the satisfaction of APMCF / SBI.

iv) Rate Inclusion

The rate shall be inclusive of supply and application of thermoplastic paints, surface preparation, tools, labour, scaffolding, and all incidentals required to complete the work. It shall also include all materials in approved colour shades as directed.

v) Mode of Measurement

Measurement shall be taken in **number (Nos.)** of accessibility symbols of size **3 ft x 3 ft** executed and accepted at site.

Item No.86- Providing & Fixing M. S. Gates Sliding/ Openable**i) Applicable Codes & Standards**

The fabrication and installation of M.S. gates shall be carried out in accordance with approved design, drawings, and specifications, and under the direction of **APMCF / SBI**. All steel sections and welding shall conform to relevant IS standards.

ii) Materials

The gate shall be fabricated using **M.S. angles and M.S. box sections** for framing. The system shall include holdfasts embedded in RCC columns, heavy-duty hinges, sliding channel, guiding plate, M.S. wheels, ball bearings, rollers, stoppers, and locking arrangements. Steel sections used shall be free from rust, cracks, and other defects.

iii) Execution

The gate shall be fabricated, welded, cut, fitted, and finished as per approved drawings. All joints shall be neat, aligned, and free from sharp edges or projections. The entire gate assembly, whether sliding or openable type, shall be erected in position with proper alignment and tested for smooth functioning.

iv) Surface Preparation & Painting

All M.S. surfaces shall be cleaned thoroughly, applied with **one coat of red oxide primer**, followed by **two coats of synthetic enamel paint** of approved shade and colour. The finish shall be uniform, smooth, and free of brush marks. All exposed joints and surfaces shall be properly finished to ensure durability and aesthetics.

v) Rate Inclusion

The quoted rate shall be inclusive of all materials, fabrication, welding, grinding, fitting, fixing in position, hardware accessories, primer, enamel painting, labour, tools, scaffolding, and handling at all levels and leads.

vi) Mode of Measurement

Measurement shall be taken as weight in Kg of all structural steel members of the installed gate on basis of standard weights of the section. Weight of accessories, locking arrangement, wheels shall not be considered for payment.

Item No. 87- G.I. chain link fabric fencing

i) Applicable Codes & Standards

The fencing work shall be carried out strictly as per approved design, drawings, and directions of PMC / APMCF / SBI. All materials and fabrication shall conform to relevant IS standards.

ii) Materials

The fencing shall consist of G.I. chain link fabric of 1.8 m height with a mesh size of 50 mm x 50 mm made of high-strength galvanized steel wire. The chain link shall be fixed within a fabricated frame using welding or riveting at top, bottom, side, and cross lengths. Vertical supports shall be welded to the frame and embedded in M15 grade concrete blocks of 450 mm length and 650 mm depth (or as per approved drawings). The system shall be strengthened with 4 mm dia wire or suitable nuts, bolts, and washers.

iii) Execution

All fabrication shall include welding, bolting, riveting, rubbing, cutting, fitting, and finishing of the chain link frame and supports. The vertical supports shall be aligned and securely fixed in concrete foundations. The entire fencing system shall be installed true to line, plumb, and level, ensuring stability and durability.

iv) Surface Preparation & Painting

All steel members shall be applied with one coat of red oxide primer followed by two or more coats of synthetic enamel paint of approved make, shade, and colour. All joints and surfaces shall be well finished, free of sharp edges and projections.

v) Rate Inclusion

The rate shall be inclusive of supply of all materials, fabrication, welding, riveting, bolting, concrete embedding including excavation, concreting, red oxide primer, enamel painting, labour, tools, and all incidental works required to complete the fencing in all respects.

vi) Mode of Measurement

Measurement shall be taken in square meters (Sqm) of finished chain link fencing of 1.8 m height, installed and accepted at site.

Item No. 88- 12.5 mm thick tapered edge gypsum plain board false ceiling**i) Applicable Codes & Standards**

The false ceiling work shall be executed in accordance with **IS: 277** (for galvanized M.S. sheets), **IS: 2095 (Part I): 2011** (for gypsum board with BIS certification marks), manufacturer's specifications, and as per approved design, drawings, and directions of **SBI / APMCF**.

ii) Materials

The framework shall be made from special sections power pressed from M.S. sheets, galvanized with zinc coating of 120 gms/sqm (both sides inclusive). Angle cleats of 25 mm width x 1.6 mm thick with flanges of 27 mm and 37 mm shall be provided at 1200 mm centers. Cleats shall be fixed

to the ceiling with dash fasteners 12.5 mm dia x 50 mm long with 6 mm dia bolts. Angle hangers of 25x10x0.50 mm shall be fixed to cleats with nuts and bolts, with the other end connected to intermediate G.I. channels 45x15x0.9 mm running at 1200 mm c/c. Ceiling sections of 0.5 mm thick, 80 mm bottom wedge with tapered flanges of 26 mm having lips of 10.5 mm shall be fixed at 450 mm c/c perpendicular to intermediate channels, using G.I. wire (2.64 mm dia x 230 mm long) clips.

Perimeter channels of 0.5 mm thick, 27 mm high with 20 mm and 30 mm flanges shall be fixed to wall/partition using rawl plugs at 450 mm centers. Fastening shall be done with dry wall screws 25 mm long @ 230 mm c/c. Gypsum boards of 12.5 mm thick tapered edge, conforming to IS: 2095 (Part I): 2011 and carrying BIS certification marks shall be fixed to the framework.

iii) Execution

Gypsum boards shall be fixed to ceiling sections and perimeter channels using dry wall screws of size 3.5 x 25 mm @ 230 mm c/c. Joints of tapered and square edges shall be finished flush with jointing compound and jointing tape, applied in 3 layers covering up to 150 mm on both sides of the joint. The ceiling shall be finished with two coats of primer suitable for gypsum board. Openings for trap doors, light fittings, grills, diffusers, and cut-outs shall be made with perimeter channel frames as per drawings. All work shall be executed as per manufacturer's specifications and under the direction of SBI / APMCF.

iv) Rate Inclusion

The rate shall be inclusive of supply, fabrication, erection, fixing, jointing, finishing, provision of trap doors, cut-outs, hangers, fasteners, rawl plugs, screws, G.I. channels, primer, and all accessories required for complete installation. It shall exclude the cost of painting.

v) Mode of Measurement

Measurement shall be taken in **square meters (sqm)** of the finished false ceiling surface area, complete and accepted at site.

Item No.89 - Acrylic sheet tiled false ceiling

i) Applicable Codes & Standards

The acrylic false ceiling shall be executed as per approved design, drawings, and directions of the Engineer-in-Charge / SBI / APMCF, and in compliance with manufacturer's specifications. All galvanized steel sections shall conform to IS standards for hot-dipped galvanization with a coating of 120 gms/sqm (both sides inclusive).

ii) Materials

The ceiling shall consist of acrylic sheet tiles of size 595 x 595 mm placed in a true horizontal level. The supporting framework shall be of an interlocking metal grid system made of hot-dipped galvanized steel sections. The grid shall consist of:

- Main "T" runner of size 24 x 38 mm (minimum 0.30 mm thick), spaced at 1200 mm c/c.
- Cross "T" members of size 24 x 25 mm (minimum 0.30 mm thick), 1200 mm long, spaced at 600 mm c/c.

- Secondary cross “T” members of 600 mm length and 24 x 25 mm size, interlocked at the mid-point to form 600 x 600 mm grid panels.
- Wall angle of size 24 x 24 x 0.3 mm fixed around the perimeter.
All T-sections shall have a 24 mm exposed bottom width and shall be factory pre-painted with polyester paint.

iii) Execution

The grid framework shall be suspended from the ceiling using G.I. slotted cleats (27 x 37 x 25 x 1.6 mm) fixed with dash fasteners 12.5 mm dia x 50 mm long, and 4 mm G.I. adjustable rods with galvanized butterfly level clips of size 85 x 30 x 0.8 mm, spaced at 1200 mm c/c along the main T. The acrylic sheet tiles of approved texture shall then be laid into the grid system. The installation shall include cutting, making, and openings for diffusers, grills, light fittings, fixtures, smoke detectors, etc. All work shall be executed as per drawings and to the satisfaction of the Engineer-in-Charge.

iv) Rate Inclusion

The rate shall be inclusive of supply and installation of the complete false ceiling system including framework, grid sections, cleats, hangers, rods, clips, acrylic tiles, cutting and openings for services, as well as all labour, tools, and accessories required to complete the work at all heights.

v) Mode of Measurement

Measurement shall be taken in **square meters (sqm)** of the finished false ceiling area, complete in all respects, installed and accepted at site.

Item No.90 - Chromium Plated Brass Curtain Rod

i) Applicable Codes & Standards

The curtain rod and its accessories shall be supplied and fixed as per approved design, manufacturer's specifications, and directions of **APMCF / SBI**.

ii) Materials

The curtain rod shall be made of chromium plated brass, of 25 mm diameter and a minimum wall thickness of 1.25 mm. It shall be supplied with two chromium plated brass brackets, fixed using C.P. brass screws and PVC sleeves wherever required.

iii) Execution

The rod shall be cut to required length and installed in the designated location using approved fixing methods. All brackets, screws, and sleeves shall be properly aligned, securely fixed, and finished neatly. Care shall be taken to ensure smooth functioning of curtains and durability of installation.

iv) Rate Inclusion

The rate shall include supply of chromium plated brass rod, brackets, screws, PVC sleeves, labour, tools, and all accessories required for complete installation in all respects.

v) Mode of Measurement

Measurement shall be taken in **running meters (R mt)** of chromium plated brass curtain rod fixed in position and accepted at site.

Item No.91- Aluminum Composite Panel (ACP) Cladding

i) Applicable Codes & Standards

All ACP cladding work shall be executed in accordance with approved architectural drawings, specifications, shop drawings, and as per the directions of SBI / APMCF. The ACP panels, accessories, and fixings shall conform to relevant IS/ASTM standards.

ii) Materials

The ACP cladding shall consist of **4 mm thick aluminum composite panels**, made up of:

- **3 mm thick FR grade mineral core** sandwiched between **two aluminum sheets (each 0.5 mm thick)**.
- Panels shall be **coil coated** with **Kynar 500 based PVDF** or **Lumiflon-based fluoropolymer resin coating** on face #1 of approved shade and colour, and **polymer (service) coating** on face #2.
- Fastening shall be done using **stainless steel screws, nuts, bolts, washers, cleats, weather silicone sealant, and backer rods**.
- Brackets shall be of **Aluminum alloy 6005 T5 / MS**, hot-dip galvanized with serrations and serrated washers to arrest wind load movements.
- Anchors and pins shall be of **SS 316**, with nylon separators to avoid bi-metallic contact.

iii) Execution

The scope includes **structural analysis and shop drawing preparation** to ensure pressure equalization and rain screen principle, along with adequate water drainage for watertightness. Panels shall be **fabricated in pan shape** in metallic colours of approved shades and fixed as per drawings. All joints shall be aligned with open grooves for linear and curvilinear profiles. The work includes:

- Fabrication, supply, and installation of ACP panels with accessories.
- Installation of brackets, anchors, and fasteners as per approved design.
- Application of weather sealants and backer rods for joints.
- Field tests on assembled ACP systems and quality testing of individual components in an approved laboratory.
- **Mock-ups at site** for approval prior to full-scale execution.
- Protection and cleaning of ACP cladding until final handing over.

iv) Rate Inclusion

The quoted rate shall include cost of all **materials, labour, ACP panels, brackets, anchors, fasteners, sealants, mock-ups, testing, installation, cleaning, and protection** of the cladding system. It shall also include all incidental works required for a fully functional ACP curtain wall system.

v) Mode of Measurement

Measurement shall be made in **square meters (sqm)** of the actual area on the external face of ACP cladding (including groove width), up to two decimal places, installed and accepted at site.

Item No. 92- Stainless Steel (S.S.) Bird Spikes

i) Applicable Codes & Standards

The bird spike installation shall be carried out strictly as per **approved design, manufacturer's specifications, and directions of APMCF / SBI**. All materials and accessories shall conform to relevant quality standards.

ii) Materials

The system shall consist of Stainless-Steel Bird Spikes mounted on a moulded virgin grade polycarbonate base with UV stabilizer for durability. The base shall have a minimum width of 20 cm, with holes of 4 mm diameter for secure fixing. The spikes shall consist of stainless-steel center projections of 3.4 mm diameter, arranged to provide an effective spread of 200 mm. The system shall be of BIRD EDGE make or equivalent approved brand.

iii) Execution

Bird spikes shall be installed at designated locations as per drawings, ensuring full coverage to prevent bird entry or nesting. Fixing shall include all fittings, fixtures, and hardware of approved make. Proper scaffolding and safety measures shall be provided during installation. The system shall be aligned and fixed securely to withstand external weather conditions.

iv) Rate Inclusion

The quoted rate shall be inclusive of supply of spikes, base, fittings, fixtures, hardware, scaffolding, labour, tools, and all other incidentals necessary to complete the work in accordance with approved specifications.

v) Mode of Measurement

Measurement shall be taken in **running meters (Rmt)** of stainless-steel bird spikes installed and accepted at site.

SECTION – O : LANDSCAPING WORKS**Item No 93. Plum Concrete****i) Applicable Codes & Standards**

The plum concrete work shall be executed as per approved design, drawings, and directions of **APMCF / SBI**, and in conformity with IS codes relevant to plain cement concrete works (IS: 456).

ii) Materials

The plum concrete shall consist of:

- **80% Plain Cement Concrete (PCC) mix of M15 grade** (1:2:4 proportion or design mix as approved).
- **20% rubble stones** of hard, durable quality with a maximum size of **150 mm**, free from weathering, cracks, and other defects.

iii) Execution

The work shall involve providing and laying plum concrete in layers. The rubble stones shall be embedded in freshly laid PCC mix and properly consolidated by ramming to eliminate voids. Adequate watering and curing shall be carried out to achieve the desired strength. Necessary dewatering shall be provided in case of water accumulation during concreting.

iv) Rate Inclusion

The quoted rate shall be inclusive of the cost and conveyance of all materials, labour charges, machine mixing, transportation, placement, ramming, watering, dewatering, finishing, and curing to complete the work in all respects.

v) Mode of Measurement

Measurement shall be taken in **cubic meters (cum)** of the finished volume of plum concrete laid, consolidated, and accepted at site.

Item No. 94- Supplying, Stacking & Spreading of Good Quality Red Earth**i) Applicable Codes & Standards**

The work shall be carried out as per approved design, drawings, specifications, and directions of **APMCF / SBI**. All red earth and manure shall be sourced from approved suppliers and conform to horticultural quality standards.

ii) Materials

The material shall consist of good quality red earth mixed with bio-organic manure in approved proportions. The earth shall be free from stones, harmful salts, weeds, or other deleterious materials.

iii) Execution

The red earth shall be supplied, stacked, and spread at site to the required depth for forming dome shapes, leveling, filling pits, and preparing flower beds around the surrounding wall. Proper mixing with bio-organic manure shall be ensured before spreading. The material shall be

spread, leveled, and consolidated neatly to achieve the required finish.

iv) Rate Inclusion

The quoted rate shall include cost of material (including royalty), bio-organic manure, labour, tools, equipment, stacking, spreading, levelling, watering, and all incidental works required for completing the work. For payment purposes, 20% deduction shall be made from the measured stack volume to account for voids.

v) Mode of Measurement

Measurement shall be taken in **cubic meters (cum)** of red earth (after deducting 20% voids) supplied, spread, leveled, and accepted at site.

Item No. 94-

Supplying & Planting of Shrubs

i) Applicable Codes & Standards

The horticulture works shall be carried out in accordance with the approved design, drawings, and directions of APMCF / SBI, and in conformity with good horticultural practices.

ii) Materials

The shrubs shall consist of **ornamental plants of various colours and species** suitable for covering edges, lawn boundaries, and areas at the base of tall trees. Indicative species include:

- Nerium Dwarf
- Tagar Green
- Variegated Acalypha (all colours)
- Green Lily
- Hibiscus
- Himalaya Pattern
- Syngonium
- Maranta Variegata
- Rhoeo Compacta
- Duranta Golden

The plants shall be of healthy nursery-grown stock, supplied in bags, with an **approximate height of 1 to 1.5 feet** at the time of planting.

iii) Execution

A total of 1500 shrubs (lump sum) for given area shall be supplied and planted at designated locations such as edges of lawn areas, boundary zones, and under-tree planting areas. Planting pits shall be prepared as per good horticultural standards, ensuring adequate space, soil enrichment, and proper compaction. Plants shall be laid with bags and watered immediately after planting.

iv) Rate Inclusion

The rate shall include supply of all shrubs, transportation, labour for planting, preparation of

planting beds, soil, manure, watering, and all incidental works. The contractor shall also ensure free-of-cost maintenance and survival guarantee for 6 months from the date of planting.

v) Mode of Measurement

Measurement shall be per Square Meter (Sq m) for 1500 shrubs supplied for a given area, planted, and accepted at site with survival for 6 months.

28.0 THEORETICAL CEMENT CONSUMPTION STATEMENT (BASE CPWD)

No	Description of item of work.	Quantity of cement to be used per Unit Quantity of work.	Unit.
1	Cement Concrete (Cast in Situ) Plain or Reinforced.		
a.	1:1:2 (1 Cement: 1 Sand :2 Graded Aggregate).	12.20 Bags.	Cubic Meter
b.	1 Cement:1.5 sand:3 Graded Aggregate).	8.00 Bags.	Cubic Meter
c.	1:2:4 (1 Cement: 2 Sand :4 Graded Aggregate).	6.40 Bags.	Cubic Meter
d.	1:3:6 (1 Cement: 3 Sand :6 Graded Aggregate).	4.40 Bags.	Cubic Meter
e.	1:4:8 (1 Cement: 4 Sand :8 Graded Aggregate).	3.40 Bags.	Cubic Meter
f.	1 Cement: 5 Sand :10 Graded Aggregate).	2.60 Bags.	Cubic Meter
g.	Providing and laying cement concrete 1:2:4 (1 Cement: 2 Coarse Sand: 4 Graded Aggregate of 20 mm. nominal size) including finishing exposed surface with 6 mm. thick cement mortar 1:3 (1 Cement: 3 Fine Sand). Krebs, Steps, and the like.	7.02 Bags.	Cubic Meter
h.	String or lacing courses, parapets, coping, bed blocks, anchor blocks, plain window sills and the like moldings in cornices, window sills etc.	7.62 Bags.	Cubic Meter
1.1	Ready Mix/Design mix Concrete		
	M20 & Above Grades	As per Approved Design Mix /RMC Batch Report	As per Approved Design Mix /RMC Batch Report
2.	Cement Mortar		
a.	1:1 (1Cement: 1 Sand)	20.40 Bags.	Cubic Meter
b.	1:2 (1Cement: 2 Sand)	13.60 Bags.	Cubic Meter
c.	1:3 (1Cement: 3 Sand)	10.20 Bags.	Cubic Meter
d.	1:4 (1Cement: 4 Sand)	7.60 Bags.	Cubic Meter
e.	1:5 (1Cement: 5 Sand)	6.20 Bags.	Cubic Meter

f.	1:6 (1Cement: 6 Sand)	5.00 Bags.	Cubic Meter
g.	1:2 (1Cement: 2 Stone Dust)	13.60 Bags.	Cubic Meter
h.	1:2 (1Cement: 2 Marble Dust)	13.60 Bags.	Cubic Meter
i.	1:5 (1Cement: 5 Marble Dust)	6.20 Bags.	Cubic Meter
j.	1:1:3 (1Cement: 1 Marble Dust: 3 Stone Dust)	7.60 Bags.	Cubic Meter
k.	White Cement Mortar 1:2 (1 White Cement: 2 Marble Dust)	13.60 Bags.	Cubic Meter
l.	White Cement Mortar 1:3 (1 White Cement: 3 Marble Dust)	10.20 Bags.	Cubic Meter
m.	White Cement Mortar 1:5 (1 White Cement: 5 Marble Dust)	6.20 Bags.	Cubic Meter
3.	Cement Lime Mortar		
a.	1:1:3 (1 Cement:1 Lime putty:3 Sand)	8.20 Bags.	Cubic Meter
b.	1:1:6 (1 Cement:1 Lime putty:6 Sand)	5.00 Bags.	Cubic Meter
4.	Brick Work in All Classes		
a.	In Cement Mortar 1:3 (1 Cement:3 Sand)	2.56 Bags.	Cubic Meter
b.	In Cement Mortar 1:4 (1 Cement:4 Sand)	1.90 Bags.	Cubic Meter
c.	In Cement Mortar 1:5 (1 Cement:5 Sand)	1.56 Bags.	Cubic Meter
d.	In Cement Mortar 1:6 (1 Cement:6 Sand)	1.24 Bags.	Cubic Meter
5.	Half Brick Work in All Classes		
a.	In Cement Mortar 1:3 (1 Cement:3 Sand) With or without hoop iron.	28.56 Bags per 100 Square Meter	
b.	In Cement Mortar 1:4 (1 Cement:4 Sand)	21.28 Bags per 100 Square Meter	
c.	In Cement Mortar 1:5 (1 Cement:5 Sand)	14.50 Bags per 100 Square Meter	
d.	Molding and cornices in brick masonry in cement mortar 1:4 Cement:4 Sand) Joining old brick work with new brick work.	0.18 Bags per 100 Square Meter per cm. Girth	
	a) Old Brick in metric or FPS. System with new brick work in metric system in cement mortar 1:4 (1 Cement: 4 Sand).	4.20 Bags per 100 Square Meter	
	b) Old Brick work in FPS. System with new brick work in cement mortar 1:4 (1 Cement: 4 Sand).	5.44 Bags per 100 Square Meter	

6.	Random Rubble Masonry		
a.	Cement Mortar 1:6 (1 Cement: 6 Sand)	1.70 Bags.	Cubic Meter
b.	Cement Lime Mortar 1:1:8 (1 Cement: 1 Lime Putty: 8 Sand)	1.32 Bags.	Cubic Meter
7.	Coursed Rubble Masonry		
a.	Cement Mortar 1:6 (1 Cement: 6 Sand)	1.50 Bags.	Cubic Meter
8.	Ashlar Masonry In plain ashlar punched (ordinary) in superstructure in cement mortar 1:6 (1 Cement: 6 Sand) including pointing with cement mortar 1:2 (1Cement:6 Stone dust) with an admixture of pigment matching the stone shade.	1.08 Bags.	Cubic Meter
9.	Stone Veneering Work For wall lining etc., average thickness 40 mm. to 170 mm. in cement lime mortar 1:1:6 (1Cement:1 Lime Putty:6 Sand) including pointing in White cement mortar 1:2 (1 White Cement: 2 Stone Dust) with an admixture of pigment matching the stone shade.	17.50 Bags per 100 Square Meter	
10.	Marble work in steps jambs, walls, pillars and other plain work in cement mortar 1:4 (1 Cement: 4 Sand) including pointing in White cement mortar 1:2 (1 Cement: 2 Marble dust).	0.136 Bags per 1.52 Bags per	Cubic Meter (Grey Cement) Cubic Meter (White Cement)
11.	Marble work in steps jambs, walls, pillars and other plain work in cement mortar 1:4 (1 Cement: 4 Sand) including pointing in cement mortar (1 Cement : 2 Marble dust).	1.66 Bags per	Cubic Meter
12.	Marble work for wall lining (Veneer) work) 2.5 cm. thick in cement mortar 1:3 (1 Cement : 3 Sand) including pointing in White cement mortar 1:2 (1 Cement : 2 Marble dust).	14.28 Bags per 100 Square Meter (Grey Cement) 3.40 Bags per 100 Square Meter (White Cement)	

13.	Marble work for wall lining (Veneer) work) 2.5 cm. thick in cement mortar 1:3 (1 Cement : 3 Sand) including pointing in cement mortar 1:2 (1 Cement : 2 Marble dust).	17.68 Bags per	Square Meter
14.	Marble work for wall lining (Veneer) work) 4 cm. thick in cement mortar 1:3 (1 Cement : 3 Sand) including pointing in White cement mortar 1:2 (1 Cement : 2 Marble dust).	20.40 Bags per 100 Square Meter. (Grey Cement) 3.40 Bags per 100 Square Meter (White Cement)	
15.	Marble work for wall lining (Veneer) work) 4 cm. thick in cement mortar 1:3 (1 Cement : 3 Sand) including pointing in cement mortar 1:2 (1 Cement : 2 Marble dust).	23.80 Bags per 100 Square Meter.	
16.	Cement Concrete Flooring Flooring 1:2:4 (1 Cement: 2 Sand : 4 Graded Stone Aggregate) finished with a floating coat of neat cement including cement slurry rounding of edges and strips etc., but excluding cost of nosing of steps etc., complete.		
a.	25 mm. thick with 20 mm. nominal size stone aggregate.	0.244 Bags	Square Meter
b.	40 mm. thick with 20 mm. nominal size stone aggregate.	0.34 Bags	Square Meter
c.	50 mm. thick with 20 mm. nominal size stone aggregate.	0.404 Bags	Square Meter
d.	75 mm. thick with 20 mm. nominal size stone aggregate.	0.564 Bags	Square Meter
17.	Cement Plaster Skirting (up to 30 cm. height) with cement mortar 1:3 (1 Cement: 3 Coarse Sand) finished with a floating coat of neat cement including rounding of junctions with floor, including slurry complete.		
a.	18 mm. thick.	0.32 Bags	Square Meter
b.	21 mm. thick.	0.35 Bags	Square Meter
18.	Pavement (25 to 50 mm. thick) with 1:2:4 (1 Cement: 2 Coarse	6.80 Bags	Cubic Meter

	Sand : 4 Graded Stone Aggregate 20 mm. nominal size) including finishing complete.		
19.	Terrazzo Flooring 40 mm. thick marble chips flooring rubbed and polished to granolithic finish, under layer 34 mm. thick cement concrete 1:2:4 (1 Cement: 2 Coarse Sand: 4 Graded Stone Aggregate 12.5 mm. nominal size) and top layer 6 mm. thick with white, black or white and black marble chips of size 1 mm. to 4 mm. nominal size laid in cement marble powder 3:1 mix. (3 Cement: 1 Marble Powder) by weight in proportion of 4:7 (4 Cement marble powder) by weight in marble powder mix:7 Marble chips) by volume including cement slurry etc., complete.		
a.	Dark shade / Light shade pigment with ordinary cement.	0.339 Bags per	Square Meter
b.	Light shade pigment with white cement.	0.258 Bags per 0.081 Bags per	Square Meter (Grey Cement) (White Cement)
c.	Medium shade pigment with approximately 50% white cement and 50% ordinary cement.	0.298 Bags Per 0.0440 Bags per	Square Meter (Grey Cement) (White Cement)
20	40 mm. thick marble chips flooring rubbed and polished to granolithic finish, under layer 31 mm. thick cement concrete 1:2:4 (1 Cement: 2 Coarse Sand: 4 Graded Stone Aggregate 12.5 mm. nominal size) and top layer 9 mm. thick marble chips, chips, size 4 to 7 mm. size, laid in cement marble powder mix. 3:1) (3 Cement : 1 Marble Powder) by volume in proportion of 4:7 (4 Cement marble powder mix. 7		

	Marble chips) by volume including cement slurry etc., complete.		
a.	Dark shade / Light shade pigment with ordinary cement.	0.357 Bags	Square Meter
b.	Light shade pigment with white cement.	0.241 Bags 0.116 Bags	Square Meter (Grey Cement) Square Meter (White Cement)
c.	Medium shade pigment with approximately 50% white cement and 50% ordinary cement.	0.299 Bags 0.058 Bags	Square Meter (Grey Cement) Square Meter (White Cement)
21	40 mm. thick marble chips flooring rubbed and polished to granolithic finish, under layer 28 mm. thick cement concrete 1:2:4 (1 Cement: 2 Coarse Sand: 4 Graded Stone Aggregate 12.5 mm. nominal size) and top layer 9 mm. thick marble chips, chips, sizes 7 mm to 10 mm. nominal size, laid in cement marble powder mix. 3:1) by weight in proportion of 2:3 (2 Cement Marble Powder mix. 3 Marble Chips) by volume including cement slurry etc., complete.		
a.	Dark or Light shade pigments with grey cement.	0.381 Bags	Square Meter
b.	Light shade pigment or without any pigment with white cement.	0.219 Bags 0.162 Bags	Square Meter (Grey Cement) Square Meter (White Cement)
c.	Medium shade pigment with approximately 50% grey cement and 50% white cement.	0.300 Bags 0.081 Bags	S.M. (Grey Cement) S.M. (White Cement)
22	Marble chips skirting (up to 300 mm high) rubbed and polished to granolithic finish top layer 6 mm. thick marble chips of sizes from		

	smallest to 4 mm. nominal size laid to cement marble powder mix. 3:1 (3 Cement: 1 Marble Powder mix. By weight in proportion of 4:7 (4 Cement Marble Powder mix: 7 marble chips) by volume including cement slurry complete.		
a.	18 mm. thick with under layer 12 mm. thick cement plaster 1:3 (1 Cement: 3 Coarse Sand) dark or light shade pigment with grey cement.	0.298 Bags	Square Meter
b.	Light shade pigment or no pigment with cement.	0.217 Bags Per Square Meter (Grey Cement) 0.081 Bags Per Square Meter (White Cement)	
c.	Medium shade colour pigment with 50% grey cement and 50% white cement.	0.258 Bags Per Square Meter (Grey Cement) 0.0406 Bags Per Square Meter (White Cement)	
d.	21 mm. thick with under layer 15 mm. thick cement plaster 1:3 (1 Cement: 3 Course Sand) dark or light shade pigment with grey cement.	0.327 Bags	Square Meter
e.	Light shade pigment or no pigment with white cement.	0.246 Bags Per Square Meter (Grey Cement) 0.081 Bags Per Square Meter (White Cement)	
f.	Medium shade pigment with 50% grey cement and 50% white cement.	0.286 Bags Per Square Meter (Grey Cement) 0.04 Bags Per Square Meter (White Cement)	
23.	Tile Flooring:		

a.	Precast terrazzo tiles 20 mm. thick white, black or white and black marble chips of size up to 6 mm. laid in floors treads of steps and landings jointed with neat cement slurry mixed with pigment to match the shade of the tile including rubbing polishing with precast tiles of 30 mm. thick bed of lime mortar 1:1.2 or 1:3 light shade using white cement.	0.088 Bags Per Square Meter (Grey Cement) 0.088 Bags Per Square Meter (White Cement)	
b.	Medium shade colour pigment with 50% white cement and 50% grey cement.	0.132 Bags Per Square Meter (Grey Cement) 0.044 Bags Per Square Meter (White Cement)	
c.	Dark shades using ordinary cement precast terrazzo tiles 20 mm. thick with marble chips of size 6 mm. in skirting and risers of steps not exceeding 30 cm. in height on wall, laid on 12 mm. thick cement plaster 1:3 mix. (1 Cement: 3 Sand) joint with neat cement slurry, light shades using white cement.	0.235 Bags Per Square Meter (Grey Cement) 0.044 Bags Per Square Meter (White Cement)	
d.	Medium shade colour pigment with 50% white cement and 50% ordinary cement.	0.257 Bags Per Square Meter (Grey Cement) 0.022 Bags Per Square Meter (White Cement)	
e.	Dark shades using ordinary cement.	0.279 Bags	Square Meter
24.	Checkered Terrazzo Tile Flooring		
a.	Checkered Terrazzo Tile 22 mm. thick with marble chips of sizes up to 6 mm. in floors, jointed with neat cement slurry mixed with pigment to match the shade of the tiles including robbing, polishing complete on 28 mm. thick bed of lime mortar 1:1.2 or 1:3.		

a.	Light shade using white cement.	0.088 Bags Per Square Meter (Grey Cement) 0.096 Bags Per Square Meter (White Cement)
b.	Medium shades using 50% grey cement and 50% white cement.	0.136 Bags Per Square Meter (Grey Cement) 0.048 Bags Per Square Meter (White Cement)
c.	Dark shade using grey cement.	0.184 Bags Per Square Meter (Grey Cement)
d.	Checkered Terrazzo Tile 30 mm. thick with marble chips of sizes up to 6 mm. in stairs, treads, jointed with neat cement slurry mixed with pigment to match the shade of the tiles including rubbing polishing rounding of nosing etc., complete on 20 mm. bed of : Lime mortar 1:1:1 (1 Lime putty:1 Surkhi:1 Coarse Sand) :	
i.	Light shade using white cement.	0.088 Bags Per Square Meter (Grey Cement) 0.136 Bags Per Square Meter (White Cement)
ii.	Medium shades using 50% grey cement and 50% white cement.	0.154 Bags Per Square Meter (Grey Cement) 0.066 Bags Per Square Meter (White Cement)
iii.	Dark shade using grey cement.	0.220 Bags Per Square Meter (Grey Cement)
e.	Cement mortar 1 :4 (1 Cement :4 Corse Sand)	
i.	Light shade using white cement.	0.258 Bags Per Square Meter (Grey Cement) 0.132 Bags Per Square Meter (White Cement)
ii.	Medium shades using 50% grey cement and 50% white cement.	0.324 Bags Per Square Meter (Grey Cement) 0.066 Bags Per Square Meter (White Cement)
iii.	Dark shade using grey cement.	0.39 Bags Square Meter (Grey Cement)
25.	White Glazed Tiles.	

	White Glazed Tiles 5,6 or 7 mm. thick in flooring treads risers of steps skirting and dado on 12 mm. thick cement plaster 1:3 (1 Cement: 3 sand) in base and cement joined with white cement slurry etc. complete.	0.188 Bags Per Square Meter (Grey Cement) 0.050 Bags Per Square Meter (White Cement)
26.	Marble Stone Flooring	
	Marble Stone slab flooring over 20 mm. thick base of lime mortar 1:1:1 (1 Lime putty:1 Surkhi:1 Sand) and jointed with grey cement slurry etc. (all marble slabs).	
a.	20 mm. thick	0.098 Bags Per Square Meter
b.	30 mm. thick	0.102 Bags Per Square Meter
c.	40 mm. thick	0.107 Bags Per Square Meter
	Marble stone slab flooring over 20 mm. thick base of cement mortar 1:4 (1 Cement:4 Sand) and jointed with grey cement slurry etc., (all marble slabs).	
d.	20 mm. thick	0.268 Bags Per Square Meter
e.	30 mm. thick	0.273 Bags Per Square Meter
f.	40 mm. thick	0.277 Bags Per Square Meter
g.	Extra if white cement slurry is used instead of grey cement slurry in joints of marble stone flooring.	0.015 Bags Per Square Meter (White Cement)
h.	Marble slabs 30 mm. thick in risers of steps, skirting dado, wall and pillars, laid on 12 mm. thick cement mortar 1:3 (1 Cement : 3 Sand) and jointed with grey cement slurry.	0.246 Bags Per Square Meter (White Cement)
27.	Kotah Stone Flooring	
	Kotah stone slab flooring over 20 mm. thick base of lime mortar 1:1:1 (1 Lime putty:1 Surkhi:1 Sand) and jointed with neat cement slurry etc.	
a.	25 mm. thick	0.128 Bags Per Square Meter
b.	30 mm. thick	0.136 Bags Per Square Meter
c.	40 mm. thick	0.152 Bags Per Square Meter
	Kotah Stone slab flooring over 20 mm. thick base of cement mortar	

	1:4 (1 Cement:4 Sand) and jointed with neat cement slurry etc.		
d.	25 mm. thick	0.298 Bags Per Square Meter	
e.	30 mm. thick	0.306 Bags Per Square Meter	
f.	40 mm. thick	0.322 Bags Per Square Meter	
g.	Kotah stone slab 25 mm. thick risers of steps, skirting, dado and pillar laid on 12 mm. thick cement mortar 1:3 (1 Cement:3 Sand) and jointed with neat cement slurry etc.	0.275 Bags Per Square Meter	
28	Sandstone Flooring		
a.	40 mm. thick sandstone flooring over 20 mm. thick base of cement mortar 1:5 (1 Cement :5 Sand) with joints finish flush.	0.155 Bags Per Square Meter	
b.	40 mm. thick sand stone flooring over 20 mm. thick base of cement mortar 1:5 (1 Cement :5 Sand) including pointing with cement mortar 1:2 (1 Cement: 2 Stone Dust).	0.186 Bags Per Square Meter	
c.	40 mm. thick sandstone flooring over 20 mm. thick base of lime mortar 1:1:1 (1 Lime :1 Surkhi:1 Sand) including pointing with cement plaster 1:2 (1 Cement :2 Stone Dust).	0.031 Bags Per Square Meter	
d.	40 mm. thick fine dressed and rubbed stone flooring over 20 mm. thick base of cement mortar 1:5 (1 Cement :5 Sand) with joints 5 mm. thick finished flush.	0.166 Bags Per Square Meter	
e.	40 mm. thick fine dressed and rubbed stone flooring over 20 mm. thick base of lime mortar 1:5 (1 Cement : 5 Sand) with joints 5 mm. thick including pointing with cement mortar 1:2 (1 Cement : 2 Stone Dust).	0.196 Bags Per Square Meter	

f.	25 mm. thick cast iron grid flooring using grid tiles of required size weighing 47 kg. per square meter on bed of 12 mm. thick cement concrete 1:2 (1 Cement : 2 Stone Aggregate 6 mm. nominal size) including filling the hollows with cement concrete same mix and tamping with 10 mm. dia. iron bars and grouting the joints with neat cement slurry complete.	0.025 Bags Per Square Meter
g.	Filling cement concrete 1:2:4 (1 Cement :2 Coarse Sand : 4 Graded Stone Aggregate 12.5 mm. nominal size) in gaps of A.C.Sheet corrugations and wings of ridges.	3.82 Bags Per Square Meter
29.	Cement Plaster	
a.	12 mm. 1:3 (1 Cement: 3 Sand).	14.68 Per 100 Square Meter
b.	12 mm. 1:4 (1 Cement: 4 Sand).	10.94 Per 100 Square Meter
c.	12 mm. 1:5 (1 Cement: 5 Sand).	8.92 Per 100 Square Meter
d.	12 mm. 1:6 (1 Cement: 5 Sand).	7.20 Per 100 Square Meter
e.	15 mm. 1:3 (1 Cement: 3 Sand).	17.54 Per 100 Square Meter
f.	15 mm. 1:4 (1 Cement: 4 Sand).	12.08 Per 100 Square Meter
g.	15 mm. 1:5 (1 Cement: 5 Sand).	10.66 Per 100 Square Meter
h.	12 mm. 1:6 (1 Cement: 6 Sand).	8.60 Per 100 Square Meter
i.	20 mm. 1:3 (1 Cement: 3 Sand).	22.84 Per 100 Square Meter
j.	20mm. 1:4 (1 Cement: 4 Sand).	17.02 Per 100 Square Meter
k.	20 mm. 1:5 (1 Cement: 5 Sand).	13.88 Per 100 Square Meter
l.	20 mm. 1:6 (1 Cement: 6 Sand).	11.20 Per 100 Square Meter
30.	Cement Plaster with a Floating Coat of neat cement	
a.	12 mm. 1:3 (1 Cement: 3 Sand).	19.08 Per 100 Square Meter
b.	12 mm. 1:4 (1 Cement: 4 Sand).	15.34 100 Per Square Meter
c.	12 mm. 1:3 (1 Cement: 3 Sand).	21.94 Per 100 Square Meter
d.	12 mm. 1:4 (1 Cement: 4 Sand).	17.48 Per 100 Square Meter
e.	15 mm. 1:3 (1 Cement: 3 Sand).	27.24 Per 100 Square Meter
f.	15 mm. 1:4 (1 Cement: 4 Sand).	21.42 Per 100 Square Meter
31.	Cement Plaster in two coats	
a.	20 mm. Cement Plaster in two coats under layer 12 mm. cement plaster 1:4 (1 Cement :4 Sand) finished with a top layer 8 mm. thick cement plaster 1:3 (1 Cement: 3 Sand)	20.00 Bags per 100 Square Meter

b.	18 mm. thick Cement Plaster in two coats under layer 12 mm. thick cement plaster 1:5 (1 Cement :5 Sand) finished with a top layer 6 mm. thick cement plaster 1:3 (1 Cement: 3 Sand)	16.26 Bags per 100 Square Meter
32.	6 mm. Cement Plaster	
a.	6 mm. Cement Plaster to ceiling 1:3 (1 Cement :3 Sand)	7.34 Bags per 100 Square Meter
b.	6 mm. Cement Plaster to ceiling 1:4 (1 Cement :4 Sand)	5.48 Bags per 100 Square Meter
c.	6 mm. Cement Plaster to ceiling 1:3 (1 Cement :3 Sand) finished with a floating coat of neat cement.	11.74 Bags per 100 Square Meter
d.	Neat Cement Punning.	4.40 Bags per 100 Square Meter
33.	Sand Cement Neeru Finished Plaster	
a.	Sand cement smooth neeru finished plaster for ceiling in cement mortar mix 1:4 (1 Cement :4 Sand), 10 to 15 mm. thick average, finished top smooth with neeru.	13.00 Bags per 100 Square Meter
b.	Sand cement smooth neeru finished plaster for walls in cement mortar mix 1:4 (1 Cement :4 Sand), 18 to 20 mm. thick average, finished top smooth with neeru.	19.00 Bags per 100 Square Meter
34.	Cast Iron Pipes	
	Providing and fixing on wall face C.I. rain water pipes including filling the joints with spun yarn soaked in neat cement slurry and cement mortar 1:2 (1 Cement: 2 Sand)	
a.	75 mm. dia pipe	0.132 Bags per 100 Running Meter
b.	105 mm. dia pipe	0.176 Bags per 100 Running Meter
c.	150 mm. dia pipe	0.264 Bags per 100 Running Meter
35.	Cast Iron Accessories	

	Providing and fixing on wall face C.I. Accessories for rain water pipes including filling the joints with spun yarn soaked in neat cement slurry and cement mortar 1:2 (1 Cement : 2 Fine Sand)		
a.	75 mm. dia pipe C.I. Plain bend.	0.0052	Each
b.	100 mm. dia pipe C.I. Plain bend.	0.0062	Each
c.	150 mm. dia pipe C.I. Plain bend.	0.010	Each
d.	75 mm. dia C.I. head flat or corner type.	0.003	Each
e.	100 mm. dia C.I. head flat or corner type.	0.003	Each
f.	150 mm. dia C.I. head flat or corner type.	0.0052	Each
g.	75 mm. dia C.I. plain shoe.	0.003	Each
h.	100 mm. dia C.I. plain shoe.	0.003	Each
i.	150 mm. dia C.I. plain shoe.	0.0052	Each
j.	75 mm.dia C.I. single branch (plain)	0.0052	Each
k.	100 mm. dia C.I. single branch (plain)	0.0062	Each
l.	150 mm. dia C.I. single branch (plain)	0.0010	Each
m.	75 mm.dia C.I. double branch (plain)	0.008	Each
n.	100 mm. dia C.I. double branch (plain)	0.009	Each
o.	150 mm. dia C.I. double branch (plain)	0.0052	Each
p.	C.I. off-sets (plain) 75 mm. dia. 55 mm. projection.	0.0052	Each
q.	C.I. off-sets (plain) 75 mm. dia. 150 mm. projection.	0.0052	Each
r.	C.I. off-sets (plain) 100 mm. dia. 55 mm. projection.	0.0052	Each
s.	C.I. off-sets (plain) 100 mm. dia. 55 mm. projection.	0.0062	Each
t.	C.I. off-sets (plain) 100 mm. dia. 75 mm. projection.	0.0062	Each
36.	A.C. Fittings & Pipes		

	Providing and fixing on wall face asbestos cement rainwater pipes including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 Cement 2 Coarse Sand) complete.				
a.	50 mm. dia.	0.150	Per 100 Running Meter		
b.	80 mm. dia.	0.250	Per 100 Running Meter		
c.	100 mm. dia.	0.300	Per 100 Running Meter		
d.	150 mm. dia.	0.320	Per 100 Running Meter		
e.	Providing and fixing A.C. Pipe (or any diameter) wall plugs and standard holder bat clamps comprising of two semi-circular halves of flat and cast-iron base screwed on wooden plugs.	0.0004	Per 100 Running Meter		
f.	Providing and fixing on wall face asbestos cement rainwater pipes including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 Cement 2 Coarse Sand) complete.				
		50 mm. (2")	80 mm. (3")	100 mm. (4")	Unit
g.	Bend of required degree with door or without door.	0.0072	0.012	0.015	Each
h.	Off-set 52.2 mm. projection.	0.0058	0.0090	0.0116	Each
i.	Off-set 76.2 mm. projection.	0.0058	0.0090	0.011	Each
j.	Off-set 114.3 mm. projection.	0.0058	0.0090	0.0116	Each
k.	Off-set 152.4 mm. projection.	0.0058	0.0090	0.0116	Each
l.	Off-set 228.6 mm. projection.	0.0058	0.0090	0.0116	Each
m.	Off-set 304.8 mm. projection.	--	0.0090	0.0116	Each
n.	Off-set 457.2 mm. projection.	--	0.0090	0.0116	Each
o.	Off-set 609.6 mm. projection.	--	--	0.0116	Each
p.	Junction equal single of required degree with or without door.	0.0072	0.0116	0.0146	Each
q.	Junction equal double with or without door or required degree.	0.0108	0.0174	0.0220	Each
r.	Standard shoe.	0.004	0.0058	0.0058	Each

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37.	Sanitary Fittings			
a.	Fixing long pan pattern or Orissa pattern squatting pan or pedestal type water closet 12.5 liters or 15 liters flushing cistern and brackets, telescopic flush pipe or bend with fittings and clamps, overflow pipe with specials and mosquito proof coupling complete including cutting and making good the walls and floors.	0.10		Each
	Fixing flat back or wall corner type, lipped front, urinal basin of 430 x 260 x 350 mm. and 340 x 430 x 265 mm. size respectively, white glazed earthenware with automatic C.I. flushing cistern with fittings, brackets, standard size flush pipe and spreaders with brass union and G.I. clamps complete including painting of cistern and fittings, cutting and making good the walls and floors.	0.050		Each
b.	One urinal basin with 5 liters C.I. automatic flushing cistern.	0.050		Each
c.	Range of two urinal basins with 10 liters C.I. automatic flushing cistern.	0.08		Each
d.	Range of three urinal basins with 10 liters C.I. automatic flushing cistern.	0.134		Each
e.	Range of four urinal basins with 15 liters C.I. automatic flushing cistern.	0.190		Each
	Fixing white glazed fire clay stall urinal with automatic C.I. flushing cistern with fittings R.S. or C.I. brackets standard size C.P. brass flush pipe and spreaders with unions and clamps, C.I. trap			

	with outlet grating and other coupling in C.P. brass including painting of cistern and fittings, cutting and making good the walls and floors.		
f.	Single stall urinal with 5 liters C.I. automatic flushing cistern.	0.102	Each
g.	Range of two urinal basins with 10 liters C.I. automatic flushing cistern.	0.204	Each
h.	Range of three urinal basins with 10 liters C.I. automatic flushing cistern.	0.306 Bags	Each
i.	Range of four urinal basins with 15 liters C.I. automatic flushing cistern.	0.406 Bags	Each
	Fixing one-piece construction white squatting plate urinal with an integral longitudinal flushing pipe 100 mm. dia. half round channel automatic C.I. flushing cistern with fittings R.S. or C.I. brackets, standard size. G.I. flush pipe for back and front flush with standard spreader pipes with fittings G.I. clamps, white vitreous tiling 1200 mm. high to the front and side walls with white vitreous china corners and angles set in neat cement, standard urinals C.I. trap 65 mm. diameter with vent arm and outlet grating and coupling in C.P. brass complete, including painting the cistern and fittings and making good the walls and floors.		
j.	Single squatting plate with 5 liters C.I. automatic flushing cistern.	0.102 Bags	Each
k.	Range of two squatting plates with 10 liters C.I. automatic flushing cistern.	0.204 Bags	Each
l.	Range of three squatting plates with 10 liters C.I. automatic	0.306 Bags	Each

	flushing cistern.		
m.	Range of four squatting plates with 15 liters C.I. automatic flushing cistern.	0.406 Bags	Each
n.	Fixing lavatory basin with brackets, pillar taps, rubber plug, waste of standard pattern, trap and unions complete including cutting and making good the walls.	0.050 Bags	Each
o.	Fixing white pedestal for wash basin completely recessed at the back for reception of pipes and fittings.	0.032 Bags	Each
p.	Fixing sink with brackets, 40 mm. rubber plus, brass chain, waste, trap with necessary unions complete including cutting and making good the walls.	0.050 Bags	Each
q.	Fixing teal-wood draining board with skirting and beading, wax polished with brackets painted white complete including making good the walls.	0.028 Bags	Each
38.	Sanitary Fittings (Items separately ordered)		
a.	Fixing long pan pattern or Orissa pattern squatting, or pedestal type W.C. pan.	0.050 Bags	Each
b.	Fixing a pair of white glazed earthenware or vitreous china footrests of standard pattern for Indian type W.C. pan.	0.010 Bags	Each
c.	Fixing flat back or wall corner type lipped front urinal basin of 430 x 260 x 350 mm. and 340 x 430 x 265 mm.	0.020 Bags	Each
d.	Fixing white glazed fire clay stall urinal of standard size.	0.04 Bags	Each
e.	Fixing white squatting plate urinal with integral longitudinal flush pipe. .	0.040 Bags	Each
f.	Fixing wash basin including making all connections excluding cost of fittings.	0.030 Bags	Each

g.	Fixing kitchen sink including making all connections complete.	0.030 Bags	Each
h.	Fixing in position 32 mm. diameter galvanised steel telescopic flush pipe complete including cutting and making good the walls and floor.	0.020 Bags	Each
39.	Sand Cast Iron Pipe and Fittings		
a.	Fixing M.S. holder bat clamp to 100 mm. dia. sand cast iron pipe embedded in cement concrete blocks 10 x 10 x 10 cm. of cement concrete 1:2:4 (1 Cement: 2 Sand : 4 Stone Aggregate) including cost of cutting holes and making good the walls etc.	0.010 Bags	Each
b.	Fixing M.S. stays and clamps for 100 mm. diameter sand cast iron pipe.	0.010 Bags	Each
c.	Fixing M.S. holder bat clamps for 50 mm. diameter sand cast iron pipe embedded in cement concrete block 10 x 10 x 10 cm. of 1:2:4 (1 Cement: 2 Sand : 4 Stone Aggregate) including cost of cutting holes and	0.010 Bags	Each
	making good the walls etc.		
d.	Fixing M.S. stays and clamps for 50 mm. diameter sand cast iron pipe.	0.010 Bags	Each
e.	Fixing sand cast iron trap 100 mm. inlet 100 mm. outlet of self-cleaning design with sand cast iron screwed down or hinged grating with or without vent arm complete including cost of cutting without and making good the walls and floor.	0.050 Bags	Each
f.	Fixing 100 mm. inlet and 50 mm. outlet sand cast iron floor trap of self-cleaning design with sand cast iron screwed down or hinged grating with or without vent arm complete including cost	0.050 Bags	Each

	of cutting and making good the walls and floors.		
40.	Asbestos Cement Soil, Waste and Vent Pipes and Fittings		
	Providing and fixing on wall face asbestos cement soil waste and vent pipe including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 Cement: 2 Sand) complete.		
a.	For 100 mm. diameter.	0.300 Bags	100 Meter
b.	For 50 mm. diameter.	0.150 Bags	100 Meter
	Fixing wooden plugs and standards holder bat clamps comprising of two semicircular halves of flat iron and cast-iron base screwed on wooden plugs.		
c.	For 100 mm. diameter.	0.0004 Bags	Each
d.	For 50 mm. diameter.	0.0004 Bags	Each
	Providing and fixing A.C. bends of required degree with access door insertion rubber washer 3 mm. thick, bolts and nuts or plain bend of heel rest unitary bend including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 Cement: 2 Sand)		
e.	For 100 mm. diameter.	0.0020 Bags	Each
f.	For 50 mm. diameter.	0.0010 Bags	Each
	Providing and fixing double equal or unequal A.C. junctions of required degree plain or with access door, insertion, rubber washer 3 mm. thick bolts and nuts, including jointing with spun yarn cement mortar 1:2 (1 Cement: 2 Sand) complete.		
g.	100 x 100 x 100 x 100 mm. double equal junctions or 100 x 100 x 50 x 50 mm. double unequal junctions.	0.004 Bags	Each
h.	50 x 50 x 50 50 mm. double equal junctions.	0.002 Bags	Each
	Providing and fixing single equal or unequal A.C. junctions of		

	required degree plain or with access door, insertion, rubber washer 3 mm. thick bolts and nuts, including jointing with spun yarn cement mortar 1:2 (1 Cement: 2 Sand) complete.		
i.	100 x 100 x 100 x 100 mm. single equal junctions or 100 x 100 x 50 x 50 mm. single unequal junctions.	0.0030 Bags	Each
j.	50 x 50 x 50 50 mm. single equal junctions.	0.0016 Bags	Each
	Providing and fixing plain A.C. invert branch of required degree including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 Cement: 2 sand).		
l.	50 x 50 x 50 x 50 mm.	0.002 Bags	Each
m.	50 x 50 x 50 x 50 mm.	0.0016 Bags	Each
	Providing and fixing A.C. offset including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 Cement: 2 Sand)		
n.	100 mm. dia. A.C. offset with any projection.	0.002 Bags	Each
o.	50 mm. dia. A.C. offset with any projection.	0.0010 Bags	Each
	Providing and fixing A.C. loose socket including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 Cement: 2 Sand) complete.		
p.	100 mm.	0.002 Bags	Each
q.	50 mm.	0.0010 Bags	Each
	Providing and fixing A.C. Terminal guard including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 Cement: 2 Sand).		
r.	100 mm.	0.002 Bags	Each
s.	50 mm.	0.0010 Bags	Each
t.	Cutting chase in brick masonry walls for fixing 100 mm diameter sand cast iron pipes and making good the same with brick work in	10.00 Bags	100 Meter

	cement mortar 1:3 (1 Cement: 3 Sand)		
u	Cutting chase in brick masonry walls for fixing 50 mm. diameter sand cast iron pipes and making good the same with the brick work in cement mortar 1:3 (1 Cement: 3 Sand).	6.66 Bags	100 Meter
8.	Drainage		
	Jointing glazed stone ware pipes grade "A" with stiff mixture of cement mortar in the proportion of 1:1 (1 Cement: 1 Sand)		
a.	100 mm. dia.	4.34 Bags	100 Meter
b.	150 mm. dia.	6.46 Bags	100 Meter
c.	200 mm. dia.	8.66 Bags	100 Meter
d.	230 mm. dia.	9.74 Bags	100 Meter
e.	250 mm. dia.	10.80 Bags	100 Meter
f.	300 mm. dia.	12.94 Bags	100 Meter
g.	450 mm. dia.	19.54 Bags	100 Meter
	Laying cement concrete 1:5:10 (1 Cement: 5 Sand : 10 Graded Stone Aggregate 40 mm. nominal size) around S.W. pipe including bed concrete 15 cm. thick.:		
h.	100 mm. dia. S.W. Pipe.	47.32 Bags	100 Meter
i.	150 mm. dia. S.W. Pipe.	50.70 Bags	100 Meter
j.	200 mm. dia. S.W. Pipe.	58.24 Bags	100 Meter
k.	230 mm. dia. S.W. Pipe.	62.92 Bags	100 Meter
l.	250 mm. dia. S.W. Pipe.	66.04 Bags	100 Meter
m.	300 mm. dia. S.W. Pipe.	73.58 Bags	100 Meter
n.	350 mm. dia. S.W. Pipe.	81.12 Bags	100 Meter
o.	400 mm. dia. S.W. Pipe.	88.40 Bags	100 Meter
p.	450 mm. dia. S.W. Pipe.	96.20 Bags	100 Meter
	Laying cement concrete 1:5:10 (1 Cement: 5 Sand : 10 Graded Stone Aggregate 40 mm. nominal size) up to haunches of S.W. pipe including bed concrete 15 cm. thick.:		
q.	100 mm. dia. S.W. Pipe.	31.72 Bags	100 Meter
r.	150 mm. dia. S.W. Pipe.	34.84 Bags	100 Meter
s.	200 mm. dia. S.W. Pipe.	40.56 Bags	100 Meter
t.	230 mm. dia. S.W. Pipe.	44.20 Bags	100 Meter
u.	250 mm. dia. S.W. Pipe.	46.54 Bags	100 Meter

v.	300 mm. dia. S.W. Pipe.	52.26 Bags	100 Meter
w.	350 mm. dia. S.W. Pipe.	58.24 Bags	100 Meter
x.	400 mm. dia. S.W. Pipe.	62.96 Bags	100 Meter
y.	450 mm. dia. S.W. Pipe.	69.94 Bags	100 Meter
z.	Laying light duty non-pressure NP2 or P1 class R.C.C. pipes with collars jointed with stiff mixture of cement mixture of cement mortar in the proportion of 1:2 (1 Cement: 2 Sand) including joints etc.		
Z1.	100 mm. dia. R.C.C. pipe (NP2) or (P1)	1.00 Bags	100 Meter
Z2.	150 mm. dia. R.C.C. pipe (NP2) or (P1)	1.20 Bags	100 Meter
Z3	250 mm. dia. R.C.C. pipe (NP2) or (P1)	1.80 Bags	100 Meter
Z4.	300 mm. dia. R.C.C. pipe (NP2) or (P1)	2.20 Bags	100 Meter
Z5.	450 mm. dia. R.C.C. pipe (NP2) or (P1)	4.80 Bags	100 Meter
Z6.	500 mm. dia. R.C.C. pipe (NP2) or (P1)	5.20 Bags	100 Meter
Z7.	600 mm. dia. R.C.C. pipe (NP2) or (P1)	6.40 Bags	100 Meter
Z8.	700 mm. dia. R.C.C. pipe (NP2) or (P1)	7.40 Bags	100 Meter
Z9.	800 mm. dia. R.C.C. pipe (NP2) or (P1)	8.40 Bags	100 Meter
Z10	900 mm. dia. R.C.C. pipe (NP2) or (P1)	9.80 Bags	100 Meter
Z11	1000 mm. dia. R.C.C. pipe (NP2) or (P1)	11.00 Bags	100 Meter

**MEP WORKS
DETAILED TECHNICAL SPECIFICATIONS**

29.0 TECHNICAL SPECIFICATIONS PLUMBING WORK**SCOPE OF WORK**

The form of Contract shall be according to the "Conditions of Contract". The following clauses shall be considered as an extension and not in limitation of the obligation of the Contractor.

Work under this Contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the plumbing and other specialized services as described hereinafter and as specified in the Bill of Quantities and/or shown on the plumbing drawings.

Without restricting the generality of the foregoing, the sanitary installations shall include the following: -

Plumbing Works

Sanitary Fixtures & C.P Brass Fittings installation only

Soil, Waste, Vent, Rainwater Pipes & Fittings

Water supply pumps, piping & accessories

Services rendered under this section shall be done without any extra charge.

ASSOCIATED CIVIL WORKS

Following civil works associated with Plumbing installation are excluded from the scope of this contract except for all minor civil work like wall chasing by wall chaser, making holes etc. for installation of pipes and making good. These shall be executed by other agencies in accordance with approved shop drawings of, and under direct supervision of the electrical contractor.

RCC works for underground and overhead tanks

PCC foundation blocks for all pump sets.

Repair of all disturbed surfaces/openings made by Plumbing Contractor.

SPECIFICATIONS

Work under this Contract shall be carried out strictly in accordance with specifications attached with the tender.

Items not covered under these specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per specifications of the latest Central Public Works Department with up-to-date amendments as applicable in the Contract.

Works not covered under Para 2.1 and 2.2 shall be carried out as per relevant Codes & Bureau of Indian Standards and in case of its absence as per British Standard Code of Practice.

EXECUTION OF WORK

The Contractor should visit and examine the site of work and satisfy himself as to the nature of the existing roads and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding, incorrect information on any of these points or on grounds of insufficient description will be allowed.

The work shall be carried out in conformity with the Plumbing drawings and within the requirements of architectural, HVAC, electrical, structural and other specialized services drawings.

The Contractor shall cooperate with all trades and agencies working on the site. He shall make

provisions for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction schedule. All support to the civil structure shall be provided with dash fasteners as per approved make only.

On award of the work, Contractor shall submit a schedule of construction in the form of a PERT chart or BAR chart for approval of the Engineer-in-charge/Architect/ Consultant. All dates and time schedule agreed upon shall be strictly adhered to within the stipulated time of completion/

commissioning along with the specified phasing, if any.

DRAWINGS

Contract drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the architectural and other services drawings.

Architectural drawings shall take precedence over plumbing or other services drawings as to all dimensions.

Contractor shall verify all dimensions at site and bring to the notice of the Engineer-in-charge all discrepancies or deviations noticed. Decision of the Engineer-in-charge shall be final.

Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small scale drawings.

Any drawings issued by the Architects/Consultant for the work are the property of the Architects/ Consultant and shall not be lent, reproduced or used on any works other than intended without the written permission of the Architects/Consultant.

INSPECTION AND TESTING OF MATERIALS

Contractor shall be required, to produce manufacturers test certificate for the particular batch of materials supplied to him. Contractor may be required to get the material tested from outside approved laboratory for confirmation of material as per PM/Client instruction as and when required. The tests carried out shall be as per the relevant Bureau of Indian Standards.

For examination and testing of materials and works at the site Contractor shall provide all testing and gauging equipment necessary but not limited to the following:

Steel tapes

Weighing machine

Plumb bobs, spirit levels, hammer

Micrometers

Hydraulic

All such equipment shall be tested for calibration at approved laboratory, if required by the Engineer-in-charge. All testing equipment shall be preferably located in special room meant for the purpose.

Samples of all materials shall be got approved by Architect/ PM and Client and should be first make of the approved make list before placing order and the approved samples shall be deposited with the Engineer-in-charge.

METRIC CONVERSION

All dimensions and sizes of materials and equipment given in the tender document are Commercial metric sizes. Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable

without any additional cost.

REFERENCE POINTS

Contractor shall provide permanent bench marks, flag tops and other reference points and check that with other agencies to confirm the same reference point for all the proper execution of work and these shall be preserved till the end of the work.

1. All such reference points shall be in relation to the levels and locations, given in the architectural and plumbing drawings.

REFERENCE DRAWINGS

The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site. All important drawings shall be mounted on boards and placed in racks indexed. No drawings shall be rolled.

All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings to be submitted by the contractor in fulfillment of the conditions of this contract.

On award of the work the contractor shall be issued four sets of consultant's working drawings stamped "good for construction" by the Engineer-in-charge. The consultant's drawings shall be the basis of contractor's shop drawings. In addition, the Engineer-in-charge shall also be issue one copy of the Interior Designer's; Electrical & HVAC approved shop drawings relevant to his work for coordination purpose.

Shop drawings are detailed working drawings which incorporate the contractor's details for execution of the work and incorporate equipment manufacturer's details and dimensions to ensure that the same can be installed in the space provided.

All shop drawings should detailed pipe routing and levels, showing location of other services at crossings etc., cable runs, route cable trays and all allied works and must be fully co-ordinated with other services and approved by the Engineer-in-charge before execution of the works. Engineer-in-charge shall arrange to issue two copies/prints of services drawings from the respective contracting agencies. All drawings will be valid only when stamped and issued by the Engineer-in-charge.

Shop drawings shall also be furnished for detailed layout of all equipment, foundation, bolting and vibration elimination details along with information on dead and dynamic load, vibration etc.

Six sets of manufacturer's equipment drawings, roughing in and wiring diagrams shall be submitted.

Contractor shall submit shop drawings furnishing all details of MCC panels, cable routes, wiring diagrams and connection details as required.

Three copies of each set of shop drawings shall be submitted for initial scrutiny, discussion and approval.

Each submission shall be accompanied by contractor's certificate stating that the shop drawings meet all the contract requirements and that the piping and equipment can be satisfactorily installed without any obstructions in the space available.

On approval of the above the contractor shall furnish six sets of the approved shop drawings for execution of the work

COMPLETION DRAWINGS

On completion of work, Contractor shall submit one complete set of original tracings and three prints of "as built" drawings to the PM duly approved and stamped by Consultant. These drawings shall have the following information:

Run of all piping, diameters on all floors, vertical stacks and location of external services.

Ground and invert levels of all drainage pipes together with location of all manholes and connections up to outfall / final disposal point of GIFT.

Run of all water supply lines with diameters, locations of control valves, access panels.

Location of all mechanical equipment with layout and piping connections and mechanical equipment.

All shop drawings shall be updated from time to time for the purpose of making Completion drawings.

No completion certificate shall be issued unless the above drawings are submitted.

Contractor shall provide four sets of catalogues, service manuals manufacturer's drawings, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.

All "warranty cards" given by the manufacturers shall be handed over to the Engineer-in-charge.

CONTRACTOR'S RATES

Rates quoted in this tender shall be inclusive of cost of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, all taxes, octroi and levies, breakage, wastage and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.

Rates quoted are for all heights and depths and in all positions as may be required for this work. All rates quoted must be for complete items inclusive of all such accessories, fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specially mentioned otherwise.

All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/concrete/water proofing of appropriate mix and strength as directed by the Engineer-in-charge. Contractor shall provide holes, sleeves, recesses in the concrete and masonry work as the work proceeds. All hot and cold water supply pipes crossing masonry walls and floors shall be provided with G.I. pipe sleeves. The annular space between the pipe and sleeve shall be filled up with fire proof sealant after testing. Contractor shall give the pipe sleeves to the civil contractor well in time so that the same can be fixed along with civil works. Any co- ordination gap shall be of Plumbing contractor's responsibility.

The Contractor shall furnish the Engineer-in-charge with vouchers & test certificates, to prove that the materials are as per the specification and to indicate that the rates at which the materials are purchased are in order to work out the rate analysis of non-tendered items which he may be called upon to carry out.

TESTING

Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.

Tests shall be performed in presence of the Engineer-in-charge and test records for the tests shall be duly signed by Plumbing Consultant, Contractor and the Engineer-in-charge.

All materials and equipment found defective shall be replaced at contractor cost and whole work shall be tested to meet the requirements of the specifications.

Contractor shall perform all such tests as may be necessary and required by the local authorities to meet municipal or other bye-laws in force.

Contractor shall provide all labour, equipment and materials for the performance of the tests at no extra cost.

SITE CLEARANCE AND CLEANUP

The Contractor shall, from time to time, clear away all debris and excess materials accumulated at the site. Failing of which attract penalties.

After the fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints, stains, stickers and other foreign matter or discoloration leaving the same in a ready to use condition. The equipment installed shall be protected by contractor till formal handing over takes place by Client.

On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done by the Engineer-in-charge at the Contractor's risk and cost. Cost of the cleanup shall be deducted from the contractor's bills on pro-rata basis in proportion to his contract value.

LICENSE PERMITS AND AUTHORITIES

Contractor must hold a valid plumbing or any other license as required by the municipal authority or other competent authority under whose jurisdiction the work falls.

Contractor must keep constant liaison with the local development, municipal/statutory authority and obtain approval of all drainage, water supply, fire suppression and other works carried out by him.

Contractor shall obtain from the municipal and other governing authorities 'C' & 'D' forms/Applicable NOCs/ approval of drainage and water supply works during execution and the completion certificate with respect to his work as required for occupation of the building. The Contractor shall obtain permanent water supply and drainage connections from authorities concerned. SBI shall re-imburse the fees paid to the authorities towards the connection charges the production of receipts for money paid.

Contractor shall get any materials tested from the appropriate authority if so, required at no extra cost.

RECOVERY OF COST FOR MATERIALS ISSUED TO CONTRACTORS

If any materials issued to the Contractor free of cost are damaged or pilfered, when in his possession, the cost of the same shall be recovered from the Contractor on the basis of actual cost to owner. The cost shall include the cost paid, freight, transportation, excise duty, sales tax, octroi, import duty and other levies, plus 100% as penalty. The decision on the actual cost given by the Employer shall be final and binding on the Contractor.

Contractor has to keep full records of material issued by the owner with reference and challans etc. Contractor has to give account of all such materials to the Engineer-in-charge

CUTTING OF WATER PROOFING MEMBRANE:

1. No walls terraces shall be cut for making and opening after water proofing has been done without written approval. Cutting of water proofing membrane shall be done very carefully so as other portions of water proofing is not damaged. On completion of work at such place the water

proofing membrane shall be made good and ensured that the opening/cutting is made fully waterproof as per specifications and details of water proofing approved by Engineer-in-charges. Actual cost of any damage to finished work by contractor shall be recovered from Plumbing Contractor.

CUTTING OF STRUCTURAL MEMBERS

No structural member shall be chased or cut without the written permission of the Engineer-in-charge. Any damage to the structure shall be on contractor's account.

MATERIALS SUPPLIED BY EMPLOYER

The Contractor shall verify that all materials supplied by the employer conform to the specifications of the relevant item in the tender. Any discrepancies found shall be brought to the notice of the Engineer-in-charge.

MATERIALS

Contractor to procure material as per first make from approved make list only unless otherwise specified and expressly approved in writing by the Engineer-in-charge/Client.

If required, the Contractor shall submit samples of materials proposed to be used in the works. Approved samples shall be kept in the office of the Engineer-in-charge.

2 SPECIFICATIONS FOR SANITARY FIXTURES & C.P BRASS FITTINGS

SCOPE OF WORK

Work under this section shall consist of furnishing all materials & labour necessary and required to completely install all sanitary fixtures, chromium-plated fittings and accessories as required by the drawings specified hereinafter and given in the Bill of Quantities.

Without restricting to the generality of the foregoing the sanitary fixtures shall include the following: -

Sanitary fixtures

Chromium plated fittings

Porcelain or stainless-steel sinks

Accessories e.g. towel rails, toilet paper holders, coat hooks etc.

Whether specifically mentioned or not, all fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.

All exposed pipes within toilets and near fixtures shall be chromium plated brass or copper unless otherwise specified.

GENERAL REQUIREMENTS

Sanitary fixtures shall be of the best quality approved by the Architect / Consultant / PM / Client. Wherever particular makes are mentioned, the choice of selection shall remain with the Architect / Consultant / PM / Client.

All fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Bill of Quantities, specifications, drawings. Accessories shall include proper fixing arrangement, brackets, nuts, bolts, screws and required connection pieces.

Fixing screws shall be half round head chromium plated brass screws with C.P. washers where necessary.

Contractor shall furnish without cost all such accessories and fixing devices that are necessary and required but not supplied along with the Plumbing Fixtures & CP Fittings by the manufacturers as a part of the original and standard supply.

All fittings and fixtures shall be fixed in a neat workmanlike manner true to level and heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractor's cost.

Contractor seal all fixtures fixed near wall, marble and edges. With an approved type of polysulphide sealant appropriate for its application.

EUROPEAN W.C

European W.C. shall be washed down or siphonic type wall mounted set flushed by means of dual flushing concealed Flush Valve which will be an integral part of the system. Framework, walling and finishing will not form a part of the contractor's work, where applicable flush pipe / bend shall be connected to the W.C. by means of a suitable rubber adapter. Wall hung W.C. shall be supported by C.I. floor mounted chair.

Each W.C. set shall be provided with a plastic seat shall be with rubber buffers and chromium

plated hinges.

Plastic seats shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C. Each W.C. shall be suitable for flushing in low volume of water 5-6 litres. Flushing Valve shall be provided with all internal flushing mechanism, 32/40 mm dia ball valve. Any framework required for fixing valve has to be provided by the contractor.

LAVATORY BASIN

Lavatory basins shall be white glazed vitreous china of size, shape and type specified in the Schedule of Quantities.

Each basin shall be provided with brackets and clips of approved and securely fixed. Placing of basins over the brackets without secure fixing shall not be accepted.

Each basin shall be provided with 32 mm dia C.P. waste with overflow, pop-up waste or rubber plug and chain as specified in the Bill of Quantities, 32 mm dia C.P. brass bottle trap with C.P pipe to wall and flange.

Each basin shall be provided with Pillar Tap as specified in the Bill of Quantities.

Basins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cms or as directed by Engineer-in-charge.

SINKS

Sinks shall be white glazed fireclay or vitreous china or stainless steel or any other material as specified in the Bill of Quantities.

Each sink shall be provided with brackets of approved and securely fixed. Counter top sinks shall be fixed with suitable brackets or clips as recommended by the manufacturer. Each sink shall be provided with 40 mm dia C.P. waste with chain and plug as given in the Bill of Quantities. Fixing shall be done as directed by Engineer-in-charge.

Supply fittings for sinks shall be mixing fittings or C.P. taps as specified in the Bill of Quantities.

URINALS

Urinals shall be white glazed vitreous china of size, shape and type specified in the Bill of Quantities.

Bowl urinals shall be provided with 15 mm dia C.P spreader, 40mm dia stainless steel domical waste and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by C.I. brackets and C.I. wall clips as recommended by manufacturers complete as directed by Owner's Site Representative.

Urinals shall be fixed with C.P. brass screws and shall be provided with 32 mm dia domical waste leading to urinal's trap.

Flush pipes shall be G.I. pipes concealed in wall chase but with chromium plated bends at inlet and outlet or as given in Bill of Quantities. Urinals shall be flushed by means of brass ball valves.

Waste pipes for urinals shall be uPVC pipes. Waste pipes may be exposed on wall or concealed in chase as directed by the Specifications.

URINAL PARTITIONS

Urinal partitions shall be white glazed vitreous china, marble, granite or any other material selected by the Owner's Site Representative. The same shall be fixed by Contractor executing the finishing work. The exact location shall however be co oriented by the Plumbing Contractor.

Urinal partitions shall be fixed at proper heights with C.P. brass bolts, anchor fasteners and M.S.

Clips as recommended by the manufacturer and directed by Owner's Site Representative

ACCESSORIES

Contractor shall install all chromium plated and porcelain accessories as shown on the drawings or directed by the Engineer-in-charge.

All C.P. accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with rawal plugs or nylon sleeves and shall include cutting and making good as required or directed by Engineer-in-charge.

Recessed porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work as per Interior Designer's drawings.

FINAL INSTALLATION

The contractor shall install all sanitary fixtures and fittings in their position in accordance with approved trial assemblies and as shown on drawings. The installation shall be completed with all supply and waste connections. The connection between building and piping system and the sanitary fixtures shall be through proper unions and flanges to facilitate removal/replacement of sanitary fixtures without disturbing the built in piping system. All unions and flanges shall match in appearance with other exposed fittings.

Fixtures shall be mounted rigid, plumb and to alignment. The outlets of water closet pans and similar appliances shall be examined to ensure that outlet ends are butting on the receiving pipes before making the joints. It shall be ensured that the receiving pipes are clear of obstruction. When fixtures are being mounted, attention shall be paid to the possibility of movement and settlement by other causes. Overflows shall be made to ensure that the necessary anchoring devices have been provided for supporting water closets, wash basins, sinks and other appliances.

PROTECTION AGAINST DAMAGE

The contractor shall take every precaution to protect all sanitary fixtures against damage, misuse, cracking, staining, breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation. At the time of handling over, the contractor shall clean, disinfect and polish all the fixtures and fittings. Any fixtures and fittings found damaged, cracked chipped stained or scratched shall be removed and new fixtures and fittings free from defects shall be installed at his own cost to complete the work.

MEASUREMENT

Sanitary fixtures and accessories shall be counted by numbers in the unit given in the Bill of Quantities.

Rates for all items shall be inclusive of cutting holes and chases and making good the same, C.P Brass screws, nuts, bolts and any fixing arrangements required and recommended by manufacturers, testing and commissioning.

3 SPECIFICATIONS FOR SOIL, WASTE, VENT & RAINWATER PIPES & FITTINGS

SCOPE OF WORK

Work under this section shall consist of furnishing all labor, materials, equipment and appliances necessary and required to completely install all soil, waste, vent rain water pipes and fittings as required by the drawings, and given in the Bill of Quantities.

Without restricting to the generality of the foregoing, the soil, waste, vent pipes system shall include the following:-

Horizontal soil, waste and vent pipes, and fittings, joints, clamps, connections to fixtures.

Floor and urinal traps, cleanout plugs, inlet fittings.

Testing of all pipe lines.

GENERAL REQUIREMENTS

All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-in-charge.

Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

Pipes shall be securely fixed to walls and ceilings by suitable clamps intervals specified.

Access doors for fittings and clean outs shall be so located that they are easily accessible for repair and maintenance. Any access panel required in the civil structure, false ceiling or marble cladding etc. shall be clearly reported to the Owner in the form of shop drawing so that other agencies are instructed to provide the same well in advance.

PIPING SYSTEM

Schedule of Pipes Use

Polypropylene EN 1451	For Drainage Stacks and internal sunken / ceiling hung piping
RCC NP2	From external storm and sewer drainage
Polypropylene EN 1451	Connections from fixtures to FT and Multi-floor traps
Polypropylene EN 1451	For Rain water System.

SOIL, WASTE & VENT PIPES

The Soil & Waste Pipe System above ground has been planned as a "single stack system" as defined in IS: 5329 having single pipe for waste for kitchen sinks, bath tubs, showers, washbasins, condensate drains and floor drains and is approved by Engineer-in-charge.

Separate Wastewater Stack for waste for kitchen sinks and dry balconies.

Vertical soil & waste stacks shall be connected to a horizontal Soil and Waste Pipe as shown on the drawings.

Toilet layouts have been arranged so that the W.C. outlets shall be with "P" trap above ground.

JOINING

The jointing of the pipes to the fittings shall be done as per the manufacturer's instructions / recommendation. The rubber ring socket fittings and pipes shall be jointed as follows: Clean the outside of the pipes spigot end and the inside of the ceiling groove of the fitting. Apply the lubricant uniformly to the spigot end, sealing ring and pass the spigot end into the socket containing sealing ring until fully home. Mark the position of the socket edge with pencil or felt open on the pipe, then withdraw the pipe from the socket by approximately 10 mm. to make the pipe fully fitted to the fitting. The horizontal pipes on the wall shall be fixed with M.S. fabricated clamps with necessary provisions to take care the expansion and contraction in PVC pipes. The spacing of the clamps shall be at the intervals of 1.5 meter to 2 meter depending on the requirement of the supporting arrangements.

FIXING

All vertical pipes shall be fixed by Galvanized clamps and galvanized angle brackets truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

Horizontal pipes running along ceiling shall be fixed on galvanized structural adjustable clamps of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.

Contractor shall provide all sleeves, openings, hangers and inserts during the construction. He shall provide all necessary information to the building Contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces.

CLAMPS

All pipe clamps, supports and hangers shall be galvanized. Factory made Pre-fabricated clamps shall be preferred. Contractor may fabricate the clamps of special nature and galvanize them after fabrication but before installation. All nuts, bolts, washers and other fasteners shall be factory galvanized.

Clamps shall be of approved designs and fabricated from M.S. flats (which shall be galvanized after fabrication) of thickness and sizes as per drawings or contractor's shop drawings. Clamps shall be fixed in accordance to manufacturer's details/shop drawings to be submitted by the contractors.

When required to be fixed on RCC columns, walls or beam they shall be fixed with approved type of galvanized expansion anchor fasteners (Dash fasteners) of approved design and size according to load.

Structural clamps e.g. trapeze or cluster hangers shall be fabricated by electro-welding from M.S. Structural members e.g. rods, angles, channels flats as per Contractors shop drawing shall be galvanized after fabrication. All nuts, bolts and washers shall be galvanized.

Galvanized slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes shown on drawings or specified in Bill of Quantities. Angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with anchor fasteners mentioned above. The spacing of support bolts on support members fixed horizontally shall not exceed 1 m.

TRAPS

Floor traps

Floor traps where specified shall be siphon type full bore P or S type or Multi-floor traps of Acoustic PP material having a minimum 50 mm or more than that which is more deep seal. The trap and waste pipes when buried below ground shall be set and encased in cement concrete blocks firmly supported on firm ground or when installed on a sunken RCC structural slab. The blocks shall be in 1:2:4 mix (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size). Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30x30 cms of the required depth.

Floor Trap inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type of floor or manhole inlet fitting fabricated from PP pipe without, with one, two or three inlet sockets welded on side to connect the waste pipe or joint between waste and inlet socket shall be rubber EPDM ring seal. Floor trap inlet and the traps shall be set in cement concrete blocks where varied in floors as specified without extra charge. Floor trap for the shower cubicle shall suit site and as per the approval of Engineer-in-charge. In ceiling hung application floor trap shall be secured firmly with Z brackets and SS threaded rods and fastened to slab.

Floor Trap Grating

Floor and urinal traps shall be provided with 100 -150mm square or round Stainless Steel gratings as approved with frame and rim of approved design and shape or as specified in the Bill of Quantities approved by the Engineer-in-charge.

CLEANOUT PLUGS

Floor Clean out Plug.

Clean out plug for Soil, Waste or Rainwater pipes laid under floors shall be provided near pipe junctions bends, tees, "Ys" and on straight runs at such intervals as required as per site conditions. Cleanout plugs shall terminate flush with the floor levels. They shall be threaded and provided with key holes for opening. Cleanout plugs shall be Cast Brass suitable for the Pipe dia. With screwed to a G.I. socket. The socket shall be drip seal to the drain pipes.

WASTE PIPE FROM APPLIANCES

Waste pipe from appliances e.g. washbasins, sinks and urinals shall be of uPVC pipes in Toilets, kitchens, pantries, Equipment and service areas where so required, and as given in the Bill of Quantities or shown on the drawings.

All pipes shall be fixed in gradient towards the connection to stack or drains. Pipes inside all toilets shall be in chase unless otherwise shown on drawings. Where so required and shown on drawings or directed by the Engineer-in-charge.

ENCASING IN CEMENT CONCRETE

Encasing of pipes is required to provide stability to the line and prevent its damage during construction.

Soil and waste pipes under floor

Pipes lay in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 12 mm size) 75 mm in bed and all round. When pipes are running well above the structural slab, the encased pipes shall be

supported with suitable cement concrete pillars of required height at intervals of 1.8 m.

CUTTING AND MAKING GOOD

Contractor shall provide all holes cut outs and chases in structural members necessary and required for the pipe work as building work proceeds. Wherever cut outs , holes are left in the original construction, they shall be made good with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) or cement mortar 1:2 (1 cement: 2 coarse sand) and the surface restored as in original condition.

SLEEVES/ CUT-OUTS.

Contractor shall utilize all cut out and sleeves provided during construction to prevent breaking. The annular space between the pipe and the sleeve shall be filled up with approved type of fire retardant sealant. When sleeves are misplaced or inaccurately located contractor shall make the holes in the wall or structural members at his own cost but only with the prior permission of the Engineer-in-charge.

TESTING

Testing procedure specified below apply to all soil, waste and vent pipes above ground. Entire drainage system shall be tested for water tightness and smoke tightness during and after completion of the installation. No portion of the system shall remain untested. PVC pipes and fittings shall be tested for three meters of water head the openings of the pipes shall be sealed for the section to be tested. The water pressure shall be maintained for maximum of one hour. The Engineer shall examine carefully all the joints for leakage. Contractor must have adequate number of expandable rubber bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests. All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site.

Measurements General

Rates quoted for all items shall be inclusive of all work and items given in the Specifications and Bill of Quantities.

Rates are applicable for the work in basements, underground, floors, in shafts at ceiling level area for all depths and building up to 45 m in height.

Rates are inclusive of cutting holes and chases in RCC and masonry work where no sleeves or cut outs have been provided during construction and making good the same.

Rates are inclusive of pre testing, on site testing, of the installations, materials and commissioning of the works.

Pipes (unit of measurement linear meter to the nearest centimeter).

Soil, waste, vent, anti-siphon age, rain water pipes, shall be measured net when fixed correct to a centimeter including all fittings along its finished length.

G.I./C.I./uPVC pipes shall measure per running meter correct to a centimeter for the finished work which shall include fittings e.g. bends, tees, elbows, reducers, crosses, sockets, nipples and nuts. The length shall be taken along center line of the pipes and fittings. All pipes and fittings shall be classified according to their diameter, method of jointing and fixing substance, quality, and finish. The diameters shall be nominal diameter of internal bore No allowances shall be made for the portions of pipe length entering the sockets of the adjacent pipe or fittings.

All supports required to support the pipes from slab/ceiling/i/c dash fasteners, M.S. structural,

slotted angles/channels including support bolts and nuts embedded in masonry walls and hangers etc shall be included in the item rate of pipe including the item of work given below:-

Expandable anchor fasteners

Galvanizing of all supports and hangers

Cutting holes in walls, ceiling of floors and making good where permitted

Nuts, bolts and washers for fixing and assembling

Wooden/PVC pipe saddles for vertical or horizontal runs

Cement concrete around pipes shall be measured along the center of the pipe line measured per linear meter and include any masonry supports ,shuttering and centering cutting complete as described in the relevant specifications.

Fittings (excluding pipe fittings) (Unit of measurement by numbers)

Urinal traps, trap gratings, hoppers, cleanout plugs khurras shall be measured by number per piece and shall include all items described in the relevant Specifications and Bill of Quantities.

4 SPECIFICATIONS FOR WATER SUPPLY SYSTEM

SCOPE OF WORK

Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Bill of Quantities.

Contractor should study the site plan and water supply system diagram for an overview of the system.

It is proposed to provide dual flushing cistern/dual flush valve for all WCs.

Without restricting to the generality of the foregoing, the water supply system shall include the following:-

Distribution system from main vertical stack to all fixtures and appliances for cold & hot water.

Pipe protection and painting.

Control valves

GENERAL REQUIREMENTS

All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Engineer-in-charge.

Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.

Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

Clamps, hangers and supports on RCC walls, columns & slabs shall be fixed only by means of approved made of expandable metal fasteners inserted by use of power drills.

All pipe clamps, supports, nuts, bolts, washers shall be galvanized MS steel throughout the building. Painted MS clamps & MS nuts, bolts & washers shall not be accepted.

Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

MATERIAL

A. PP-R (Polypropylene Random Copolymer) Or PERT (Polyethylene Raised Temperature) FOR COLD AND HOT WATER SUPPLY PIPING MATERIALS

The piping system shall consist of Polypropylene Random Copolymer Type 3 pipes and fittings conforming to DIN 8078/IS15801:2008. The sizes and makes are specified in the Schedule of Quantities.

For any internal works, the Polypropylene pipes and fittings shall be embedded in the wall chase or run on the floor/ ceiling unless otherwise specified. No unsighted exposed runs shall be permitted. Outside the building the piping shall be installed at least 1.0 meter below the finished grade level.

Cold Water system pipe shall be of following pressure & Class: PN 16 –SDR-7.4 as per IS:15801/manufacturers specifications.

Hot Water system pipe for solar Hot water down-takes to kitchen shall be of following pressure & Class: PN 20 –SDR-6 as per IS:15801/manufacturers specifications. Colour coding has to be required to identify PN-20 pipes and fittings differently at site (Preferable RED colour).

Fusion Welded Polypropylene Pipes and fittings

The pipes shall be 3 – Layered Polypropylene Random Copolymer whereby the different layers of the pipes shall consist of:-

The inner-most layer of the pipe to be Anti – bacterial to prevent bacteria growth inside the pipe surface.

The middle layer to be of plain PP-R which is neither in contact with Water and nor under direct effect of the atmospheric conditions.

The outer-most layer to be of U.V. stabilized PP-R to prevent the pipe surface from sunlight under exposed atmospheric conditions.

The pipes should be conforming to the requirements of DIN 8078 April 1996 (PPR pipes General Quality requirements and Testing) and DIN 8077 December 1997 (PPR Pipe dimensions). The pipes should have smooth inner surface with Non – contracting diameters. The pipes shall be cleanly finished, free from cracks and other defects.

The pipes shall be clean and well cut along ends after taking into consideration the desired length, using the Pipe scissors.

The fittings shall be as follows:-

a) Plain fittings from sizes 16mm to 160mm

Chrome Plated Brass Threaded fittings from sizes 16mm to 75mm.

Valves from sizes 20mm to 63mm.

The plain fittings shall be Polypropylene Random Copolymer and comply with all the requirements of the pipes. The size of fitting is specified in the schedule of quantities, corresponding to the size of the pipe. The plain fittings shall comprise of Socket, Elbow, Tee, Cross, Unions, Reducer socket, Reduction Tee, End Cap, Crossover, Omega, Threaded plug, and Wall Clamps in available sizes.

The Chrome Plated Brass threaded fittings shall be Chrome or Nickel Plated Brass threaded piece molded inside Polypropylene Random copolymer fitting. The Plastic end shall comply with all the requirements of the pipes while the C.P. Brass end shall comply with BSP standards of Threading. The size of the C.P. Brass threaded fitting is specified in the schedule of quantities, corresponding to the pipe size. The Chrome plated Brass threaded fittings shall comprise of Socket, Elbow and Tee (Male & Female) in available sizes. These are the fittings for C.P. connections and for continuations from existing Galvanized Iron Pipes and fittings.

Horizontal and Vertical clamp support spacing shall be as per guidelines in UPC-India 2014. In general a spacing of 900 mm is acceptable for ceiling-hung PPR pipes.

The valves shall be Polypropylene Random Copolymer Valves. The valves comprise of Gate Valve, Ball Valve, Concealed Stop Cock and Chrome Coated Valve in available sizes. The size and type of the Valve is specified in the Schedule of quantities.

The Valves sizes availability in Polypropylene Random Copolymer is as follows :-

- i) Gate Valve - 20 MM & 63 MM
- ii) Ball Valve - 20 MM, 25 MM, 32 MM, 40 MM, 50 MM
- iii) Butter fly valve - 63 MM 75 MM 90 MM
- iv) Concealed Stop Cock- 20 MM & 25 MM.
- v) Chrome Coated Valve- 20 MM & 25 MM.

However, the other Brass/ Bronze Valves can be connected to Polypropylene Random pipes using C.P. Brass threaded fittings of desired sizes.

Training and Supervision of Fusion Jointing

PPr piping is prone to leakage or blockage if fusion jointing is not carried out correctly, therefore, the contractor shall ensure:

All personnel carrying out jointing of PPr are fully trained in the usage of the fusion welding equipment, and

Additional supervision of installation personnel is provided to ensure all joints are made correctly.

Laying and Jointing of Polypropylene Random Pipes and Fittings

The Polypropylene Random Pipes and Fittings shall run in wall chase or ceiling or as specified. The installation of Polypropylene Random Copolymer pipes is similar to that of the metal pipes with the only difference in the Jointing procedure. The jointing of the Fusion welded PP-R pipes and fittings are done by means of a Welding Machine.

The quality of each installation system ultimately depends on the tightness, stability and lifetime of its connections. The homogeneous connection of PP-R pipes by fusion welding gives an absolutely safe pipe connection and guarantees utmost operational safety. It takes only a few seconds to make a connection by fusion welding process. After a couple of minutes, the welded joint cools down sufficiently and can be fully loaded. The pipe to the desired length is cut using the Pipe Scissors. The proper heating piece is taken and mounted on the welding machine. The welding device is switched on – Control lamp and switch lamp will light. When ready, control lamp gets off, which means that welding temperature of 260 Degrees +/- 10 Degrees Celsius has been reached. The Pipe end and the fitting to be welded are heated on the welding machine. Before heating the fitting and the pipe, the dirty welding tools, pipe and fitting is cleaned with a cloth. When heated up (with heating time as per the Table shown below), the pipe and the fitting is removed from the welding machine and the two pieces connected together by applying a little pressure without twisting. The joint is allowed to cool down for a few seconds. The welding process is that safe because the properly heated parts of Polypropylene create a homogeneous connection.

Guidelines for Welding PP-R Pipes and fittings (DVS guideline 2207, Part 11): Note: welding of PP-r pipe shall be carried out in accordance with the recommendations of the pipe manufacturer.

Outer diameter of pipe (MM)	Heating Time (Seconds)	Cooling Period (Minutes)
16	5	2
20	5	2
25	7	2
32	8	4
40	12	4
50	18	4
63	24	6
75	30	8
90	30	8
110	45	10
160	60	12

The same procedure shall be adapted for exposed as well as concealed fittings. The Crossovers may be used wherever the overlapping of the PP-R pipes is required. The fixing shall be done by means of Wall Support Clamps keeping the pipes about 1.5 cm clears of the wall where to be laid on the surface. Where it is specified to conceal the pipes, chasing may be adopted. For pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes with the usual tools. Where directed by the owner’s site representative/ Architect, pipe sleeves shall be fixed at a place the pipe is passing, through a wall or floor for reception of the pipe and allow freedom for expansion and contraction and other movements. Fixed supports prevent any movement of the pipe by fixing it at some points. Fittings are used in creating the fixed points. Fixed supports must not be installed at bending parts and the direction changes must be done in the pipe itself. In between the fixed supports some arrangements must be done to compensate any potential elongation or shrinkage in the pipe length. Clamps shall be clevis clamps with rubber gasket to protect pipe from damage from clamp and allow minor movements.

Expansion or shrinkage compensation arrangements can be installed in buildings very easily. For making one expansion loop, four elbows will be enough. For straight pipes having length more than 5 meters, to compensate the expansion an expansion piece must be used.

PIPING INSTALLATION SUPPORT

Architectural and Services Consultant drawings indicate the schematic Line diagram for the size and location of the pipes. The Services Consultant /Architect before the perusal of actual work on site by the contractor shall prepare the detailed working drawings, showing the cross-sections, longitudinal sections, fittings details, locations of control valves and all pipe supports. The consideration while doing all this designing part is to keep in view the specific openings in buildings and other structure through which the pipes are desired to pass.

Piping shall be properly supported by means of wall support clamps as specified and as required, keeping in view the proper designing for expansion and contraction. Risers shall be supported at each floor with Clamps.

When necessary Polypropylene Random pipes can be bend by heating, but the pipes should not be put on flame. Heating should be done by hot air blowing device. To bend the pipes, they

should be heated up to 140 Degree Celsius. Advised minimum radius for bending are shown in the under table:-

PIPE DIAMETER (d)	BEND RADIUS, MINIMUM (R= 8x d)
20	160
25	200
32	256
40	320
50	400
63	500
75	600
90	720
110	880
160	1280

Due to high coefficient of thermal expansion the heat losses through the pipes is highly reduced. Therefore, for internal Bathroom hot geyser water distribution lines, the insulation is often not required. However, where the hot water has to travel long distances before being distributed in the individual connections, the insulation shall in the form of tubular sleeves of nitrile rubber or PU foam pipes. All hot water pipes including concealed piping shall be insulated. However, for long distance distribution the following table could be followed for providing the insulation:-

Pipe external diameter	Suitable Insulation thickness
16 mm	18.4 mm
20 mm	18.4 mm
25 mm	27.5 mm
32 mm	27.5 mm
40 mm	36.5 mm
50 mm	45.7 mm
63 mm	57.6 mm
75 mm	68.5 mm
90 mm	81.0 mm
110 mm	100.0 mm
160 mm	145.0 mm

Insulated pipes should be supported in such a manner as not to put undue pressure on the insulation.

All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work, so that all works can be carried out in one

stretch.

PP-R pipes can be used in mixed installations and repair works. The pipes running parallel should be separated by putting insulation parts to prevent sound reflection. To prevent noise, under or above ground installations the pipes should not contact to each other.

Cut-outs in the floor slab for installing the various pipes are indicated in the drawings. The Contractor should carefully examine the cut-outs provided and clearly point out wherever the cut-outs shown in the drawings, do not meet with the requirements.

All pipes shall be accurately cut to the required lengths and then cleaned with a clean cloth before fusion welding. Open ends of the pipes where the C.P. Brass threaded fittings are welded for C.P. connections at the later stage should be closed by means of Plugs to avoid the entrance of foreign matter.

Automatic air valves shall be provided at all high points in the piping system for venting. Automatic air valves shall also be provided on hot water risers. Discharge from the air valves shall be piped to the nearest drain or sump. All pipes shall be pitched towards the drain points.

Pressure gauges and Thermometers shall be provided as per the approved drawings and included in the Bill of quantities. Care should be taken to prevent these during Pressure testing.

B. GALVANIZED IRON PIPES AND FITTINGS (FOR COLD WATER SUPPLY PUMP RISERS / DELIVERY):
The pipes shall be galvanised mild steel welded (ERW) or (HFW) screwed and socketed conforming to the requirements of IS:1239. The Galvanising shall conform to IS:4736, the zinc coating shall be uniform, adherent reasonably smooth and free from such imperfections as flux, ash and drop inclusions, bare patches, black spots, pimples, lumpiness, runs, rust strains, bulky white deposits and blisters. The pipes and sockets shall be cleanly finished, well galvanised in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly, and square with the axis of the pipe. The fittings shall be malleable iron and comply with all the requirements of the pipes. The sizes of pipes and fitting is specified in the schedule of quantities.

Laying And Jointing Of GI Pipes:

The galvanised pipes and fittings shall run in wall chase or ceiling or as 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 where to be laid on surface. Where it is specified to conceal the pipes, chasing may be adopted for pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes with the usual tools. As far as possible, pipes may be buried for short distances provided adequate protection is given against damage and where so required special care to be taken at joints.

Where directed by the Owner's Site Representative, pipe sleeves shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and allow freedom for expansion and contraction and other movements. In case of pipe is embedded in walls or floors it shall be painted with anticorrosive bitumastic paints of approved quality. Under the floors the pipes shall be laid in layer of sand filling. Galvanised iron pipes shall be jointed with threaded and socket joints, using threaded fittings. Care shall be taken to remove any burr from the end of the pipes

after threading. Teflon tape, White lead or an equivalent jointing compound of proprietary make shall be used, according to the manufacturer's instructions, with a grommet of a few strands of fine yarn while tightening. Compounds containing red lead shall not be used because of the danger of contamination of water. Any threads exposed after jointing shall be painted with bituminous paint to prevent corrosion.

PIPING INSTALLATION SUPPORT (VALID FOR GI / METAL PIPING ONLY)

Tender drawings indicate schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass. Piping shall be properly supported on , or suspended from , on stands, clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability. Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. All accessories and ancillaries of support system such as brackets, saddles, clamps, hangers etc. shall be hot dip galvanized after fabrication. Further to permit free movement of common piping, support shall be from a common hanger bar, fabricated from galvanised steel sections. Pipe hangers shall be provided at the following maximum spacings: Pipe Dia (mm) Hanger Rod Dia (mm) Spacing between Supports (m) Up to 25 6 2 32 to 50 10 2.7 80 to 100 12 2.7 125 to 150 16 3.6 200 to 300 19 5.3

Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 14 gauge metal sheet shall be provided between the insulation and the clamp, saddle or roller, extending atleast 15 cm. on both sides of the clamps, saddles or roller. All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work, so that area can be carried out in one stretch. Cut-outs in the floor slab for installing the various pipes area are indicated in the drawings. Contractor shall carefully examine the cut-outs provided and clearly point out wherever the cutouts shown in the drawings, do not meet with the requirements. Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fiberglass and finished with retainer rings.

The contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified / approved by Consultants. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required. All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used. All buried pipes for CWS shall be cleaned and coated with two coats of bitumen and then wrapped with two layers of 400 micron polythene sheet coating. Automatic air valves shall be provided at all high points in the piping system for venting. All valves shall be of 15mm pipe size and shall be associated with an equal size isolation ball valve. Automatic air valves shall also be provided on hot water risers. Discharge from the air valves shall be piped through a galvanized steel pipe to the nearest drain or sump. All pipes shall be pitched towards drain points. Pressure gauges shall be provided as shown on the approved drawings and include in Bill of Quantities.

Care shall be taken to protect pressure gauges during pressure testing. Temperature gauge as specified shall be provided at the hot water supply and return and as shown on drawings and included in Bill of Quantities.

TESTING

After installation the piping shall be pressure tested to 1.5 times the system working pressure in accordance with the requirements of this specification. In addition to this a flow test shall be provided for all pipe sections to ensure that there are blockages/restrictions caused by the fusion joints.

The Contractor shall inform in advance of any test so that the Architect and consultant or site engineer can witness the tests if he so wishes. All water supply system shall be tested to Hydrostatic pressure test of at least one and a half (1.5) times the maximum working pressure but not less than 12 Kgs/ Sq. Cm for a period of not less than 8 hours.

The pressure test is performed in 3 steps being preliminary test, main test and final test. For the preliminary test a pressure which is 1.5 times higher than the possible working pressure is applied and this is repeated two times in 30 minutes with intervals of 10 minutes. After a test period of 30 minutes, the test pressure must not be dropped more than 0.6 bars (0.2 bars) and no leak must occur. Main test follows the preliminary test. Test time is two hours, in doing so the test pressure taken from the preliminary test must not have fallen more than 0.2 bars. After completion of these tests, the final test comes which has to be done under a test pressure of 12 bar and 3 bar in the interval of 15 minutes. Between the respective test courses, pressure has to be removed. All joints should be manually checked for any dampness/leaks.

All leaks and defects in joints revealed during the testing shall be rectified and got approved at site by retest. Piping required subsequent to the above pressure test shall be retested in the same manner. A record of Pressure test has to be prepared and signed by the Client/ Architect and Contractor with statement of place and date.

Above testing is for PPR piping upto Pex manifold. Internal Pex piping shall be tested for 7bar pressure for 8 hr.

PIPE SUPPORTS

All pipes clamps, supports, hangers, rods, pipe supports, nuts bolts & washers shall be factory made galvanized Mild Steel or alternatively galvanized after fabrication to suit site requirements.

CLAMPS

Galvanized iron pipes in shafts and other locations shall be supported by GI. clamps of design approved by Engineer-in-charge. Pipes in wall chases shall be anchored by iron hooks, Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. structural as described above. Pipes in typical shafts shall be supported on slotted angles/channels as specified elsewhere.

ANCHOR FASTENERS

All pipes supports, hangers and clamps to be fixed on RCC walls, beams, columns, slabs and masonry walls 230mm thick and above by means of galvanised expandable anchor fasteners in

drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by approved type of power drill as recommend and approved by manufacturer of the anchor fasteners. Failure of any fastening devices shall be the entire responsibility and contractor shall redo or provide additional supports at his own cost. He shall also compensate the owner for any damage that may be caused by such failures.

UNIONS

Contractor shall provide adequate number of unions on all pipes to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock, or check valve and on straight runs as necessary at appropriate locations as required and/or directed by Engineer-in-charge.

FLANGES

Flanged connections shall be provided on pipes as required or where shown on the drawings, all equipment connections as necessary and required or as directed by Connections shall be made by the correct number and size of GI nuts, bolts & washers with 3 mm thick gasket. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by Bolt hole dia for flanges shall conform to match the specification for G.M. sluice valve to I.S. 778. And C.I. butterfly valve to IS: 13095.

TRENCHES

All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows:-

Dia of pipe	Width of trench	Depth of trench
15 mm to 50 mm	30 cms	75 cms
65 mm to 100 mm	45 cms	100 cms

SAND FILLING

PVC Pipes in trenches shall be protected with fine sand 15 cms all round trenches.

VALVES:

BALL VALVES

Valves up to 40 mm dia. shall be screwed type Brass Ball Valves with stainless steel balls, spindle, Teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm², and accompanying couplings and steel handles. (to BS 5351)

BUTTERFLY VALVES

Valves 40 mm dia and above shall be cast iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction with accompanying flanges and steel handle. Butterfly valve shall be of best quality conforming to IS: 13095.

NON-RETURN VALVE (SLIM TYPE)

Where specified non return valve (wafer type) shall be provided through which flow can occur in one direction only.

Each Butterfly and Slim Type Swing Check (NRV) Valve shall be provided with a pair of flanges screwed or welded to the main line and having the required number of galvanized nuts, bolts and washers of correct length.

AIR RELIEF VALVE

Where specified air relief valve shall be provided through which air trapped in the system can be relieved automatically.

Each air relief valve shall be provided with an isolation ball valve used to the main line The air relief valve shall be of Cast Iron body and conforming to IS 14845; single air valve small orifice type.

TESTING

All pipes, fittings and valves after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 20 kg/cm² whichever is more.

Pressure shall be maintained for a period of at least two hours without any drop.

A test register shall be maintained and all entries shall be signed and dated by Contractor (s) and Engineer-in-charge.

In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defects liability period without any cost. After commissioning of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

MEASUREMENT

All pipes above ground shall be measured per linear meter (to the nearest cm) and shall be inclusive of all fittings e.g. coupling, tees, bends, elbows, unions, flanges and U clamps with nuts, bolts & washers fixed to wall or other standard supports. No allowance shall be made for the portions of pipe length entering the sockets of the adjacent pipe or fittings.

All supports required to support the pipes from slab/ceiling/i/c dash fasteners. M.S. structural, slotted angles/channels including support bolts and nuts embedded in masonry walls and hangers etc shall be incl. in the item rate of pipe including the item of work given below:-

Expandable anchor fasteners

Galvanizing of all supports and hangers

Cutting holes in walls, ceiling of floors and making good where permitted

Nuts, bolts and washers for fixing and assembling

Wooden/PVC pipe saddles for vertical or horizontal runs

Jointing with Teflon tape, white lead and insertion gasket of appropriate temperature grade.
Cutting holes, and chases in walls, floors, any pipe support required for pipes below ground & making good the same.
Excavation, back filling, disposal of surplus earth and restoring the ground & floor in original condition.

PIPE SUPPORTS.

Rate quoted for supports & hangers shall be inclusive of:-

Expandable anchor fastens.

Galvanizing of all supports & hangers.

Cutting holes in walls, ceilings on floors and making good where permitted.

Nuts, bolts and washers for fixing and assembling.

Wooden/PVC pipe saddles for vertical or horizontal runs.

VALVES

Gunmetal, cast iron, butterfly and non-return valves and puddle flanges shall be measured by numbers and shall include wheels/caps, GI nuts, bolts, washers and insertion gasket.

PAINTING / PIPE PROTECTION/INSULATION

Painting / pipe protection / insulation for pipes shall be measured per linear metre over finished surface and shall include all valves and fittings for which no deduction shall be made. of extra payment shall be made for fittings, valves or flanges.

5 SPECIFICATIONS FOR WATER SUPPLY & DRAINAGE PUMPS

SCOPE OF WORK

Work under this section shall consists of furnishing all labour, materials, equipment and appliances necessary and required to supply install and commission the water supply and drainage pumps as described hereinafter and given in the schedule of quantities and/or shown on the drawings.

GENERAL REQUIREMENTS

All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-in-charge/Owner rep.

All equipment shall be of the best available as per approved make list manufactured by reputed firms.

All equipment shall be installed on suitable foundations true to level and in a neat workmanlike manner.

Equipment shall be so installed as to provide sufficient clearance between the end walls and

between equipment to equipment.

Piping within the pump house shall be so done as to prevent any obstruction in the movement within the pump house.

Each pumping set shall be provided with a butterfly valve on the suction and delivery side and a flap type non return valve on the delivery side along with pressure gauges as required.

All pump couplings and belt guards for air compressors shall be totally enclosed with 5 mm mesh.

SPECIFICATIONS FOR PUMPS

Pumping sets for Water Supply Pumps (Imported Stainless Steel Pumps)

Water supply pumps shall be suitable for clean filtered water. Pumps shall be single stage, vertical/horizontal, centrifugal pumps with stainless steel body and stainless steel (DIN W-Nr .1.4301) impeller, stainless steel shaft and mechanical seal and coupled to a TEFC electric motor. Each pump should be operating to a curve required by the operating conditions.

All parts in contact with water shall be corrosion resistant stainless steel DIN-Nr.1.4401.

Each pumping set shall be provided with 100-mm dia gunmetal "Borden" type pressure gauge with gunmetal valve and connecting piping.

Pump or the whole set shall be stable on rubber vibration eliminating pads appropriate for each pump as recommended by the manufacturer and accepted by the Engineer-in-charge/Owner

PUMPING SETS FOR GARDEN IRRIGATION PUMPS (IMPORTED STAINLESS STEEL PUMPS)

Water supply pumps shall be suitable for clean filtered water. Pumps shall be single stage, vertical/horizontal, centrifugal pumps with stainless steel body and stainless steel (DIN W-Nr .1.4301) impeller, stainless steel shaft and mechanical seal and coupled to a TEFC electric motor. Each pump should be operating to a curve required by the operating conditions.

All parts in contract with water shall be corrosion resistant stainless-steel DIN-Nr.1.4401.

Each pump shall be provided with a totally enclosed fan cooled induction motor of suitable H.P. The motors shall be suitable for 410 volts, 3 phases, 50 cycles A.C. power supply and shall conform to IS 325 operating at 2900 RPM nominal speed.

Each pumping set shall be provided with 100-mm dia gunmetal "Borden" type pressure gauge with gunmetal valve and connecting piping.

Pump or the whole set shall be stable on rubber vibration eliminating pads appropriate for each pump as recommended by the manufacturer and accepted by the Engineer-in-charge/Owner rep.

PUMPS

Pumps for water supply shall be Double suction single stage pump. Pump shall be with C.I. casing and dynamically balanced Bronze impeller connected to a common shaft to the motor. Stuffing box shall be provided with mechanical seals

Each pump shall be provided with air cooled cage induction motor suitable for 415 volts, 3 phase, 50 cycles AC power supply.

Each pump shall be provided with liquid level sensor to prevent dry running of pumps. Operation of level sensor shall be similar to as discussed in Para below.

Each pump shall also be provided with a pressure vessel & pressure switch arrangement as indicated in the drawings to automatically cut-off the pump when the overhead tanks are filled completely. The pressure switch shall sense the rise in system pressure due to closure of float valve at the inlet of overhead tank. The pump shall be cut off after a pre-set pressure is reached in the system. Pressure vessel shall be provided to absorb the surges in the system and shall be with proper draining and air relief arrangements.

The pumping set shall be for stationary application and shall be provided with pump connector in it. The delivery pipe shall be joined to the pump through a rubber diaphragm, and bend and guide pipe for easy installation, without disturbing delivery pipe the pump unit shall have a back pull out design. A rust proof chain shall be provided for each pump.

Pump shall be provided with all accessories and devices necessary and required for the pump to make a complete working system.

LEVEL CONTROLLERS

Level controllers shall be electronic low voltage type using required number of stainless steel type probes, shrouded in PVC sheath or encapsulated in a stainless-steel pipe. The level controller will be used for following applications: -

To cut off all operating pumps when:-

Water level is low in storage water tanks with low water level audible alarm.

PIPE & FITTINGS (FOR HEADERS AND CONNECTIONS)

Pump suction and delivery headers shall be uPVC Sch.-40 with matching fittings. The pipe joints shall be made by solvent cement as per manufacturer's instructions.

Vibration Eliminators

Provide on all suction and delivery lines as shown on the drawings double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer details.

Valves: Butterfly Valves

Butterfly Valves shall be cast iron body with following details:-

Disc shall be CI heavy duty electrolyses nickel plated abrasion resistant.

The shaft is EN-8 Carbon Steel with low friction nylon bearings.

The seat shall be drop tight constructed by bonding resilient elastomer inside a rigid backing.

Built in flanged rubber seals.

Actuator to level operated for valves above ground and T Key operated for valves below ground.

Built in flanges for screwed on flanged connections.

Manufacturer's details on fixing and installation will be followed.

Non-Return Valves (NRV)

Non return valves will be used at location to allow flow only in one direction and prevent flow in the opposite direction.

NRV shall be cast iron slim type with cast iron body and gunmetal internal parts and accompanying flanges. Valves shall conform to BS.

PAINTING AND CLEANUP

On completion of the installation contractor shall scrub clean all pumps, piping, filters and equipment and apply one coat of primer.

Apply two or more coats of synthetic enamel paint of approved make and shade on steel pipes. Provide painted identification legend and direction arrows on all equipment and piping as directed by engineer-in-charge.

On final completion of the work, contractor should cleanup the site, filter room of all surplus materials rubbish and leave the place in a broom-clean condition.

MEASUREMENT General

Unit rate for individual items, e.g., Pumps, MCC and level controller are for purposes of payments only. Piping, headers, valves, accessories, cabling, and MCC to measured separately in this contract only.

All items must include all accessories fittings as described in the specifications, BOQ and shown on the drawings.

All water supply pumps

Pumps shall be measured by numbers and shall include all items as given in the specifications and schedule of quantities to provide a complete working system.

Drainage Pumps

Drainage pumps shall be measured by numbers and shall include all items as given in the specifications and schedule of quantities to provide a complete working system.

Level controllers & Alarms

Level controllers for each set of pumps shall be measured by number and inclusive of probes, cabling unto surface box near the pump and shall include all items as given in the specifications and schedule of quantities to provide a complete working system.

Piping Work

Suction and delivery headers for each pumping system shall be measured per linear meter of finished length and shall include all items as given in the schedule of quantities. Painting shall be included in rate of headers.

G.I. pipes between various equipment's shall be measured per linear meter of the finished length and shall include all fittings, flanges, jointing, clamps for fixing to walls or hangers and testing. Flanges shall include 3 mm thick insertion rubber gasket, nuts, bolts, and testing.

Water Tank, Vibration eliminators, "Y" strainers, butterfly valves, slim non return valves shall be measured by numbers and shall include all items as given in the schedule of quantities and specifications.

6 I.S. CODES AND REFERENCE STANDARDS.

Codes and reference standards referred to in the contract shall be understood to form a part of the contract.

Alternative reference standards produced by different standards authorities may be specified in a Section. Standards of any of the specified authorities may be acceptable, however, materials specified in the Section shall be incorporated in the works from only one of the specified standards authority to ensure compatibility in the performance of the materials.

The contractor shall be responsible for adherence to reference standard requirements by subcontractors and suppliers.

Where edition date is not specified, consider that reference to manufacturer's and published codes, standards and specifications are made to the latest edition (revision or amendment) approved by the issuing organization current at issue date of the Tender.

The specified reference standards are INDIAN STANDARD CODES and are intended to establish the quality of materials and workmanship required for the works. Reference standards published in other countries may, in the sole judgment of the owner's consultant, also be acceptable providing that the Contractor furnishes sufficient data for the Owner's Consultant to determine if the quality of materials and workmanship at least equals or exceeds all tests prescribed by the specified reference Indian Standards codes.

Such other reference standards published by the following will be considered: BSI:

British Standards Institute

AFNOR : Association Francise de Normalization
(French Standards Institute)

DIN : Deutsche Industries Norman (German Standards) ANSI : American
National Standards Institute

ASTM : American Society for Testing and Materials

Reference standards and specifications are quoted in the specification to establish minimum standards. Works of quality or of performance characteristics that exceed these minimum standards will be considered to confirm.

Should regulatory requirements or the contract conflict with specified reference standards or specifications, the more stringent in each case shall govern.

Where reference is made to manufacturer's directions, instructions or specifications they shall include full information on storing, handling, preparing, mixing, installing, erection, applying or other matters concerning the materials pertinent to their use in the works and their relationship to materials with which they are incorporated.

Obtain copies of codes applying to the Work, manufacturer's directions and reference standards referred to in the contract within 90 days of signing the contract.

Submit a copy of each code, reference standard and specification, and manufacturer's directions, instructions and specifications, to which reference is made in the specification to the Owner's Authorized Representative's.

LIST OF CODES (INDIAN STANDARD CODES)

Standards, specifications, associations, and regulatory bodies are generally referred to throughout the specifications by their abbreviated designations. The materials workmanship shall be in accordance with the requirement of the appropriate CP, I.S code wherever applicable together with any building regulations or bye-laws governing the works.

The following list is included for guidance only and the omission of any CP, I.S. codes from the list does not relieve the contractor from compliance therewith:

The more important Codes, Standards and Publications applicable to this section are listed hereinafter:

1.	General	Standard for
	SP : 6 (1)	Structural Steel Sections
	IS : 27	Pig Lead
	IS : 325	Three Phase Induction Motors
	IS : 554	Dimensions for pipe threads where pressure tight joints are required on the threads.
	IS : 694	PVC insulated cables for working voltages upto & including 1100 V.
	IS : 779	Specification for water meters (domestic type).
	IS : 782	Specification for caulking load.
	IS : 800	Code of practice for general construction in steel
	IS : 1068	Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium.
	IS : 1172	Code of Basic requirements for water supply drainage and sanitation.
	IS : 1367 (Part 1)	Technical supply conditions for threaded steel fasteners: Part 1 introduction and general information.
	IS : 1367 (Part 2)	Technical supply conditions for threaded steel fasteners: Part 2 product grades and tolerances.
	IS : 1554 (Part 1)	PVC insulated (heavy duty) electric cables: Part 1 for working voltages upto and including 1100 V.

	IS : 1554 (Part 2)	PVC insulated (heavy duty) electric cables: Part 2 for working voltages from 3.3 KV upto and including 11 KV.
	IS : 1726	Specification for cast iron manhole covers and frames.
	IS : 1742	Code of practice for building drainage.
	IS : 2064	Selection, installation and maintenance of sanitary appliance code of practice.
	IS : 2065	Code of practice for water supply in buildings.
	IS : 2104	Specification for water meter for boxes (domestic type)
	IS : 2373	Specification for eater meter (bulk type)
	IS : 2379	Colour code for identification of pipe lines.
	IS : 2629	Recommended practice for hot dip galvanizing on iron and Steel.
	IS : 3114	Code of practice for laying of cast iron pipes
	IS : 4111 (Part 1)	Code of practice for ancillary structures in sewerage system : Part 1 manholes.
	IS : 4127	Code of practice for laying glazed stoneware pipes.
	IS : 4853	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes.
	IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
	IS : 5455	Cast iron steps for manholes.
	IS : 6159	Recommended practice for design and fabrication of material, prior to galvanizing.
	IS : 7558	Code of practice for domestic hot water installations.
	IS : 8321	Glossary of terms applicable to plumbing work.
	IS : 8419 (Part 1)	Requirements for water filtration equipment: Part 1 Filtration medium sand and gravel.
	IS : 8419 (Part 2)	Requirements for water filtration equipment: Part 2 under drainage system.
	IS : 9668	Code of practice for provision and maintenance of water supplies and firefighting.
	IS : 9842	Preformed fibrous pipe insulation.
	IS : 9912	Coal tar-based coating materials and suitable primers for protecting iron and steel pipe lines.
	IS : 10221	Code of practice for coating and wrapping of underground mild steel pipelines.

	IS : 10446	Glossary of terms relating to water supply and sanitation.
	IS : 11149	Rubber Gaskets
	IS : 11790	Code of practice for preparation of butt-welding ends for pipes, valves, flanges and fittings.
	IS : 12183 (Part 1)	Code of practice for plumbing in multistoried buildings : Part 1 water supply.
	IS : 12251	Code of practice for drainage of building basements.
	IS : 5572	Code of practice for sanitary pipe work.
	BS : 6700	Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their cartilages.
	BS : 8301	Code of practice for building drainage.
	BSEN : 274	Sanitary tap were, waste fittings for basins, bidets and baths. General technical specifications.
2.	Pipes and Fittings	
	IS : 458	Specification for precast concrete pipes (with and without reinforcement)
	IS : 651	Salt glazed stone ware pipes and fittings.
	IS : 15801	Polypropylene-random copolymer pipes for hot and cold water supplies
	IS : 1239 (Part 2)	Mild Steel tubes, tubular and other wrought steel fittings: Part 2 Mild Steel tubular and other wrought steel pipe fittings.
	IS : 1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
	IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.
	IS : 1538	Cast Iron fittings for pressure pipes for water, gas and sewage.
	IS : 1729	Sand Cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
	IS : 1879	Malleable cast iron pipe fittings.
	IS : 1978	Line pipe
	IS : 1979	High test line pipe.
	IS : 2501	Copper tubes for general engineering purposes
	IS : 2643 (Part 1)	Dimensions for pipe threads for fastening purposes: Part 1 Basic profile and dimensions.

	IS : 2643 (Part 2)	Dimensions for pipe threads for fastening purposes: Part 2 Tolerances.
	IS : 2643 (Part 3)	Dimensions for pipe threads for fastening purposes: Part 3 Limits of sizes.
	IS : 3468	Pipe nuts.
	IS : 3589	Seamless or electrically welded steel pipes for water, gas and sewage (168.3 mm to 2032 mm outside diameter).
	IS : 3989	Centrifugally cast (sun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
	IS : 4346	Specifications for washers for use with fittings for water services.
	IS : 4711	Methods for sampling steel pipes, tubes and fittings.
	IS : 6392	Steel pipe flanges
	IS : 6418	Cast iron and malleable cast iron flanges for general engineering purposes.
	IS : 7181	Specification for horizontally cast iron double flanged pipe for water, gas and sewage.
3.	Valves	
	IS : 778	Specification for copper alloy gage, globe and check valves for water works purposes.
	IS : 14846	Specification for sluice valves for water works purposes (50 mm to 300 mm size).
	IS : 1703	Specification copper alloy float valves (horizontal plunger type) for water supply fittings.
	IS : 2906	Specification for sluice valves for water works purposes (350 mm to 1200 mm size)
	IS : 3950	Specification for surface boxes for sluice valves.
	IS : 5312 (Part 1)	Specification for swing check type reflux (non return) valves : part 2 Multi door pattern.
	IS : 5312 (Part 2)	Specification for swing check type reflux (non return) valves: part 2 Multi door pattern.
	IS : 12992 (Part 1)	Safety relief valves, spring loaded : Design
	IS : 13095	Butterfly valves for general purposes.
4.	Sanitary Fittings	
	IS : 771 (Part 1 to 3)	Specification for glazed fire clay sanitary appliances.
	IS : 774	Specification for flushing cistern for water closets and urinals (other than plastic cistern)

	IS : 775	Specification for cast iron brackets and supports for wash basins and sinks
	IS : 781	Specification for cast copper alloy screw down bib taps and stops valves for water services
	IS : 1700	Specification for drinking fountains.
	IS : 2548 (Part 2)	Specification for plastic seats and covers for water closets: Part 1 Thermo set seats and covers.
	IS : 2556 (Part 1)	Specification for vitreous sanitary appliances (vitreous china) : Part 1 General requirement.
	IS : 2556 (Part 2)	Specification for vitreous sanitary appliances (vitreous china): Part 2 Specific requirements of wash-down water closets.
	IS : 2556 (Part 3)	Specification for vitreous sanitary appliances (vitreous china): Part 3 Specific requirements of squatting pans.
	IS : 2556 (Part 4)	Specification for vitreous sanitary appliances (vitreous china): part 4 specific requirements of wash basins.
	IS : 2556 (Part 6 Sec 2)	Specification for vitreous sanitary appliances (vitreous china): part 6 Specific requirements of urinals, section 2 half stall urinals.
	IS : 2556 (Part 6 Sec 4)	Specification for vitreous sanitary appliances (vitreous china): Part 6 specific requirements of urinals, section 4 partition slabs.
	IS : 2556 (Part 6 Sec 5)	Specification for vitreous sanitary appliances (vitreous china): Part 6 Specific requirements of urinals, section 5 waste fittings.
	IS : 2556 (Part 6 Sec 6)	Specification for vitreous sanitary appliances (vitreous china) : Part 6 Specific requirements of urinals, section 6 water spreaders for half stall urinals.
	IS : 2556 (Part 7)	Specification for vitreous sanitary appliances (vitreous china) : Part 7 Specific requirements of half round channels.
	IS : 2556 (Part 8)	Specification for vitreous sanitary appliances (vitreous china): Part 8 Specific requirements of siphoning wash down water closets.
	IS : 2556 (Part 11)	Specification for vitreous sanitary appliances (vitreous china): Part 11 Specific requirements for shower rose.
	IS : 2556 (Part 12)	Specification for vitreous sanitary appliances (vitreous china): Part 12 Specific requirements of floor traps.
	IS : 2556 (Part 15)	Specification for vitreous sanitary appliances (vitreous china): Part 15 Specific requirements of universal water closets.
	IS : 2692	Specification for ferrule for water services

	IS : 2717	Glossary of terms relating to vitreous enamelware and ceramic metal systems
	IS : 2963	Specifications for waste plug and its accessories for sinks and wash basins.
	IS : 3311	Specification for waste plug and its accessories for sinks and wash basins.
	IS : 5961	Specification for cast iron gratings for drainage purposes.
	IS : 6249	Specification for gel-coated glass fiber reinforced polyester resin bath tubs.
	IS : 6411	Specification for gel-coated glass fiber reinforced polyester resin bath tubes.
	IS : 8931	Specification for copper alloy fancy single taps, combination tap assembly and stop valves for water services.
5.	Pumps & Vessels	
	IS : 1520	Specification for horizontal centrifugal pumps for clear cold fresh water.
	IS : 2002	Steel plates for pressure vessels for intermediate and high temperature service including boilers.
	IS : 2825	Code for unfired pressure vessels.
	IS : 4648 (Part 1)	Code of practice for lining of vessels and equipment for chemical processes Part 1 : Rubber lining.
	IS : 5600	Specification for sewage and drainage pumps
	IS : 8418	Specification for horizontal centrifugal Self priming pumps.

LIST OF APPROVED MAKES- PLUMBING WORKS		
Sr. No.	DESCRIPTION OF ITEM	MAKE LIST
1	Polypropylene Random Co-polymer based (PP-R) Triple layered mix with mineral fillers (MF) pipes, UV Stabilized	Prince, Supreme, Poloplast, Vectus
2	Polypropylene-based (PP) mix with mineral fillers (MF) pipes	Hulliot, Astral, Valsir, Wavin
3	Valves	Zoloto, Sant, Leherly
4	Hot dipped MS angle	TATA, Jindal,
5	G.I."C" Class pipe confirming to IS:1239	Jindal, Swastik pipes, GI Pipes India, Tata Steel
6	Pressure switch with 15m flexible cable	Danfoss, Indfos, HD Fire
7	Pressure gauges	Swagelok, Akvalo, HD Fire
8	Pumps	Grundfos, Wilo, Bell &Gossett (USA)
9	Solenoid Valves	Sant, Apollo, Audco
10	SWR Poly Vinyl Chloride (PVC) class B pipes as per IS:13592	Finolex, Raksha, Supreme
11	C.I. Centri pipes conforming to I.S. 3989 – 84	NECO, Kapilansh, SINGHAL
12	Rigid U.P.V.C. pipes IS:4985	Finolex, Raksha, Supreme
13	Cleanout Plug with suitable inset keys and opening male threaded joint	Finolex, Raksha, Supreme
14	Stoneware Glazed Gully Trap class SP-1	Samvridhi, Rajhans, Perfect
15	RCC NP2 class Hume pipe	BSP, Grewal, BFS, Pranali
16	Glazed stone ware Sewer Trap	Samvridhi, Rajhans, Perfect

Sr. No.	DESCRIPTION OF ITEM	MAKE LIST
17	Bell Mouth Inlets	Local make
18	C.I. Centri pipes conforming to IS. 3989 - 84	NECO, NIF, SINGHAL, Kapilansh
19	Hot water Insulation	Kaiflex, Eurobatex
20	Anti-Corrosion tape for pipe protection	PYPCOTE, IWP, Safeworld
21	Ball Valve	Zoloto, Sant, Leader
22	Butterfly valve	Audco, VEESON, Zoloto
23	PRV	Cla-Val, Airaindia, Watts
24	Water Meter	Kranti, D Wren, Desmesh
25	Water closet	Hindware, Jaquar, Parryware
26	Flush tank, Flush Valve	Geberit, Jaquar, Hindware
27	C.P. 2 way Bib cock, health faucet, Metal Hose and Holder, connector pipes with one meter length of flexible pipe, C.P. wall bracket	Jaquar, Hindware, Parryware
28	Wash basins	Jaquar, Hindware, Parryware
29	Pillar cock	Jaquar, Hindware, Parryware
30	Bottle trap, CP dome shape coupling, CP spreader	Jaquar, Hindware, Parryware
31	Urinals (with Sensor)	Jaquar, Hindware, Parryware
32	Toilet paper holder	Jaquar, Hindware, Parryware
33	Soap Dispenser	Kimberly-Clark, Hindware
34	Towel Bar	Jaquar, Hindware, Parryware
35	Bib Taps	Jaquar, Hindware, Parryware
36	Kitchen sink	Jaquar, Hindware, Parryware
37	Kitchen Faucet	Jaquar, Hindware, Parryware
38	Angle Valve	Jaquar, Hindware, Parryware

Note:

I. The Contractor shall offer all materials for inspection prior to dispatch. All materials not otherwise specified shall be in accordance with the latest Indian Standard Specification, or with Standards as listed in the Contract documents. The Contractor - where deemed necessary by the Client and at the Contractors expense - shall be bound to offer samples of materials, which are claimed to be conforming to IS Specifications, for testing at an approved Test Laboratory.

The Contractor shall purchase all materials from the makers or their authorized stockiest only. Necessary Purchase Orders / Delivery Dockets or such documentary evidences as deemed necessary must be provided to the Client on demand.

If any of the make for above materials is not available, then Architect/ Client reserves the right to suggest/ approve the alternate make for the same.

Till the closure of the project any equipment failure at site will be the responsibility of the contractor.

Note: - Besides the above makes, Banks Engineer / Architect has the right to permit use of any equivalent brand / material matching the specified criteria / quality standards.

30.0 DETAILED TECHNICAL SPECIFICATIONS OF FIRE FIGHTING SYSTEM WORK

BASIS OF DESIGN

The Fire Protection System for the project is designed keeping in view the following:

Proposed Residential Buildings at Block no 41, Gift City, , Gujarat.

Requirement of adequate pressure availability of fire mains, Hydrant points as well as sprinklers head.

Adequate storage of water in underground fire water tanks, as per the NBC/NOC guidelines.

Provision of firefighting appurtenance such as sprinklers, fire hydrants, hose reel, and portable extinguishers.

The execution of works and materials used shall be as per the latest relevant I.S. specifications.

The extension of work shall in strict compliance to the Environmental Clearance granted by EIA, Govt. of India & NOC issued by Fire Department.

Wherever reference has been made to Indian Standard or any other specifications, the same shall mean to refer to the latest specification irrespective of any particular edition of such specification being mentioned in the specifications below or Schedule of Quantities.

1. REFERENCE STANDARDS

The design and planning of Fire Protection System shall be done keeping in view the following criteria:

National Building Codes of India – Part IV

National Fire Protection Association (NFPA)

Rules of Insurance Company & TAC Manual (for reference and guideline).

Consultation with local Chief Fire Officer.

IS Standards as follows:

IS : 1641 : 1988 Code of practice for fire safety of buildings (general): General principles of fire grading and classification.

IS : 1642 : 1989 Code of practice for fire safety of buildings (general): Details of construction.

IS : 1643 : 1988 Code of practice for fire safety of buildings (general): Exposure Hazard.

IS : 1644 : 1988 Code of practice for fire safety of buildings (general): Exit requirements and personal Hazard.

IS : 2190 : 2010 Selection, Installation, and maintenance of first aid fire extinguishers - Code of practice.

IS : 3884 : 1989 Code of practice for installation and maintenance of internal fire hydrants and hose reels on premises

IS : 9668 : 1990 Code of practice for provision and maintenance of water supplies for firefighting.

2. IS : 12469 : 1988 Specification for Pumps for Fire Fighting System

IS : 13039 : 1991 External hydrant systems - provision and maintenance - Code of practice

IS : 15105 : 2002 Design and Installation of Fixed Automatic Sprinkler Fire Extinguishing Systems - Code of Practice

Basis/ Concept of Design

The fire fighting arrangement shall be designed as per the requirement of local guidelines, NBC & NFPA standard.

The entire fire safety installation shall be compliant with the most stringent codes / standard for

the entire Complex to ensure the highest safety standard and uniformity of system. Further, before property is opened to public, the fire protection shall be fully operated and tested under simulated conditions to demonstrate compliance with the most stringent standards, codes and guidelines.

System Description

Fire water storage

Static fire water storage tank for Fire Protection System has been provided at ground level of capacity 600 cum fire water storage i.e. 300 Cum for Tower A & B. Also 25 cum at terrace level of each building.

Fire department connections shall also be provided on the external wall of the property near the main entrance of each block. These shall comprise of 4 Nos. 63 mm dia male outlets capable of directly feeding the ring mains through non return valves or directly filling the static fire storage tanks. Also 2-way & 3-way connections should be provided. These shall be mounted in specially identified boxes.

Fire pumping system:

Sr. No.	Pump Set	Flow (lpm)	Zone	Head
1.1	Hydrant Main Pump (Multi-stage, Multi-outlet)	2850	Low	45m static head + 12.35m friction head + 35m residual head = 92.35m~93
1.2			High	93m static head + 24.50m friction head + 35m residual head = 152.5m~153
2.1	Sprinkler Main Pump (Multi-stage, Multi-outlet)	2850	Low	93m
2.2			High	153m
3.1	Hydrant Jockey Pump (Multi-stage, Multi-outlet)	180	Low	93m
3.2			High	153m
4.1	Sprinkler Jockey Pump (Multi-stage, Multi-outlet)	180	Low	93m
4.2			High	153m
5.1	Stand-by Diesel Pump (Multi-stage, Multi-outlet)	2850	Low	93m
5.2			High	153m
6	Water Curtain Pump (W + SB)	1850	Low	45m

Terrace Level:

Down Comer Pump (Terrace Level) : Capacity 900 LPM 35m Head

Electrical pump shall provide adequate flow for catering requirement of hydrant system. Diesel engine driven fire pumps shall be provided for ensuring operation & performance of the system in case of total electrical power failure. Jockey pumps shall compensate for pressure drop and line leakage in the hydrant and sprinkler installation. Provision of PRS/ orifice plate shall be made in sprinkler riser to restrict pressure on sprinkler system.

Individual suction lines shall be drawn from the fire reserve tanks at the basement level and connected to independent fire suction header. The electric fire pumps, diesel engine driven fire pumps and the jockey pumps shall all draw from this suction header.

Delivery lines from various pumps shall also be connected to a common header in order to ensure that maximum standby capacity is available. The sprinkler pump shall be isolated from the main discharge header by a non-return valve so that the hydrant pump can also act as standby for the sprinkler system. The ring main shall always remain pressurized and Jockey pumps shall make up minor line losses. Automation required to make the system fully functional shall be provided.

Fire hydrant system

Internal and external standpipe fire hydrant system shall be provided with landing valve, hose reel, first aid hose reels, complete with instantaneous pattern short gunmetal pipe in the Complex.

The internal diameter of inlet connection shall be at least 80/100 mm. The outlet shall be of instant spring lock type gunmetal ferrule coupling of 63 mm dia for connecting to hose pipe. Provision of flow switch on riser shall be made for effective zone monitoring. The flow switch shall be wired to FAP and shall indicate water flow on hydrant of the identified zone.

Recessed cupboard/ fire hydrant cabinet shall be strategically located for firefighting requirement. Location of cabinets shall be accessed as per compartmentation plan in consultation with the Architect.

External hydrant shall be located within 2 m to 15 m from the building to be protected such that they are accessible and may not be damaged by vehicle movement. A spacing of about 45-50 m between hydrants for the complex shall be adopted.

2.0 Sprinkler system

Sprinklers shall be distributed in all blocks of the residential as per the National Building Code requirement, so as to cover 12-21 sqm area within the buildings and 9 sqm area in basement areas from each sprinkler head.

Elaborate automatic sprinkler system shall be provided throughout the Public areas as explained above. The system shall be suitably zoned for its optimum functional performance.

The maximum floor area on any one floor to be protected by sprinkler supplied by any one sprinkler system riser or combined system riser shall be covered 52,000 sqft area of each control valve, flow and tamper switches at suitable location and shall be connected to control module of the fire alarm system for its monitoring and annunciation in case of activation.

Sprinkler type along with its bulb rating shall be selected based on the requirement of the space

and shall be specified accordingly.

Wet pipe sprinkler shall be provided for all habitable spaces such as Apartments, corridors and other public areas.

Two layer of sprinklers at common areas like lift lobby areas, corridors etc. will be done by developer. Pipe sizing should be done by consideration of both the levels of sprinkler system.

Hand held fire extinguishers

Portable fire extinguishers of ABC type, Carbon-di-oxide and foam type shall be provided as first aid fire extinguishing appliances. These extinguishers shall be suitably distributed in the entire public as well as service areas. The following extinguisher shall be provided as per local Authorities (CFO).

One ABC Powder extinguisher of 6 kgs. capacity and two fire buckets filled with clean dry fine sand should be provided for every 8 cars at each common basement parking area and also on the setback parking area (under shelter).

One Co2 extinguisher of 4.5 kgs. capacity should be provided near the entrance to each main switch board room, inside each lift machine room and inside each kitchen.

b) One ABC Powder extinguisher of 6 kgs. capacity should be provided near the transformer, if installed.

One ABC powder extinguisher of 9 kgs. capacity should be provided near the entrance to the each D.G. Room.

Scale of suitable extinguishers for Office area shall be collected before approaching the department for final clearance after finalizing the utility of each area.

3.0 WORKMANSHIP

The workmanship shall be best of its kind and shall conform to the specifications, as below or Indian Standard Specifications in every respect or latest trade practices and shall be subject to approval of the APMCF/SBI . All materials and/or Workmanship which in the opinion of the APMCF/SBI / Architect / Consultant is defective or unsuitable shall be removed immediately from the site and shall be substituted with proper materials and/or workmanship forthwith.

4.0 MATERIALS

All materials shall be best of their kind and shall conform to the latest Indian Standards. All materials shall be of approved quality as per samples and origins approved by the APMCF/SBI / Architect / Consultants.

As and when required by the APMCF/SBI / Consultant, the contractor shall arrange to test the materials and/or portions of works at his own cost to prove their soundness and efficiency. If after tests any materials, work or portions or work are found defective or unsound by the APMCF/SBI / Consultant, the contractor shall remove the defective material from the site, pull down and re-execute the works at his own cost to the satisfaction of the APMCF/SBI / Consultant. To prove that the materials used are as specified the contractor shall furnish the APMCF/SBI with original vouchers on demand.

FIRE PROTECTION SYSTEM**SCOPE**

The scope of this section consists of but is not necessarily limited to supply, installation, testing and commissioning of the fire protection system. The philosophy of the system is as follows :

The Fire Suppression System shall comprise the Fire Hydrants System, the Sprinkler System (Wet type), Hand Appliances.

Water from the underground Fire Water Storage Tanks, each of 200 cum capacity, shall be supplied for the uses listed below.

Fire Hydrant System (Pressurized) both for the external hydrants, the internal landing valves and the hose reels at landings.

Sprinkler System (Wet Type)

The Hydrant System and the Sprinkler System, under normal conditions, shall be lowest pressurized by means of the electric motor driven Jockey Pump.

The Hydrant System shall be provided with two pump sets, one of which will be diesel engine driven and the other electric motor driven.

The Sprinkler System shall be provided with an electric motor driven pump set.

The piping and valve connections shall be done so that the water from the discharge of the Hydrant Pump sets is able to supply water, automatically to the Sprinkler System whenever, the Sprinkler Pump is unable to maintain the pressure or fails and not vice versa.

The starting and stopping of the Jockey pump shall be automatic based on the pressure switches at preset low and high pressure.

The electric motor driven Hydrant Pump starts automatically at a preset pressure by means of a pressure switch. As soon as the Hydrant Pump starts, the Jockey Pump Stops. If for any reason the electric motor driven Hydrant Pump does not start at the preset pressure or is unable to maintain the pressure, the diesel engine driven Hydrant Pump starts at the preset pressure.

The Hydrant Pump, whether electric motor driven or the diesel engine driven shall be stopped only manually.

The Sprinkler Pump shall be started automatically at a preset pressure but shall be stopped only manually.

Contractor shall ensure that all false ceiling voids greater than 800 mm are provided with sprinklers.

Contractor shall ensure Hydro Testing for the complete system.

The Contractor shall obtain the necessary approval of the drawings and the schemes from the local authority as called for. The contractor shall also take care of any other requirement so that insurance cover can be obtained, if required at minimum premium at a later date.

The contractor shall design and after approval of Project Manager display near each staircase landing at floor levels, a glass covered framed floor plan clearly showing the locations of all landing valves, hose reels, hand appliances, as well as the DO's and DON'T's for the personnel and the exit direction in case of an emergency. The dimensions of the floor plan, its scale, lettering size, colour scheme etc shall be as directed by the Project Manager.

The Contractor shall provide labeling tag at each Valve.

1.0 PIPE WORK

General Requirements

All materials shall be of the best quality conforming to the specifications and subject to the approval of the Consultants.

Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

Pipes shall be securely fixed to walls and ceilings by suitable clamps and M.S. supports at intervals specified. Only approved type of anchor fasteners shall be used for RCC slabs and walls / floors etc.

Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workman like manner.

Pipe accessories such as gauges, meters, control devices, etc. shall have the same/more working pressure rating as per applicable standard the associated pipe work. All pipe work shall be free from burrs, rust and scale and shall be cleaned before installation. All personnel engaged on welding operations must possess a certificate of competence issued by an acceptable / recognized authority.

Pipes of following types are to be used:

GI pipelines upto 150 mm dia shall be as per IS: 1239, Part-II (heavy grade) while pipelines above 150 mm dia shall be as per I.S.:3589. GI pipes buried below ground shall also be suitably be lagged with layer of anticorrosive treatment with 4mm thick polymer.

Galvanize Iron pipelines Shall be used only for Hydrant-Riser system (inside the building) upto 150 mm dia shall be as per IS: 1239, Part-I (Heavy grade) while pipelines above 150 mm dia shall be as per I.S.:3589. G.I.Heavy class pipe shall be use after deluge valve.

All pipe clamps and supports shall be fabricated from MS steel sections use at site. Welding of galvanized clamps and supports shall not be permitted.

Pipes shall be hung by means of expandable anchor fastener of approved make and design. The hangers and clamps shall be fastened by means of galvanized nuts and bolts. The size/diameter of the anchor fastener and the clamps shall be suitable to carry the weight of water filled pipe and dead load normally encountered.

Hangers and supports shall be thoroughly galvanized after fabrication. The selection and design of the hanger & support shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. All guides, anchor braces, dampener, expansion joint and structural steel to be attached to the building/structure trenches etc. shall be provided. Hangers and components for all piping shall be approved by the Consultants.

The piping system shall be tested for leakages at 2 times the operating pressure or 1.5 time shut-off pressure, whichever is highest including testing for water hammer effects.

Flanged joints shall be used for connections for vessels, equipment, flanged valves and also on two straight lengths of pipelines of strategic points to facilitate erection and subsequent maintenance work.

For pipes underground installation the pipes shall be buried at least one meter below ground level and shall have 230 mm x 230 mm masonry or concrete supports at least 300 mm high at 3m intervals. Masonry work to have plain cement concrete foundation (1 cement: 4 coarse sand : 8 stone aggregate) of size 380x380x75 thick resting on firm soil. Mains below ground level shall be supported at regular intervals not exceeding 3.0 metres and shall be laid at least 2.0 metre away from the building.

2.0 PIPING ACCESSORIES

Flexible Connections

Flexible connections at outlets of pumps shall be of stainless steel corrugated inner tube and stainless-steel wire braid outside the tube with flanged ends. The flexible connectors shall be designed for excellent vibration and noise protection. Isolated tension members shall be provided to prevent excessive elongation. The end flange connection shall be rated at 20 kg/cm² (300 psi).

Flexible connections shall be suitable for the working fluid and for the working pressure and temperature.

Expansion Joints

Pack-less type expansion connectors shall be used where the expansion and contraction of the pipe is excessive or cannot be compensated for by expansion loops or offsets.

Anchors and pipe guides shall be provided and installed at the recommended locations. All expansion connectors shall have flanged ends with working pressure corresponding with the piping system.

Flexible pipe connections shall be installed at every structural expansion joint.

Strainers

Water strainers shall be of the Y type. Strainers of 50 mm (2 inches) in diameter and smaller shall have bronze or iron bodies with screwed connections while 65 mm (2 ½ inches) in diameter strainers and larger shall have iron bodies and flanged connections. They shall have the same pressure rating as the piping system.

The free area of each screen shall be not less than three times the area of the strainers of 65 mm (2 ½ inches) in diameter and larger shall be provided with 15 mm (½ inch) diameter valve drains. The outlet shall be piped to the nearest drain.

Air Vent and Drain

Manual air vent shall be furnished as required for purging air or other gases from the water circuit during filling. The outlet shall be piped to the nearest drain.

Automatic air vents, conforming to ASA standards, shall be furnished at the top of main risers. A shut-off valve shall be provided at the inlet of each automatic air vent. The outlet of each vent shall be piped to the nearest drain.

A plug-type drain cock shall be provided at all low points of pipework systems.

Drains shall be installed to ensure easy access and convenience for maintenance and removal of all piping, valves, fittings and equipment without undue spillage.

Drainage facilities shall be provided and suitably sized to drain expeditiously the entire system and equipment involved.

Pressure Gauges

Pressure gauges shall be of the bourdon type, stainless steel casing, round type of 100 mm (4

inches) dial and scale range of approximately 150 per cent of the normal operation. Pressure readings shall be in kg/cm^2 and psig.

A shut-off valves and snubbed with working pressure corresponding with the piping system shall be provided for each pressure gauge.

Oil filled pressure gauges shall be installed where there is excessive vibration.

Flow Measuring Equipment

Flow measuring devices shall be annubar flow measuring stations and a portable meter set complete with master chart for direct conversion of meter readings to m^3/h (or gpm), carrying case, two 4-m hoses, equalizer manifold, check seal, installation and operating instructions. Meters shall become the property of the Employer/Owner.

Meters shall be approved factory assembled Eagle Eye flow meters or equal approved. Each station shall be completed with safety shut-off valves and quick connect coupling connections.

Annubar elements shall be made of stainless steel and rated to $20 \text{ kg}/\text{cm}^2$ (300 psig) at 204°C (400°F).

The flow measuring equipment shall be the product of Annubar by Ellison Instrument Division, Dieterich Standard Copr., or approved equivalent.

Each station shall be tagged by means of a brass tag, attached with a chain, that indicates the station number, meter setting and m^3/h (or gpm).

Welding sockets shall be supplied by the flow meter manufacturer.

The flow meters shall be equipped with a built-in electronic totalizer, a square- root extractor, and a power unit for the transmitter to the central control panel.

Piping Installation & Support

Tender drawings indicate schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

Piping shall be properly supported on , or suspended from , on stands, clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. Risers shall be supported at each floor with Galvanised steel clamps.

Pipe hangers shall be provided at the following maximum spacings:

Pipe Dia (mm)	Hanger Rod Dia (mm)	Spacing between Supports (m)
Up to 25	6	2
32 to 50	6	2.5
65 to 80	8	2.5
80 to 100	10	2.5
125 to 150	10	3.0
200 to 300	12	3.5

The end of the steel rods shall be threaded and not welded to the threaded bolt. All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work, so that area can be carried out in one stretch. Cut-outs in the floor slab for installing the various pipes area are indicated in the drawings. Contractor shall carefully examine the cut-outs provided and clearly point out wherever the cut-outs shown in the drawings, do not meet with the requirements. Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fiberglass and finished with retainer rings. The contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified / approved by Consultants. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required. All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used. Automatic air valves shall be provided at all high points in the piping system for venting. All valves shall be of 15mm pipe size and shall be associated with an equal size gate valves. Automatic air valves shall be provided on water risers. Discharge from the air valves shall be piped through a pipe to the nearest drain or sump. All pipes shall be pitched towards drain points. Pressure gauges shall be provided as shown on the approved drawings. Care shall be taken to protect pressure gauges during pressure testing.

Pipe Fittings

Pipe fittings mean tees, elbows, couplings, unions, flanges, reducers etc and all such connecting devices that are needed to complete the piping work in its totality. Ductile Iron mechanical coupling (Victaulic) type grooved fitting should be used for pipe. In all common area shafts should have the conventional welded joints up to the 65 mm dia and for pipe 50 mm & below should be threaded. Fabricated fittings shall not be permitted for pipes diameters 50mm and below in the common areas. Grooved End Fittings used on pipe, Fittings shall be cast of ductile iron conforming to ASTM A-536,

Grade 65-45-12. Fittings provided with an alkyd enamel finish or hot dip galvanized to ASTM A-153. Zinc electroplated fittings and couplings conform to ASTM B633.

Procedure For Pypkote / Coatek Application

Surface Preparation - The pipe surface shall be cleaned by a wire brush.

Application of Primer - Pypkote / Coatek primer is to be applied on pipes immediately after cleaning. This is to prevent any further accumulation of rust on the pipe. This is a cold applied primer and is applied by brush.

Application of Pypkote / Coatek 4 mm Tape - After the primer is applied on the pipe, it is allowed to dry for about 30 min. till it becomes touch dry. Before adhering the tape to the pipe, it is advisable to gently heat the primer coated pipe by a run of LPG torch. Remove the bottom polyethylene from the tape & then heat bottom surface of the tape by LPG torch or any heat source & start wrapping the tape to the pipe by heating the primer coated pipe & by removing the bottom polyethylene from the tape before wrapping better adhesion between the tape & pipe is obtained. Overlaps are maintained with a minimum of 12.5 mm.

Tape coating of weld joints - The tape is applied over the weld joints after the necessary welding & testing methods of the joints is completed. The procedure for application of tape shall be the same as bare pipe procedure. Overlaps on each side of the weld joints shall be 50 mm.

A final coat of White wash with water-based cement paint is done immediately over the entire coated pipe.

“HOLIDAY” Testing must be required for the “External Piping”. The Contractor shall be arrange all testing tools and machines for holiday testing.

Jointing

Mechanical Coupling

Mechanical coupling shall be UL listed or FM Global approved for fire protection service, ductile or iron housing, rust inhibiting no-lead painted coating, zinc electroplated heat treated bolts and heavy hex carbon steel nuts meeting ASTM F- 1476

The grooved pipe shall be prepared with a roll groove.

Hangers and pipe support shall be installed in accordance with the manufacturer’s recommendation.

After the completion of the installation, contractor shall be responsible for arranging an inspection by the technical staff of the supplier of the purchased mechanical couplings and requesting the inspection report from the supplier and submitting to the supervisor for approval.

Welded Joints:

Joints between pipes and fittings shall be made with the pipes and fittings having “V” groove and welded with electrical resistance welding in an approved manner. But welding without “V” groove shall not be permitted. 2-3% welding shall be radio- graphically tested or satisfaction of Project engineer.

All joints in the pipe line with screwed fittings shall be seal welded after testing and the weld plus the adjoining portion shall be given two coats of zinc rich primer. (Warranty period 36 month from date of commissioning

Flanged joints (65 mm dia and above)

Flanged joints with flanges conforming to IS: 6392 shall be provided on

Straight runs at intervals not exceeding 25-30m on pipe lines of 50 mm dia and above and as directed by the Project Manager.

For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and as required for good engineering practice and as shown/noted on the drawings.

Flanges shall be with GI bolts and nuts and 3mm insertion gasket of natural rubber conforming to IS: 11149.

4.0 ROSETTE PLATE

Rosette plate should be double recessed escutcheons. It should be selected as per the size i.e., 1/2" or 3/4" fire sprinkler. It should be chrome plated.

5.0 AIR RELEASE VALVE

Air release valve should be suitable for clean or raw water service with pressure up to 740 PSIG (5100 kPa). Air release valve shall be automatic float operated valves designed to release accumulated air from a piping system while the system is in operation and under pressure. The capacity and pressure rating of the valve is dependent on the diameter of the precision orifice in the cover. A large inlet connection is required for proper air and water exchange. The valve body shall be threaded with NPT inlets and outlets. The body inlet connection shall be hexagonal for a wrench connection. The valve shall have two additional NPT connections for the addition of gauges, testing and draining.

Design of the valve: The cover shall be bolted to the valve body and seated with a flat gasket. Resilient seats shall be replaceable and provide drop tight shut off to the full valve pressure rating. The floats shall be unconditionally guaranteed against failure including pressure surges. Mechanical linkage shall provide sufficient mechanical advantage so that the valve will open under full operating pressure. Simple lever designs shall consist of a single pivot arm and a resilient orifice button.

Material: The valve body and cover shall be constructed of ASTM A126 Class B cast iron for working pressure upto 300 psig. The higher pressure rated valves shall be constructed of ASTM A536 Grade 65-45-12 ductile iron.

Certification: Valves shall be manufactured and tested in accordance with American Water Works Association Standard C512. The valves shall be UL listed.

6.0 EXHAUST PIPES

The material used for exhaust pipe including all the fixing accessories and hardware shall be Mild steel (Class-'C'). The exhaust pipes shall be insulated with 75 mm thick mineral wool (density 100 kg/m³) insulation wrapped in chicken mesh and clad with 26 gauge aluminum sheet including all hot dip galvanized support structural.

Adequate sized pipes and fittings shall be installed to carry away the exhaust discharge into the atmosphere at a height as indicated in the drawings & as per the requirement of Center / State Pollution Control Board or Pollution Control Committee as the case may be. The galvanized M.S. structural support and vibration arrestors to specify along with drawing for statutory clearance.

7.0 MECHANICAL SEAL

A mechanical seal must contain four functional components, primary sealing surfaces, secondary sealing surfaces, a means of actuation, and a means of drive:

The primary sealing surfaces are the heart of the device. A common combination consists of a

hard material, such as silicon carbide, Ceramic or tungsten carbide, embedded in the pump casing and a softer material, such as carbon in the rotating seal assembly. Many other materials can be used depending on the liquid's chemical properties, pressure, and temperature. These two rings are in intimate contact, one ring rotates with the shaft, the other ring is stationary. These two rings are machined using a machining process called lapping in order to obtain the necessary degree of flatness.

The secondary sealing surfaces (there may be a number of them) are those other points in the seal that require a fluid barrier but are not rotating relative to one another. Usually the secondary sealing elements are 'O'-rings, PTFE wedges or rubber diaphragms.

In order to keep the two primary sealing surfaces in intimate contact, an actuation force is required and is commonly provided by a spring. In conjunction with the spring, it may also be provided by the pressure of the sealed fluid.

The primary sealing surfaces must be the only parts of the seal that are permitted to rotate relative to one another, they must not rotate relative to the parts of the seal that hold them in place. To maintain this non-rotation a method of drive must be provided.

8.0 LEVEL CONTROLLER/INDICATORS

Water Level Controller should automatically START the pump set as soon as the water level falls below the predetermined level and shall SWITCH OFF the pump set as soon as tank is full or water level in the lower tank is at below minimum level. The level controller should provide the flexibility to the user to decide the water levels for operations of pump set in upper/lower tanks. The built in indications for showing full, empty levels in Upper Tank and Lower Tank Empty Indication. The manual operation switch for special operations like- watering the plants from pump set. The water level controller should ensure no overflows or dry running of pump there by saves electricity and water low AC voltage sensing circuit to avoid polarization of electrodes in water (requires very rare cleaning of electrode ends). The level controllers shall be provided with special stainless steel conductive electrodes. It should consume very little energy and should be ideal for continuous operation. The rated supply voltage should be 220V AC, 50Hz.

9.0 AIR VESSEL

The air vessel shall be provided to compensate for slight loss of pressure in the system and to provide an air cushion for counter-acting pressure, surges, whenever the pumping sets come into operation. Air vessel shall conform to IS:3844. It shall be normally half full of water, when the system is in normal operation. Air vessel shall be fabricated with 8 mm thick M.S. plate with dished ends and suitable supporting legs. It shall be provided with one 100 mm dia flanged connection from pump, one 25 mm drain with valve, one water level gauge and 25 mm sockets for pressure switches. The air vessel shall be tested to pressure for 12 hours at 2 times the operating pressure or 1.5 times the shut-off. (Warranty period 12 month from date of commissioning)

10.0 AIR CUSHION TANK

Every wet riser shall be provided with an air cushion tank at its top most point. The air cushion shall be provided with an automatic air release cock, 20 mm dia drain pipe, drain valve and shut

off valve.

11.0 FIRE BRIGADE CONNECTION

The storage tank shall be provided with a 150 mm fire brigade pumping connection to discharge at least 2275 liters / minute into it. This connection shall not be taken directly into the side of the storage tank, but arranged to discharge not less than 150 mm above the top edge of the tank such that the water flow can be seen. The connection shall be fitted with stop valve in a position approved by the Project Manager. An overflow connection discharging to a drain point shall be provided from the storage tank.

The fire brigade connection shall be fitted with four numbers of 63mm instantaneous inlets at a suitable position at street level, so located as to make the inlets accessible from the outside of the building. The size of the wall box shall be adequate to allow hose to be connected to the inlets, even if the door cannot be opened and the glass has to be broken. Each box shall have fall of 25mm towards the front at its base and shall be glassed with wired glass with "FIRE BRIGADE INLET" painted on the inner face of the glass in 50 mm size block letter. Each such box shall be provided with a steel hammer with chain for breaking the glass.

In addition to the emergency fire brigade connection to the storage tank, a 150mm common connection shall be taken from the four 63mm instantaneous inlets direct to hydrant main so that the fire brigade may pump to the hydrants in the event of the hydrant pumps being out of commission. The connection shall be fitted with a sluice valve and reflux valve. Location of these valve shall be as per the approval of the Project Manager.

Three way collecting head with three numbers 63 mm instantaneous type inlets shall be connected to the Fire water tank (Draw-in). All other details shall be as described above.

Two way collecting head with two numbers 63 mm instantaneous type inlets shall be connected to the Fire Water Tank as (Draw-out). All other details shall be as described above.

12.0 SYSTEM DRAINAGE

The system shall be provided with suitable drainage arrangement with drain valves complete with all accessories.

13.0 VALVE CHAMBERS

Provision of suitable brick masonry chambers in cement mortar 1:5 (1 cement : 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement:5 fine sand : 10 graded stone aggregate 20 mm nominal size) with 15 mm thick cement plaster inside and outside finished with a plaster inside and outside finished with a floated coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back-filling complete shall be made.

14.0 VALVES

Sluice Valves

Sluice valves shall be double flanged valves with cast iron body. The spindle, wall seat and wedge nuts shall be of bronze. They shall generally have non-rising spindle and shall be of the particular duty and design called for.

The valves shall be supplied with suitable flanges, non- corrosive bolts and asbestos fibre gaskets. Sluice valves shall conform to Indian Standard IS : 780-1969 and IS : 2906 .

Butterfly Valve

The butterfly valve shall be suitable for waterworks and rated for 300 P.S.I

The body shall be of cast iron to IS:210 in circular shape and of high strength to take the water pressure. The disc shall be heavy duty cast iron with anti-corrosive epoxy or nickel coating.

The valve seat shall be of high grade elastomer or nitrile rubber. The valve in closed position shall have complete contact between the seat and the disc throughout the perimeter. The elastomer rubber shall have a long life and shall not give away on continuous applied water pressure. The shaft shall be EN 8 grade carbon steel.

The valve shall be fitted between two flanges on either side of pipe flanges. The valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.

Ball Valve

The ball valve shall be made forged brass and suitable for test pressure of pipe line. The valve shall be internally threaded to receive pipe connections.

The ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body-bonnet gasket and gland packing shall be of Teflon.

The handle shall be provided with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the Teflon packing shall be sealed to prevent water seeping.

The handle shall also be provided with a lug to keep the movement of the ball valve within 90°. The lever shall be operated smoothly and without application of any unnecessary force.

Gate Valve

The Gate valve ANSI Class 1500, Conforming to API 600, RTJ flanged ends, solid wedge disc; BODY AND BONNET – ASTM A216 WCB cast carbon steel; STEM, DISC, AND SEATS - ASTM A182 F6, 11.5 to 13.5% chromium steel; PACKING - flexible graphite with braided carbon/graphite end rings; Bevel gear operator 150 DN and above, bolted bonnet, OS&Y - rising stem, full port.

The gate closure system will not be damaged by the hydrostatic test pressure when the valve is closed.

The pressure-containing components are designed in accordance with ASME B31.3

The seats were tested in accordance with API standard 598, Valve Inspection and Test.

a) The manufacturer shall guarantee that the body and weld ends of gate valves have the required corrosion allowances.

c) Gate valves shall meet the high-pressure closure test requirements of API Standard 598.

Gun Metal Valves

Gun metal Valves shall be used for smaller dia pipes, and for threaded connections. The Valves shall bear certification as per IS:778

The body and bonnet shall be of gun metal to IS:318. The stem gland and gland nut shall be of forged brass to IS:6912. The hand wheel shall be of cast iron to IS:210.

The Hand wheel shall be of high quality finish to avoid hand abrasions. Movement shall also be easy. The spindle shall be non-rising type.

Non-Return Valve

Non-Return valves shall be cast iron double flanged with cast iron body and gunmetal internal parts conforming to IS:5312.

Pressure Relief Valve

Each System shall be provided with a Pressure Relief Valves. The Valve shall be spring actuated and set to operate as per field requirement. The Valve shall be constructed of bronze and provided with an open discharge orifice for releasing the water. The Valve shall be open lift type.

"Y"- Strainer, Basket Strainer

Cast Iron Top Flange open-able Filter Element can be replaced without Disconnecting Pipe Line, Filter Element Stainless Steel – SS-304/Brass/Bronze, A permanent magnet is also provided on demand. Pressure rating 10 kg/cm² to 21 kg/cm².

Vertical piping, frequently found at pump inlets, necessitates the use of a Y strainer or a tee type basket strainer. Most basket strainers are intended for horizontal or slightly inclined piping. Special attention must be given to the orientation of the debris collection chamber and drain (blowdown) connection of the strainer. The strainer must be installed such that it is located at the lowest possible position. A Y-strainer in vertical piping must be placed with its screen in the downward position to trap the sediment in the debris collection chamber and Y-strainer body and cover conforming to ASTM A126.

15.0 PRESSURE SWITCH

The pressure switches shall be employed for starting and shutting down operation of pumps automatically, dictated by line pressure. The Pressure Switch shall be diaphragm type. The housing shall be die cast aluminum, with SS 316 movement, pressure element and socket. The set pressure shall be adjustable.

The Switch shall be suitable for consistent and repeated operations without change in values. It shall be provided with IP:55 water and environment protection.

16.0 PRESSURE GAUGE

Pressure gauge shall be provided near all individual connections of the hydrant system with isolation valves and near each flow switch assembly of the sprinkler system. Pressure gauge shall be 50 mm dia gunmetal bourdon type with gunmetal isolation ball valve, tapping and connecting pipe and nipple. The gauge shall be installed at appropriate height for easy readability.

17.0 PAINTING

All Hydrant and Sprinkler pipes shall be painted with post office red colour paint. All M S pipes shall first be cleaned thoroughly before application of primer coat. After application of primer coat two coats of enamel paint shall be applied. Each coat shall be given minimum 24 hours drying time. No thinners shall be used. Wherever required all pipe headers shall be worded indicating the direction of the pipe and its purpose such as "TO RISER NO.1" etc.

Painting shall be expertly applied, the paint shall not over run on surfaces not requiring painting such as walls, surfaces etc. Nuts and bolts shall be painted black, while valves shall be painted blue/silver.

18.0 EXCAVATION

Excavation for pipe lines shall be in open trenches to levels and grades shown on the drawings or as required at site. Pipe lines shall be buried with a minimum cover of 1 meter or as shown on drawings.

Wherever required Contractor shall support all trenches or adjoining structures with adequate timber supports, shoring and strutting. On completion of testing in the presence of the Project

Manager and pipe protection, trenches shall be backfilled in 150 mm layers and consolidated. Contractor shall dispose of all surplus earth as directed by the Project Manager.

19.0 ANCHOR / THRUST BLOCK

Contractor shall provide suitably designed anchor blocks in cement concrete/steel support to cater to the excess thrust due to work hammer and high pressure.

Thrust blocks shall be provided at all bends, tees and such other location as determined by the Project Manager.

Exact location, design, size and mix of the concrete blocks/steel support shall be as shown on the drawings or as directed by the Project Manager prior to execution of work.

20.0 FIRE HYDRANTS

External Hydrants

Contractor shall provide external hydrants. The hydrants shall be controlled by a cast iron sluice valve. Hydrants shall have instantaneous type 63mm dia outlets. The hydrants shall be single Gun metal outlet conforming to IS:908 with CI duck foot bend and flanged riser or required height to bring the hydrant to correct level above ground.

Contractor shall provide for each external fire hydrant two numbers of 63mm dia. 15 m long controlled percolation (RRL)hose pipe with stainless steel male and female instantaneous type couplings machine wound with GI wire (hose to IS:636 type certification) , stainless steel branch pipe with nozzle to IS:903. This shall be measured and paid for separately.

Each external hydrant hose cabinet shall be provided with a drain in the bottom plate.

Each external hydrant hose cabinet containing items as above shall also be provided with a nozzle spanner. This shall be measured and paid for separately.

Each hose cabinet shall be conspicuously painted with the letters "FIRE HOSE".

Internal Hydrants

Contractor shall provide on each landing and other locations as shown on the drawings double headed Gun metal landing valve with 100 mm dia inlet as per IS:5290, with shut off valves having cast iron wheels as shown on the drawings. Landing valve shall have flanged inlet and instantaneous type outlets as shown on the drawings.

Instantaneous outlets for fire hydrants shall be standard pattern and suitable for fire hoses.

Contractor shall provide for each internal fire hydrant station two numbers of 63 mm dia. 15 m long rubberized fabric lined(RRL)hose pipes with SS male and female instantaneous type coupling machine would with GI wire (hose to IS:636 type 2 and couplings to IS:903 with IS certification), fire hose reel, stainless steel branch pipe with nozzle to IS:903. This shall be measured and paid for separately.

Contractor shall provide standard fire hose reels of 25mm dia high pressure rubber hose 40 m long with stainless steel nozzle, all mounted on a circular hose reel of heavy duty mild steel construction having cast iron brackets. Hose

reel shall be connected directly to the wet riser with an isolating valve. Hose reel shall conform to IS:884 and shall be mounted vertically. This shall be measured and paid for separately.

Each internal hydrant hose cabinet shall be provided with a drain in the bottom plate. The drain point shall be lead away to the nearest general drain.

Each internal hydrant hose cabinet containing items as above shall also be provided with a nozzle

spanner. The cabinet shall be recessed in the wall as directed. This shall be measured and paid for separately.

Each hose cabinet shall be conspicuously painted with the letters "FIRE HOSE".

Hose Reel

Hose reel shall conform to IS : 884, heavy duty, 25 mm dia length shall be 40 meter long fitted with stainless steel chromium plated nozzle, mild steel pressed reel drum which can swing up-to 170 degree with wall brackets of cast iron finished with red and black enamel complete.

Fire Hose

All hose pipes shall be of 63 mm diameter RRL/ CP as required, conforming to IS : 636 or IS : 8423. The hose shall be provided with stainless steel delivery coupling. The hose shall be capable of withstanding a bursting pressure of 35.7 Kg/Sq.cm without undue leakage or sweating. Hose shall be provided with instantaneous spring-lock, type couplings.

Branch Pipe, Nozzle

Branch pipes shall be of stainless steel with loaded tin bronze ring at the discharge and to receive the nozzle and provided at the other with a leaded tin bronze ring to fit into the instantaneous coupling. Nozzle shall be of spray type of diameter of not less than 16 mm and not more than 25 mm. Nozzle shall be of loaded tin bronze branch pipe and nozzle shall be of instantaneous pattern conforming to Indian Standard - 903.

Hose Cabinet

Hose cabinet shall be provided for all internal fire hydrants. Hose cabinets shall be fabricated from 16 gauge MS powder coated sheet of fully welded construction with hinged double front door partially glazed (3 mm glass panel) with locking arrangement, stove enameled fire red paint (shade No. 536 of IS:5) with "FIRE HOSE" written on it prominently (size as given in the schedule of quantities). Cabinet surfaces in contact with the walls shall not be powder coated but instead given two coats of anti- corrosive bitumastic paint.

Internal Hose Cabinet

Hose cabinet shall be of glass fronted with hinged door & lock. The cabinet shall be made of 16 gauge thick MS sheet and spray painted to shade No. 536 of IS:5. The hose cabinet shall be of size to accommodate the following:

Landing Valves (Single/double headed)

Hose pipe

Hose reel (40 mtr.)

Branch pipes, nozzles (2 sets)

External Hose Cabinet

The hose cabinet shall be of size to accommodate the following:

Single/Double headed yard hydrant valve

Hose pipe (2 length of 15 m)

Branch pipes, nozzles (2 sets)

21.0 SPRINKLER SYSTEM

General Specification

The scope of work shall include supply, commissioning, testing of the system as a whole. The sprinkler heads are to be fixed into heavy Grade quality black steel pipes, conforming to IS 1239 or any other approved specification. The size of pipe will vary from 20 mm to 150mm to suit the hydraulics of the system. The System shall conform to CFO Rules for the installation of sprinkler systems in general for 'Low Hazard' category- in respect of design, density and spacing of sprinkler heads.

Two layer or Both type of sprinklers at common areas like lift lobby areas, corridors etc. will be done by developer. Pipe sizing should be done by consideration of both the levels of sprinkler system.

Reduction in pipe sizes shall not be made by use of bushings. All piping shall be done by means of welding, screwed & flanged jointing as per codes.

Due care shall be taken that sprinklers are not applied with paint at the time of applying paint to piping and fittings.

All control, drain, test and alarm valves shall be provided with signs to identify their purposes, functions, direction of flow the satisfaction of the Consultants.

Quartzoid Bulb Automatic Sprinkler

Sprinkler heads shall be made of brass/quartzoid bulb sufficiently strong, in compression to withstand any pressure, surge or hammer likely to occur in the system. The yoke & body shall be made of high quality gun metal brass with arms streamlined to ensure minimum interference with the spread of water. The deflector of suitable design shall be fitted to give even distribution of water over the area commanded by the sprinkler.

The bulb shall contain a liquid having a freezing point below any natural climatic figure and a high coefficient of expansion. The temperature rating of the sprinkler shall be stamped on the deflector & the colour of the liquid filled in the bulb shall be according to the temperature rating as per NFPA standard. The sprinkler heads shall be of type & quality approved by the local fire brigade authority. The inlet shall be screwed.

The sprinklers shall have 15mm nominal size of the orifice for ordinary hazard. The orifice size shall be marked on the body or the deflector of the sprinkler.

Metal guards for protection of sprinkler against accidental or mechanical damage shall be provided as desired by the Project Manager.

Contractor shall submit detailed submittal and discharge spray pattern for the Sprinkler for the approval of consultant.

Upright Sprinkler Head

Applicable for ceiling spaces, storage areas, plant rooms, and as specified on the drawings.

Frangible bulb type.

Upright style.

13 mm (½ inch) in diameter nominal orifice. Chrome finish.

Temperature rating as specified on drawings.

68oC temperature rating or same temperature rating as of the existing sprinkler heads.

Pendent Sprinkler Head

Ceiling sprinkler heads shall be of the semi-recessed type. Frangible bulb type.

Pendant style.

13 mm (1/2 inch) in diameter nominal orifice.

Chrome-plated escutcheon around ceiling penetration. Temperature rating as specified on drawings.

68oC temperature rating or same temperature rating as of the existing sprinkler heads.

Sidewall Sprinkler Head

Applicable for ramp areas and the like where ceiling sprinklers cannot be used. Frangible bulb type.

14 mm (17/32 inch) in diameter nominal orifice. Chrome finished.

68oC temperature rating or same temperature rating as of the existing sprinkler heads.

Water distribution at pressure 2.1 kg/cm² (30 psi) not less than 6 m (20 ft) length and 4.5 m (15 ft) width.

Extended coverage sidewall sprinkler water distribution at pressure 2.1 kg/cm² (30 psi) not less than 7.3 m (24 ft) length and 4.5 m (15 ft) width.

Concealed Pendent Sprinkler Head

Applicable for lift lobbies & corridors with in the apartments. Concealed pendent sprinkler heads shall be of the sprinkler heads designed for installation on concealed type system with an aesthetic ceiling appearance. The contractor shall submit colour of the decorative finished plate to approval from the supervisor.

They shall, furthermore, have the following features: - Pendant style.

Quick response type.

Nominal K-factor shall be 5.6 gpm/(psi)^{1/2} or 8.1 dm³/min/(kPa)^{1/2} with 15 mm (1/2 inch NPT) thread size.

Recessed brass sprinkler cup and brass cover plate with Listed cover plate finish.

Fusible link type or Glass bulb type, 68oC – 74oC Sprinkler head temperature rating and 68oC Cover plate temperature rating.

The contractor shall not apply any other paint on the concealed sprinkler cover plate.

Concealed Side Wall Sprinkler Head

Applicable for bed rooms & living room with in the apartments. Concealed side wall sprinkler heads shall be of the sprinkler heads designed for installation on concealed type system with an aesthetic ceiling appearance. The contractor shall submit colour of the decorative finished plate to approval from the supervisor.

They shall, furthermore, have the following features:- Quick response type.

14 mm (17/32 inch) in diameter nominal orifice.

Glass bulb type, 68oC – 74oC Sprinkler head temperature rating and 57oC Cover plate temperature rating

Water distribution at pressure 2.1 kg/cm² (30 psi) not less than 6 m (20 ft) length and 4.5 m (15 ft) width.

Extended coverage sidewall sprinkler water distribution at pressure 2.1 kg/cm² (30 psi) not less than 7.3 m (24 ft) length and 4.5 m (15 ft) width.

Recessed brass sprinkler cup and brass cover plate with Listed cover plate finish. The contractor shall not apply any other paint on the concealed sprinkler cover plate.

Spare Sprinkler Heads

Spare sprinkler heads with wrench and cabinet shall be provided in accordance with NFPA 13 and other documents.

The stock of spare sprinklers shall include all types and ratings installed and shall be as follows:
For systems having less than 300 sprinklers, not fewer than six sprinklers
For systems with 300 to 1,000 sprinklers, not fewer than 12 sprinklers
For systems with over 1,000 sprinklers, not fewer than 24 sprinklers

Sprinkler Installation

Sprinkler heads shall be located in positions shown on the drawings. While slight relocation may result from building construction features or interference from other services, the maximum spacing between sprinkler heads and coverage area shall not exceed those stipulated in the TAC regulations and the NFPA 13-1994 Rules.

Allowance shall be made for such relocations within a radius of 1500 mm of the indicated positions without additional cost. The Fire Protection Services Trade shall co-ordinate with the ceiling Trade to set out the sprinkler locations to suit the site location of the unit grid. In general, all sprinklers shall be located at the centre of the ceiling unit and a provision of about 10% more sprinklers and pipe work than required in TAC and NFPA Rules shall be included in this sub-contract. Chrome plated wire mesh guards shall be used to protect the sprinkler heads which are liable to accidental or mechanical (at no extra cost) damage.

Operating Temperature

The Operating temperature at which the quartzoid bulb of the sprinkler head shall actuate, shall be 68 degree C or as specifically mentioned.

Flow Requirements

The flow requirement for sprinkler heads shall be specifically approved for the designated area of installation.

Orifice Plates

For restricting pressure at lower levels in the sprinkler system, orifice plates of appropriate sizes shall be fitted at different floor levels, at the branching points from Riser Main.

The Diameter of such orifice shall not be less than 50% of the dia of pipe into which it is to be fitted, which shall not be less than 50mm dia. These orifice plates must be of stainless steel with plain central hole without burrs, and the thickness shall be 3mm for pipe size up to 80 mm, 6 mm for pipes from 80 to 125 mm dia and 9 mm for pipes greater than 125 mm dia. Such orifice plate must have a projecting identification tag.

The orifice plate shall fitted not less than two pipe internal diameters down-stream of the outlet from any elbow or brand.

Contractor shall submit the design and identify location on drawing before installation. And the design of orifice size should be as per the building height.

Installation Control Valves

Each installation shall be provided with a set of installation control valves comprising: -

An Alarm Valve.

A Water Motor Alarm & Gong.

Installation valves shall be installed on the sprinkler circuits as shown on the drawings.

Contractor shall submit detailed shop drawings showing the exact location, details of installation of the valves/alarm in all respects.

Installation valve shall comprise of a cast iron body with gunmetal trim, and double seated clapper check valves, pressure gauges, test valve and orifice assembly and drain valve with pressure gauges, turbine water gong including all accessories necessary and required and as supplied by original equipment manufacturer and required for full and satisfactory performance of the system. A cast iron isolation valve with lock and chain at the inlet of the installation valve shall be provided.

Inspection And Test Valve Assembly

Inspection and testing of the automatic starting of the sprinkler system shall be done by providing an assembly consisting of gunmetal valves, gunmetal sight glass, bye-pass valve and orifice assembly as per approved drawing.

Flow Switch

Flow switch shall have a paddle made of flexible and sturdy material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle/ pipe through a connecting socket. The Switch shall be potential free in either N O or N C position as required. The switch shall be able to trip and make / break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation Panel. The flow switch shall have connections for wiring the seat shall be of S.S to the Annunciation Panel. The flow switch shall have IP: 55 protection.

The flow switch work at a triggering threshold bandwidth (flow rate) of 4 to 10 GPM. Further, it shall have a 'Retard' to compensate for line leakage or intermitted flows.

Deluge Valve

A Deluge System shall have a fixed fire protection system in which the pipe system is empty until the deluge valve operates to distribute pressurized water from open nozzles or sprinklers. Deluge systems are more complex than wet pipe and dry systems because they contain more components and equipment. The deluge valve is activated by operation of a fire detection system installed in the same area as the sprinklers. Various types of detection systems may be used, including smoke, heat, ultraviolet (UV), or infrared (IR) detection. The Viking deluge system can be activated by a hydraulic, pneumatic, electric, or manual release system or any combination of these release systems. But, in all cases, the deluge valve itself is activated hydraulically. When the detection device is activated, the deluge valve is tripped and water flows into the piping system, discharging through all spray nozzles or sprinklers simultaneously. There are a number of arrangements that can be used for operating the deluge system. The simplest of these is to use sprinklers in a pilot line under system water pressure. The pilot line is piped from the priming chamber to the area protected with connections to the PORV and emergency release. When a pilot head operates, pressure in the priming chamber is relieved faster than it can be replenished through the restricted orifice. Supply pressure overcomes the clapper differential, forcing the clapper off its seat, allowing water to flow to the system outlets and sound the water flow alarm. G.I. Medium class pipe shall be use after deluge valve.

Solenoid Valve

The solenoid valve shall have a two-way type with one inlet and one outlet. It is a packless, internal pilot operated valve, suitable for use in releasing water pressure from the priming

chamber. The solenoid valve has floating diaphragm construction, which requires a minimum pressure drop across the valve to operate properly. The valves are available with a voltage rating of 24V DC in a normally closed or normally open configuration, or 110/50-120/60 normally closed configuration. These solenoid valves are for use with system control units that are listed and/or approved for releasing service for water based fire protection systems.

The solenoid valve shall have an internal pilot operated valve with pilot and bleed orifices utilizing line pressure for operation. Normally closed, de-energized valves open when energized. Power is applied to the solenoid coil, causing the solenoid core to lift, opening the pilot orifice to the outlet side of the valve. This relieves pressure on the top side of the diaphragm and allows the line pressure to open the valve. When de-energized, the solenoid core reseals the pilot orifice, allowing the line pressure to build above the diaphragm, closing the valve.

Fire Sealant

ASTM C-834-00 specification for latex sealing compounds. USDA acceptance for use in meat and poultry processing plants, ASTM C-919 standard practice per use of sealants in acoustical applications, and ASTM E-90-09. Fire Rated System: Two-hour Fire and Temperature Rated wall and floor joint systems up to 7" (178mm) wide and four-hour systems up to 4" Ultra Block fire blocking material in fire-rated walls and floors. Reference: ANSI/UL 263, ASTM E-119, NFPA No. 251. The guarantee of flow measuring assembly shall not be less than the Defect Liability Period specified in the Tender/RFP

Flow Meter

Flow meters shall be primarily used for measuring instantaneous flow rate and volume of water or similar liquids passed through the meter. Measurements shall be done in both flow directions, with high measurement accuracy over a wide range of flow rates 0.1 to 10 m/s. The minimum required conductivity of the measured medium is 20 μ S/cm. The measurement evaluation electronic unit includes a two-line alphanumeric display to show the measured values where various operational parameters of the meter can be selected by means of an associated keyboard. The Flow Meters and the accessories shall be suitable for continuous operation under an ambient temperature of 0-55°C and Relative Humidity of 0-95% unless specified otherwise in volume IIB Section-B or Section-C. All accessories required for mounting/erection of these instruments shall be furnished as necessary for completeness of the system.

The Main Stop Valve

These shall be of cast iron body of requisite size. When closed, these will shut off supply of water to the installation.

A location plate must be fixed on the outside or an external wall, as near to the main stop valve as possible, bearing the following words on raised letters or other approved type letter.

Sprinkler Stop Valve Inside: The word 'sprinkler stop valve' shall be in letters of at least 35mm and the word "INSIDE" at least 25mm in height. The words shall be painted white on black background.

All stop valves shall be right-handed i.e. they shall be so constructed that in order to shut the valve the spindle shall turn from left to right. There shall be an indicator which will show whether the valve is open or shut.

Pipes For Drainage

Sprinkler pipes shall be so installed that the system can be thoroughly drained. As far as possible all pipes shall be arranged to drain to the installation drain valve as shown in the drawing for ordinary hazard system.

In the case of basement & other areas where sprinkler pipe-work is below the installation drain valve & in other trapped points in the system, auxiliary valves of the following sizes shall be provided.

-20 mm valves for pipes upto 50mm dia.

-25 mm valves for 80mm dia pipe.

-50 mm valves for pipes larger than 80mm dia.

System Design

The entire sprinkler installation shall be designed to make it a hydraulically balanced system. The pressure requirement at typical floors shall be designed between 2.5 bar and 3.5 bar.

Supervisory Switch (Monitor Switch)

Supervisory switch or monitor switch are designed for mounting to most Outside Screw and Yoke (O.S. & Y) gate valves. The monitor switch are intended to be used for the supervision of the open position of O.S. & Y gate valves which control water supplies to automatic sprinkler or stand pipe fire protection system.

Supervision of the open position of a main control valve is required to indicate a condition closing of the valve, that could prevent the required operation of the fire protection system.

Supervision switches or monitor switches are operated by movement of the trip rod or by removal of the cover. The trip rod is spring loaded and double action, consequently, lateral movement of the trip rod, in either direction from its normally installed position will result in operation of the switching components.

The monitor switch has one single pole, double throw snap-action switch.

The switching components shall be enclosed in NEMA type 1 general purpose-indoor rated housing. The electrical switch contacts are rated at 220 VAC, 15 A.

The monitor switches shall be used in conjunction with proprietary and central station alarm systems to provide a supervisory signal indicating unauthorized closing of the O.S. & Y gate valve, as well as removal of the monitor switch from the gate valve. A supervisory signal shall also be initiated by the unauthorized removal of a monitor switch cover, due to the release of the cover tamper tab which is linked to the switching components and normally held depressed by the cover.

22.0 HAND HELD FIRE EXTINGUISHERS

Hand Appliances

Scope

Work under this section shall consist of furnishing all labour, materials, appliances and equipment necessary and required to install fire extinguishing hand appliances as per relevant specification of various authorities.

Without restricting to the generality of the foregoing, the work shall consist of the following:

Installation of fully charged and tested fire extinguishing hand appliances of A B C powder type as required and specified in the drawings and schedule of rates. Fire Extinguishers installed as per latest IS standards.

General Requirements

Hand appliances shall be installed in easily accessible locations with the brackets fixed to the wall by suitable anchor fasteners.

Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.

All appliances shall be fixed in a true workmanlike manner truly vertical and at correct locations. Distribution / installation of fire extinguisher to be in accordance to IS:2190.

Measurement

Fire extinguishers shall be counted in numbers and include installation of all necessary items required as given in the specifications.

ABC Type Dry Powder Extinguisher

The Extinguisher shall be filled with ABC, Mono Ammonium Phosphate 40% from any approved manufacturer.

The capacity of the extinguisher when filled with Dry Chemical Powder (First filling) as per IS 4308, Part II, shall be 6 Kg +/-2% or 9 Kg +/- 3%.

The distribution of fire extinguishers to be as per IS 2190 – 1992.

It shall be operated upright, with a squeeze grip valve to control discharge. The plunger neck shall have a safety clip, fitted with a pin, to prevent accidental discharge. It shall be pressurized with Dry Nitrogen, as expellant. The Nitrogen to be charged at a pressure of 15 Kg/cm²

Body shall be of mild steel conforming to relevant IS Standards. The neck ring shall be also mild steel and welded to the body. The discharge valve body, shall be forged brass or leaded bronze, while the spindle, spring and siphon tube shall be of brass. The nozzle shall be of brass, while the hose shall be braided nylon. The body shall be cylindrical in shape, with the dish and dome welded to it. Sufficient space for Nitrogen gas shall be provided inside the body, above the powder filling.

The Neck Ring shall be externally threaded - the threading portion being 1.6 cm. The filler opening in the neck ring shall not less than 50 mm. Discharge nozzle shall be screwed to the hose. The design of the nozzle shall meet the performance requirement, so as to discharge at least 85% of contents upto a throw of 4 mtrs, continuously, at least for 15 seconds. The hose, forming part of discharge nozzle, shall be 500 mm long, with 10 mm dia internally for 5 Kg capacity and 12 mm for 10 Kg capacity. It shall have a pressure gauge fitted to the valve assembly or the cylinder to indicate pressure available inside. The extinguisher shall be treated with anti-corrosive paint, and it shall be labelled with words ABC 2.5 cm long, within a triangle of 5 cm on each face. The extinguisher body and valve assembly shall withstand internal pressure of 30 Kg/cm² for a minimum period of 2 minutes. The pressure gauge shall be imported and suited for the purpose.

Carbon Dioxide Extinguisher

The Carbon Dioxide Extinguisher shall be as per IS: 2878

The body shall be constructed of seamless tube conforming to IS:7285 and having a convex dome and flat base. Its dia shall be maximum 140 mm, and the overall height shall not exceed 720 mm.

The discharge mechanism shall be through a control valve conforming to IS:3224. The internal

syphon tube shall be of copper aluminium conforming to relevant specifications.

Hose Pipe shall be high pressure braided Rubber hose with a minimum burst pressure of 140 Kg/cm² and shall be approximately 1.0 meter in length having internal dia of 10 mm. The discharge horn shall be of high quality unbreakable plastic with gradually expanding shape, to convert liquid carbon dioxide into gas form. The hand grip of Discharge horn shall be insulated with Rubber of appropriate thickness.

The gas shall be conforming to IS:307 and shall be stored at about 85 Kg/cm². The expansion ratio between stored liquid carbon dioxide to expanded gas shall be 1:9 times and the total discharge time (effective) shall be minimum 10 secs and maximum 25 secs.

The extinguisher shall fulfill the following test pressures:

Cylinder: 236 Kg/cm² Control Valve: 125 Kg/cm²

Burst Pressure of Hose: 140 Kg/cm² minimum

It shall be an Upright type. The cylinder, including the control valve and high-pressure Discharge Hose must comply with relevant Statutory Regulations, and be approved by Chief Controller of Explosives, Nagpur and also bear IS marking.

The Extinguisher including components shall be IS marked.

Kitchen Portable Fire Extinguishers

Kitchen portable fire extinguisher shall be provided and installed in the kitchen that has fryers, griddles, range tops, char broilers or woks. The agent shall be aqueous solution of inorganic salts that can put out fires that involve combustible cooking vegetable or animal fats in commercial cooking equipment or class K fire.

The extinguisher body shall be constructed of stainless steel. The unit shall have stainless steel bourdon tube pressure gauge and bar code name plate. The extinguishers shall comply to the latest NFPA 10 or have at least UL rating 2A : K.

MECHANICAL FOAM TYPE FIRE EXTINGUISHER

Mechanical foam fire extinguisher shall be provided and installed in the DG & Transformer room, plant room & in the basement, that is suitable for Class A & Class B fire. In addition to this, these mechanical foam type fire extinguishers offered by us are known to extinguish wood, paper, cloth, textile, stationery & very special blanket effect on flammable & volatile liquids like oil, petrol, kerosene, solvent & chemical, wax, resins and allied.

These products are suitably utilized for:

Flammable and volatile liquid Petrol Paints

Specifications	9 ltrs	50 Ltrs
Body	MS IS 513	MS IS 1079
Neck-ring	Seamless MS	Seamless MS
Cap	Brass	Gun Metal
Cap-washer	Rubber	Rubber

Nozzle	Plastic	Plastic
Hose	Braided PVC	Braided PVC
Snifter Valve	Brass	Brass
Safety Clip	Steel	Steel
Cartridge	60 Gms MS IS 4947	300 Gms MS IS 4947
Test Pressure	30 kgf/cm ³	30 kgf/cm ³
Anti-Corrosive Treatment	Epoxy Coating (min) 50 Polyester 50 micron	Epoxy Polyester Coating 50 micron (min)

Specifications	9 ltrs	50 Ltrs
Dimensions		
Thickness	1.6mm	3.15 mm
Diameter	175mm	300 mm
Height	585mm	1130mm
Gross Weight (approx.)	14.3 kgs	86 kgs
Fire Openings	58 mm	75 mm
Thread Length	16 mm	28 mm
Performance		
Discharge Time	25-60 sec	60-180 sec
Discharge %	90	90
Jet Length	6 m	10 m

(Warranty period 12 month from date of commissioning)

MOBILE FOAM AND POWDER FIRE EXTINGUISHER

The Mobile Foam and Powder Fire Extinguisher with nitrogen propellant cylinder. All the components of form and powder fire extinguisher shall be in compliance with the ISO 2859-1 standard.

Component’s Constructions

22.10.2 Trolley

The trolley structure should be made of steel sections, with rubber wheels. The foam cylinder, the nitrogen cylinder and the accessories should be fixed by saddles on a sturdy hand pulled trolley.

The arrangement of the individual equipment should be designed for maximum ease of handling

Extinguisher Unit

The foam cylinder should be made of Mild steel, while the one containing the powder is made of Mild steel, both tested at 35 kgf/cm². A large-diameter threaded ring nut should be welded at the top of the cylinders for easy charging and internal inspection during periodic testing. The rear part of the trolley should be fixed with the pressurization, control and discharge unit consisting of a nitrogen cylinder tested at 250 bars 6.8 Ltr. charged at 200 bars and having a rapid opening valve for quick pressurization of the powder and foam cylinders. The discharge of nitrogen for the pressurization is controlled by an intermediate pressure reducer calibrated at 12 bars, so, as to obtain a uniform discharge at constant pressure. Two on-off valves placed between the reducer and the cylinders can allow independent pressurization of the two cylinders. The discharge should be controlled by means of two spray nozzles made of light alloy/plastic with ergonomically designed handgrip for an easy and rapid grip. The spray nozzles should be fed by two plastic hoses, each of 19mm diameter and 5m long and should offer maximum agility and ease of handling to the operator. The unit is charged with ABC 50% powder, compatible with the AFFF 6% film-forming foam

Use

The mobile fire extinguisher is used in large fires of any class A, B, or C type, of vertically stored goods and of inflammable liquids that can spread on the surface. Normally it is used by first discharging the foam to knock down the high flames and then if necessary using the powder, compatible with the foam, to immediately put out already reduced flames

MAINTENANCE: Maintenance should be done in compliance with IS: 2190 standard (Warranty period 12 month from date of commissioning)

FIRE PUMPS AND ALLIED EQUIPMENTS

Scope

Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically operated and diesel driven pumps and as required by drawings and specified hereinafter or given in the schedule of rates.

Electrically operated pumps with motors and diesel engine driven pumps with diesel engine, common base plates, coupling, coupling guard and accessories.

Automatic starting system with all accessories, wiring and connections and pressure switches.

Motor control centre.

Annunciation system with all accessories wiring and connections.

Pressure gauges with isolation valves and piping, bleed and block valves.

Suction strainers and accessories.

Vibration eliminator pads and foundation bolts.

Leak-off drain shall be led to the nearest floor drain.

General Requirements

Pumps shall be installed true to levels on suitable concrete foundations. Base plate shall be firmly fixed by properly grouted foundation bolts.

Pumps and motors shall be truly aligned by suitably instruments. Record of such alignment shall

be furnished to the Project Manager.

All pump connections shall be standard flanged type with number of bolts as per relevant standard requirement for the working pressure. Companion flanges shall be provided with the pumps.

Manufacturers' instructions regarding installation, connections and commissioning shall be strictly followed.

Contractor shall provide necessary test certificates, type test certificates, performance curves and NPSH curves of the pumps from the manufacturer when called for. The contractor shall provide facilities to the Project Manager & Consultant for inspection of equipment during manufacturing and also to witness various tests at the manufacturer's works without any cost to the Project Manager or Consultant.

Seismic isolation and clamping for each pump and flexible connection on the suction as well as the discharge side shall be provided and spacing of pumps as per latest standards and all pumps shall be installed in positive suction.

The contractor shall submit with this tender a list of recommended spare parts for two years of normal operation and quote the prices for the same as a separate submittal / annexure.

Flow direction tagging shall be provided to each line.

Electric Fire Pump General

The electric fire pump shall be suitable for automatic operation complete with necessary electric motor and automatic starting gear, suitable for operation on 415 volts, 3 phase, 50 Hz. A.C. system. Both the motor and the pump shall be assembled on a common base plate, fabricated M.S. channel type or cast iron type.

Drive

The pump shall be direct driven by means of a flexible coupling. Coupling guard shall also be provided.

Fire Pump

The fire pump shall be horizontally mounted Split Casing centrifugal type (Multistage). It shall have a capacity to deliver 2850 lpm as specified, and developing adequate head so as to ensure a minimum pressure of 3.5 Kg/Sq.cm at the highest and the farthest outlet.

The pump shall be capable of giving a discharge of not less than 150 per cent of the rated discharge, at a head of not less than 65 per cent of the rated head. The shut off head shall be within 120 per cent of the rated head.

The pump casing shall be of cast iron to grade FG 200 to IS: 210 and parts like impeller, shaft sleeve, wearing ring etc. shall be of non-corrosive metal like bronze/brass/gun metal. The shaft shall be of stainless steel (SS 410). Provision of factory fitted mechanical seal shall also be made. Bearings of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water. The pump shall be provided with a plate indicating the suction lift, delivery head, discharge, speed and number of stages. The pump casing shall be designed to withstand 1.5 times the working pressure.

Provision of Jockey Pump for low and high zone shall be made. The pump shall be vertical SS type and of detail as in schedule of quantity. Contractor shall verify that the capacity of the Jockey pump shall not be less than 3% (Minimum 180 LPM) and not more than 10% of the installed pump capacity.

Motor

The motor shall be squirrel cage A.C. induction type suitable for operation on 415 volts 3 phase 50 Hz. system. The motor shall be totally enclosed fan cooled type conforming to protection clause IP 55. The class of insulation shall be F. The synchronous speed shall be 1500 RPM as specified. The motor shall be rated for continuous duty and shall have a horse power rating necessary to drive the pump at 150 per cent of its rated discharge with at least 65 per cent rated head. The motor shall conform to I.S.325-1978.

Motor Starter

The motor starter shall be as per detail in MCC. The unit shall include suitable current transformer and ammeter of suitable range on one line to indicate the current. The starter shall not incorporate under voltage, no voltage trip overload or SPP.

The starter assembly shall be suitably integrated in the power and control panel for the wet riser system & sprinkler system.

Diesel Fire Pump General

The diesel pump set shall be suitable for automatic operation complete with necessary automatic starting gear, for starting on wet battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common base plate.

Drive

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided. The speed shall be 1500 RPM as specified.

Fire Pump

The fire pump shall be horizontally mounted Split Casing centrifugal type (Multistage). It shall have a capacity to deliver 2850 lpm as specified, and developing adequate head so as to ensure a minimum pressure of 3.5 Kg/Sq.cm at the highest and the farthest outlet.

The pump shall be capable of giving a discharge of not less than 150 per cent of the rated discharge, at a head of not less than 65 per cent of the rated head. The shut off head shall be within 120 per cent of the rated head.

The pump casing shall be of cast iron to grade FG 200 to IS: 210 and parts like impeller, shaft sleeve, wearing ring etc. shall be of non-corrosive metal like bronze/brass/gun metal. The shaft shall be of stainless steel (SS 410). Provision of factory fitted mechanical seal shall also be made. Bearings of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water. The pump shall be provided with a plate indicating the suction lift, delivery head, discharge, speed and number of stages. The pump casing shall be designed to withstand 1.5 times the working pressure.

Diesel Engine

Engine Rating - The engine shall be cold starting type without the necessity of preliminary heating of the engine cylinders or combustion chamber (for example, by wicks, cartridge, heater, plugs etc.). The engine shall be multi cylinder/vertical 4 stroke cycle, air-cooled, diesel engine, developing suitable HP at the operating speed specified to drive the fire pump. Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and the after correction for altitude, ambient temperature and humidity for the specified environmental conditions. This shall be at least 20% greater than the maximum HP

required to drive the pump at its duty point. It shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head. The engine shall be capable of continuous non-stop operation for 8 hours and major overhaul shall not be required before 3000 hours of operation. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run. The engine shall accept full load within 15 seconds from the receipt of signal to start. The diesel engine shall conform to BS 649/IS 1601/IS 10002, all amended up to date.

Engine Accessories - The engine shall be complete with the following accessories: -

Fly wheel dynamically balanced.

Direct coupling for pump and coupling guard. Corrosion Resistor.

Air cleaner.

Fuel service tank support, and fuel oil filter with necessary pipe work. Elect. starting battery (2X24 v).

Exhaust silencer with necessary pipe work. Governor.

Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual starting).

Necessary safety controls.

Fuel System - The fuel shall be gravity fed from the engine fuel tank to the engine driven fuel pump. The engine fuel tank shall be mounted either over or adjacent to the engine itself or suitably wall mounted on bracket. The fuel filter shall be suitably located to permit easy servicing. All fuel tubing to the engine shall be with copper, with flexible hose connections where required. Plastic tubing shall not be permitted.

The fuel tank shall be of welded steel construction (3 mm. thick) and of capacity sufficient to allow the engine to run on full load for at least 8 hours. The tank shall be complete with necessary wall mounted supports, level indicator (protected against mechanical injury) inlet, outlet, overflow connections and drain plug and piping to the engine fuel tank. The outlet shall be so located as to avoid entry of any sediments into the fuel line to the engine.

As semi rotary hand pump for filling the daily service tank together with hose pipe 5 mtr. long with a foot valve etc. shall also form part of the scope of supply.

Lubricating Oil System- Forced feed Lub. Oil system shall be employed for positive lubrication. Necessary Lub. oil filters shall be provided, located suitably for convenient servicing.

Starting System- The starting system shall comprise necessary batteries (2x24v), 24 volts starter motor of adequate capacity and axle type gear to match with the toothed ring on the fly wheel. Bi metallic relay protection to protect starting motor from excessively long cranking runs suitably integrated with engine protection system shall be included within the scope of the work.

The capacity of the battery shall be suitable for meeting the needs of the starting system.

The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression.

The scope shall cover all cabling, terminals, initial charging etc.

Exhaust System - The exhaust system shall be complete with silencer suitable for outdoor installation and silencer piping including bends and accessories needed for a run of 15 metre from the engine manifold. (Adjustment rates for extra lengths shall also be given). The total back pressure shall not exceed the engine manufacture's recommendation. The exhaust piping shall be suitably supported and cover with insulation sheet.

Engine shut down mechanism- This shall be auto/ manually operated and shall return automatically to the starting position after use.

Governing System- The engine shall be provided with an adjustable governor to control the engine

speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

Engine Instrumentation- Engine instrumentation shall include the following:-

Lub. oil pressure gauge.

Lub. oil temperature gauge.

Water pressure gauge.

Water temperature gauge.

Tachometer.

Hour meter.

The instrumentation panel shall be suitably resident mounted on the engine.

Engine Protection Devices- Following engine protection and automatic shut- down facilities shall be provided: -

Low lub.oil pressure.

High cooling water temp.

High lub.oil temperature.

Over speed shut down.

Pipe Work - All pipe lines with fittings and accessories required shall be provided for fuel oil, lub.oil and exhaust systems, copper piping of adequate sizes, shall be used for Lub.oil and fuel oil. M.S. piping will be permitted for exhaust.

Anti-Vibration Mounting- Suitable vibration mounting duly approved by Project Manager shall be employed for mounting the unit so as to minimize transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

Battery Charger-Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery in trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided.

Pump Sets Assembly

On the main fire sprinkler and hydrant headers near pump sets a 150 mm dia by-pass valve located in an accessible location shall be provided along with a rate of flow Rota meter calibrated in 1 pm and able to read 200% of the rated pump capacity. The delivery shall be connected to the fire tank.

Each and every pump set assembly shall be provided with suction valve (only for positive suction head), discharge valve, non-return valve and 150 mm dia Bourdon type pressure gauge with isolation valve.

Flexible Connectors

On all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors shall be provided control unit assemblies shall also be provided for additional safety factor, minimizing possible failure of the expansion joint or damage to the equipment. The flexible connectors shall be designed for excellent vibration and noise protection. Isolated tension members shall be provided to prevent excessive elongation. The end flange connection shall be rated at 20 kg/cm² (300 psi). Connectors should be suitable for maximum working pressure of each pipe line on which it is mounted and tested to a test pressure of 1:5 time the operating pressure. Length of the connector shall be as per manufacturers standard.

Interlocking

The following inter-locking between the two main fire pumps (i.e. wet riser pump & sprinkler pump), the jockey pump and the diesel engine driven pump.

Only one category of pumps will work at a time i.e. either jockey pump or main fire pumps (wet riser and sprinkler, both the wet riser and sprinkler can come up at a time) or diesel driven pump.

SR.NO	JOCKEY PUMP	WET RISER PUMP	DIESEL DRIVEN PUMP
i.	ON	OFF	OFF
ii.	OFF	ON	OFF
iii.	OFF	OFF	OFF
iv.	OFF	ON	OFF
v.	OFF	OFF	ON
vi.	OFF	OFF	ON
vii.	OFF	ON	ON

Annunciation Panel

One solid state electronic annunciation panel, fully wired with visual display and audible alarm unit shall be provided to indicate:

Flow condition in any flow switch indicating the area of distress and fire alarm.

Starting and stopping of each hydrant pump.

Starting and stopping of each jockey pump.

Starting and stopping of each sprinkler pump.

Failure of Hydrant / Sprinkler pump to start.

High level in fire water storage tank compartment.

Low level in fire water storage tank compartment.

Low level in HSD Day tank of the fire pump.

Panel indication motors

The panel shall be factory fabricated, wired and tested. All details shall be submitted with the tender.

The annunciation panel shall be located in the security office / reception on the ground floor or as instructed by the Project Manager.

Vibration Isolation

The pump-set shall be mounted on rolled steel channels and 150 mm thick inertia block spring and ribbed neoprene vibration isolation mounting shall support the inertia block onto 100 mm thick concrete plinths. The spring mountings shall have a maximum deflection of 15 mm. Reference shall be made to the section on "Nose and Vibration" for further technical requirements.

FIRE FIGHTING WORKS - LIST OF APPROVED MAKES		
Sr. No.	Description of Items	Brand
1	Main Pumps	Kirloskar / WILLO
2	Motors	Kirloskar / Siemens / Crompton Greaves
3	Butterfly Valves (PN-16)	Lehry Valves / Advance / Kirloskar / Leader
4	Check Valve (PN-20)	Lehry Valves / Advance / Kirloskar / Leader
5	GI Pipes	Tata / Zenith / Jindal
6	Fittings	R Brand / Unco / Unik
7	Gate Valve (PN-20)	Lehry Valves / Advance / Kirloskar / Leader
8	Non return valve (PN -16)	Lehry Valves / Advance / Kirloskar / Leader
9	Y Type Strainer (PN-16)	Lehry Valves / Advance / Kirloskar / Leader
10	Foot valve with Strainer	Leader / normex/ hammer
11	Hydrant Valve	Newage / Arihant / Safex
12	Water Monitor	Newage / Arihant / Safex
13	Hose	Newage / Arihant / Safex
14	Branch Pipe & Nozzle	Newage / Arihant / Safex
17	Hose Reel Drum	Newage / Arihant / Safex
18	Rubber Hose	Newage / Arihant / Safex
19	PVC Hose	Duplon / Revlon
20	Pressure Switch	Tyco / Indfoss / Danfoss
21	Pressure Gauge	H.Guru / Fiebig / A.N. instruments
22	Expansion joint	Hitech / Cori Rubber / Manometer D.
23	Strainer	Zoloto / Grandpix / Jaypee / Champion
24	Sprinkler alarm valve	HD Fire / Viking / Tyco
25	Spray Nozzle (Water curtain)	HD Fire / Viking / Tyco
26	Sprinklers	HD Fire / Viking / Tyco
27	Control Panel	UL / FM Approved/fabricated
28	Power Cable	Finolex / Polycab / Siemens
29	Control cable	Finolex / Polycab / Siemens
31	Level Switch	Levcon / Minilec / Ti-Tech / TECON
32	Flow Switch	Tyco / Procicon / Switzer / Honeywell
33	Gate Valve (PN-20)	Lehry Valves / Advance / Zoloto / Leader
34	Ball Valve (PN-20)	Lehry Valves / Advance / Zoloto / Leader
35	Globe Valve (PN-20)	Lehry Valves / Advance / Kirloskar / Leader
36	Extinguishers	Minimax / New Age/ Cease Fire / Safex / SRI

37	S.S. Flexible Pipes	UL / FM Approved
38	Air Vent Valve	TBS / HAWA / Inter Valve / ITAP
39	Vibration Eliminator Pads &	Dunlop
40	Connectors (water bellows)	Resistoflex, Relay Corp.
41	Anti Corrosive Tape (U/G pipes)	PYPKOTE
42	Annuciation Panel	Agni / Qualt / ASES
43	Deluge Valve	HD Fire / Tyco
44	Deluge Release Panel	Honeywell
45	Sluice valve	Lehry Valves / Advance / Zoloto / Leader
46	start / stop push button	Finolex / Polycab / Siemens
47	M.S. / CRCA cabinet	Newage / Arihant / Safex

31.0 DETAILED TECHNICAL SPECIFICATIONS ELECTRICAL WORK**1 SCOPE OF WORK**

The general character and the scope of work to be carried out under this contract are illustrated in Drawings, Specifications and Schedule of Quantities. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Owner's site representative. The contractor shall furnish all labour, materials and equipment (except those to be supplied by the owner) as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete electrical system as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The electrical system shall comprise of (but not limited to) the following:

- a) Supply, Installation, Testing and Commissioning LT panel, Main Distribution / Sub Distribution panels, Final Distribution panels & Capacitor Panels.
- b) Supply, Installation, Testing and Commissioning Rising Mains, Cables on cable trays and / or within suspended ceiling spaces including installation, cable trays, hangers, supports, cable terminations and all fixing accessories
- c) Supply, Installation, Testing and Commissioning Earthing (Grounding) System.
- d) Supply, Installation, Testing and Commissioning Lightning Protection System
- e) Supply, Installation, Testing and Commissioning All conduit work including junction boxes, outlet boxes and wiring for lighting and power circuit.
- f) Supply, Installation, Testing and Commissioning Switches, plug sockets, cover plates and other wiring accessories.
- g) Supply, Installation, Testing and Commissioning Raceways and junction boxes.
- h) Supply and Installation of Lighting Fixtures.
- i) Design Supply and Installation of Landscape/Facade lighting, supply and installation of cabling, feeder pillars, earthing.
- j) Design, Supply, Installation, Testing and Commissioning of Solar Photovoltaic Grid connected System

Associated Civil Works

Following civil works associated with Electrical installation are excluded from the scope of this contract except for all minor civil work like wall chasing by wall chaser, making holes etc. for installation of conduits/cables and making good. These shall be executed by other agencies in accordance with approved shop drawings of, and under direct supervision of the electrical contractor.

RCC foundation for Transformer with angle iron frame (properly painted with fire retardant paint) at the edges to protect these from damage.

PCC foundation blocks with angle iron frame work edging for all power control centre's and motor control centre.

Air-tight fire doors shall be as per FIRE norms and requirement of GIFT Ready reckoner for Sub-Stations & LT panel room.

However, these will be of minimum 2 hour fire rating as per I.E. Rules 1956. Repair of all disturbed surfaces/openings made by Electrical Contractor.

Project Execution and Management

3. The Contractor shall ensure that senior planning and erection personnel from his organization are assigned exclusively for this project. The Contractor shall appoint the staff as per Clause Number 78 of SCC. The entire staff shall be posted at site on full time basis. Separate ID cards to be given by the Contractor to each worker working on site.

The project management shall be through modern technique. The Contractor's office at site shall be fully equipped with computers & plotter as per Clause no 57 of SCC and shall prepare proper bar chart and completion schedules to be submitted & ensure timely completion. Erection engineers and supervisors shall be provided with mobile communication system so that they can always be reached.

3. For quality control & monitoring of workmanship, contractor shall assign at least one full-time engineer as per clause no 78 of SCC who would be exclusively responsible for ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the electrical installation. Contractor shall furnish details of licenses of supervisors/workmen to be employed at site.

Performance Guarantee

The contractor shall carry out the work in accordance with the Drawings, Specifications, Schedule of Quantities and other documents forming part of the Contract.

The contractor shall be fully responsible for the performance of the selected equipment (installed by him) at the specified parameters and for the efficiency of the installation to deliver the required end result.

3. The contractor shall guarantee that the Electrical system as installed shall perform to complete satisfaction of the owner. The guarantee shall be submitted in the Performa given by the PMC /Client.

Complete set of architectural drawings will be available in the Architect/Consultant's office and reference may be made to same for any details or information. The contractor shall also guarantee that the performance of various equipment individually, shall not be less than the quoted capacity; also actual power consumption shall not exceed the quoted rating, during testing and commissioning, handing over and guarantee period.

At the close of the work and before issue of final certificate of virtual completion, the contractor shall furnish written performance guarantee against defective materials and workmanship for a period of two years from date of testing, commissioning and handing over. The guarantee shall be submitted in proforma given in Appendix-II. The Contractor shall hold himself fully responsible for reinstallation or replacement, free of cost to Owner the following:

- a. Any defective work or material supplied by the Contractor.
- b. Any material or equipment damaged or destroyed because of defective workmanship by the Contractor.

Byelaws and Regulations

3. The work shall be carried out to the satisfaction of the Owner's site representative and in accordance with the NBC (2005), Latest GIFT Ready Reckoner for Electrical services, Electrical specification, Regulations of the Electric Supply Authority, Indian Electricity Rules and Regulations, latest Indian Standards.

Fees and Permits

The Contractor shall pay all fees and obtain permits required for the installation of this work. On completion of the work, the contractor shall obtain and deliver to the Owner, certificate of final inspection and approval by the local electricity authority (GIFT/Municipal, State/Central govt. whichever is applicable)

Drawings

The Electrical Drawings listed under/ which may be issued with tenders, are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The architectural/interiors drawings and details shall be examined for exact location of equipment, electrical points & fixtures.

Shop drawings need to be submitted by the contractor. The contractor shall follow the tender drawings for preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed.

Before submission of shop drawing for approval, the contractor shall examine all architectural, structural, plumbing, HVAC and other services drawings works before starting the work and report to the Owner's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate design of his work with other services and trades, shall be made with prior approval of the Architect/Consultant/Owner's site representative without additional cost to the Owner.

Maximum headroom and space conditions shall be maintained at all points. Where headroom appears inadequate, the contractor shall notify the Architect/Consultant/Owner's site representative before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and contractor shall rectify the same at his own cost.

The contractor shall examine all architectural, structural, plumbing, HVAC and other services drawings and check the as-built works before starting the work and report to the Owner's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Architect/Consultant/Owner's site representative without additional cost to the

Owner.

Specifications

The Specifications shall be considered as part of this contract. The Drawings indicate the extent and general arrangement of power distribution, location of lighting fixtures, controlling switches, wiring system, cabling and earthing. These drawings are essentially diagrammatic. The Drawings indicate the point of termination of conduit runs and broadly suggest the routes to be followed. The work shall be installed as indicated on the Drawings. However, any change found essential to coordinate the installation of this work with other trades shall be made without any additional cost to the Owner. The data given herein and on the Drawings is as exact as could be secured, but its complete accuracy is not guaranteed. The drawings are for the guidance of the contractor, exact locations, distances and levels shall be governed by the site conditions and the Architectural & Interior layouts.

Shop Drawings

All the shop drawings shall be prepared on computer through AutoCAD System based on Architectural Drawings, site measurements and Interior Designer's Drawings. Within eight weeks of the award of the contract, contractor shall furnish, for the approval of the Architect/Consultant, two sets of detailed shop drawings of all equipment and materials including layouts for all conduit layouts, distribution panels, switchboards, cabinets, special pull boxes, cable trays and any other requirement to be fabricated or purchased by the contractor.

Shop drawings need to be submitted by the contractor. The contractor shall follow the tender drawings in preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed.

These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Architect/Consultant/Owner's site representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/ works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings.

Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer strictly from the manufacturers listed in the tender document.

When the Architect/Consultant makes any amendments in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated along with check print, for approval. The contractor shall submit further twelve sets of shop drawings to the Owner's site representative for the exclusive use by the Owner's site representative and all other agencies. No material or equipment may be delivered or installed at the job site until the contractor has in his possession the approved shop drawing for the particular material/equipment/installation.

Shop drawings shall be submitted for approval sufficiently in advance of planned delivery and installation of any material to allow Architect/Consultant ample time for scrutiny. No claims for

extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved programme.

Manufacturer's drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labeled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

Samples of all materials like conduits, accessories, switches, wires, control cables etc shall be submitted to the Owner's site representative prior to procurement. These shall be submitted in twosets for approval and retention by Owner's site representative and shall be kept in their site office for reference and verification till the completion of the Project.

Approval of shop drawings/Material Submittal shall not be considered as a guarantee of measurements or of building dimensions. Where shop drawings/Material Submittal are approved, said approval does not mean that the shop drawings/Material Submittal supersede the contract requirements or Local codes, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract or local codes.

Where the contractor proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the contractor at his own expense and gotten approved by the Architect//Consultant/ Owner's site representative.

The contractor shall extend full cooperation to HVAC contractor in preparation of his coordinated services drawings. He shall issue floppies and hard prints of his shop drawings to HVAC contractor well in advance to complete the co-ordinated services drawings in accordance with schedule prepared by the Owner site representatives. Where the work of the contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Owner's site representative, the contractor shall prepare composite working drawings and sections at a suitable scale, not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Owner.

Within four weeks of approval of all the relevant shop drawings, the contractor shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by manufacturers) imported and local spare parts and tools, covering all equipment and materials in this contract. The Project Manager shall make recommendation to Owner for acceptance of anticipated variation in contract amounts and also advise Owner to initiate action for procurement of spare parts and tools at the completion of project.

Accessibility

The Contractor shall verify the sufficiency of the size of the shaft openings, clearances in wall cavities and suspended ceilings for proper installation of his conduits cables, cable trays, panels etc. His failure to communicate insufficiency of any of the above shall constitute his acceptance

of sufficiency of the same. The Contractor shall locate all equipment which must be serviced, operated or maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed control damper, valve or other devices requiring attendance, shall be finalized and communicated in sufficient time, to be provided in the normal course of work. Failing this, the Contractor shall make all the necessary repairs and changes at his own expense. Access panel shall be standardized for each piece of equipment / device / accessory and shall be clearly nomenclature / marked.

Materials and Equipment

All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be strictly in conformity with list of approved manufacturers as per tender document.

The Contractor shall be responsible for the safe custody of all materials and shall insure them against theft or damage in handling or storage etc. A list of items of materials and equipment, together with a sample of each shall be submitted to the Owner's site representative within 15 days of the award of the contract. Any item which is proposed as a substitute, the contractor shall state the credit, if any, due to the Owner in the event the substitution is approved. All changes and substitutions shall be requested in writing and approvals obtained in writing from the Owner's site representative.

Manufacturer's Instructions

Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, manufacturer's instructions shall be followed in that case.

Completion Certificate

On completion of the electrical installation a certificate shall be furnished by the Contractor countersigned by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local, state/central govt. / municipal / fire authorities concerned.

Inspection and Testing

The Owner may carry out inspection and testing at manufacturer's works for this contract. No equipment shall be delivered without prior written confirmation from the Owner's site Engineer. In case factory inspection is carried out then all travelling and lodging expenses for two persons one from owner and one from consultants shall be borne by the Contractor, also all expenses related to testing shall be to Contractor account. Tests on site of completed works shall demonstrate the following:

That the equipment installed complies with specification in all respect and is of the correct rating for the duty and site conditions.

That all items operate efficiently and quietly to meet the specified requirements.

That all circuits are fully protected and that protective devices are properly co-ordinated.

That all non-current carrying metal parts are properly and safely grounded in accordance with the specification and appropriate Codes of Practice.

The contractor shall provide all necessary instruments and labour for testing, shall make adequate records of test procedures and readings, shall repeat any tests requested by the Owner and shall provide test certificate signed by an authorized person. Such test shall be conducted on all materials and equipment and tests on completed work as called for by the Owner at contractor's expenses unless otherwise called for.

If it is proved that the installation or part thereof is not satisfactorily carried out then the contractor shall be liable for the rectification of the same. Owner Site Engineer's decision as to what constitutes a satisfactory installation shall be final.

All tests shall be carried out by a test house approved by the Owner / Consultants.

Completion Drawings

Upon completion of the work and before issuance of certificate of virtual completion the contractor shall submit to the Owner's site representative four sets of layout drawings in progressive manner for individual systems drawn at approved scale indicating the complete wiring system as installed. Drawings shall be prepared on AUTO-CAD (latest version). Along with the hard copies, the contractor shall submit copies of all drawings on CD and one set of all drawings on RTF shall also be submitted. These drawings must provide:

- a. Substation equipment layout & all power distribution panel layout.
- b. Single line power distribution diagram including control wiring.
- c. Cable Trays with number and size of cables installed.
- d. Run and size of conduits, inspection, and junction and pull boxes.
- e. Raceways and Junction Boxes.
- f. Number and size of conductors in each conduit with phase identification.
- g. Location and rating of sockets and switches controlling the lighting and power outlets.
- h. Location and details of distribution boards/panels, mains, switches along with phase balancing details.
- i. 3. A complete wiring diagram as installed and single line diagrams showing all connections in the complete electrical system.
- j. Location of all earthing stations, route and size of all earthing conductors' manhole.
- k. Layout and particulars of all HT & LT cables.

- l. 3. Instruction, maintenance and operation manuals including maintenance schedule for all equipment. Testing & commissioning reports of all electrical equipment.

Operating Instruction & Maintenance Manual

Upon completion and commissioning of part Electrical system the contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and Owner's site representative and two for Owners Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment.

On Site Training

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labour and helpers for operating the entire installation for a period of thirty (30) working days of ten (10) hours each, to enable the Owner's staff to get acquainted with the operation of the system. During this period, the contractor shall train the Owner's personnel in the operation, adjustment and maintenance of all equipment installed.

Maintenance during Defects Liability Period

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free of charge to the Owner.

Uptime Guarantee

The contractor should guarantee for the installed system an up time of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

The Contractor shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all temperatures, pressures, humidity, power consumption, starting and stopping times for various equipment, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Contractor shall also submit preventive maintenance schedule.

Each Bidder shall submit along with the tender, a detailed operation assistance proposal for the Owner's site representatives/Consultant's review. This shall include the type of service planned to be offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.

The Bidder shall include a list of other projects where such an Operation Assistance has been provided.

Method of Measurement

The works shall be measured in accordance with relevant IS codes. Notwithstanding any general or local custom, except where otherwise specifically described or prescribed in the contract.

Demonstration to Owner

At completion, devices subject to manual operation shall be operated at least five times in presence of Owner's site representative to demonstrate satisfactory operation.

Tools and Tackles

The Contractor shall provide and install all necessary hoists, ladders, scaffolding, tools, and tackles, all transport for labour and materials and plant necessary for the proper execution and completion of the work to the satisfaction of the Owner's site representative.

Partial Ordering

Owner through the Architect/Consultant/ Owner's site representative reserves the right to order equipment and material from any and all alternates, and /or to order high side and /or low side equipment and materials or parts thereof from one or more tenderers.

Site Conditions

Location: Gandhinagar, Gujarat

Notes: All equipment shall give required output under the conditions of Gandhinagar, Gujarat.

System of Wiring

2 INTERNAL WIRING

The system of wiring shall consist of PVC insulated copper stranded conductor flexible wires in metallic / nonmetallic (Rigid heavy Duty ISI -marked FRLS PVC Conduits of minimum 2mm Wall thickness and Sizes starting from 20 mm diameter conduits and shall be concealed or surface mounted above false ceiling as called for

General

Prior to laying and fixing of conduits, the contractor shall mark the conduit route, carefully examine the working drawings prepared by him and approved by the Consultant indicating the layout, satisfy himself about the non-interference in the route, sufficiency of number and sizes of conduits, location of junction boxes, sizes and location of switch boxes and other relevant details. Any discrepancy found shall be brought to the notice of the Owner's site representative. Any modifications suggested by the contractor should get written approval before the actual laying of conduits is commenced.

In laying of conduits, it is important that not more than two right angle bends are provided for each circuit without a pull box. No junction box shall be provided in the entire length of conduit run for drawing of wires. Only switch outlets, lighting fixture outlets, equipment power outlets and socket outlets shall be considered for drawing of wires.

Metal Conduits & Accessories

a) CONDUITS

Conduits and Accessories shall conform to latest edition of Indian Standards IS-9537 part 1 & 2. 16/14 (16 gauge up to 32mm diameter & 14 gauge above 32 mm diameter) gauge screwed GI or MS conduits as specified on schedule of quantities shall be used. Joints between conduits and accessories shall be securely made by standard accessories, as per IS-2667, IS-3837 and IS-5133 to ensure earth continuity. All conduit accessories shall be threaded type only.

Only approved make of conduits and accessories shall be used.

Conduits shall be delivered to the site of construction in original bundles, and each length of conduit shall bear the label of the manufacturer.

Note. : Whatever materials required to be billed by the Contractor should come on site with proper Challan Numbers and quantity mentioned in each such Challan.

Shaft which supports sheaves, Gears, coupling and other member which transmit torque shall be provided with tight fitting keys of sufficient strength and quality.

b) JOINTS

All jointing shall be subject to the approval of the Owner's site representative. The threads and sockets shall be free from grease and oil. End termination of conduit on GI boxes shall be by means of hexagon check nuts & spring washer on both sides of the conduit. The joints in conduits shall be free of burrs to avoid damage to insulation of conductors while pulling them through the conduits. Rubberised bushes shall be used in the conduit entry and exit from DBs, switch boxes etc, so that wires are protected from damage to insulation of the incoming and outgoing wires

c) RECESSED OR EXPOSED CONDUITS

All conduits shall be as per Schedule of Quantities/As per approved drawings.

d) FLEXIBLE CONDUITS

Flexible conduits shall be made of heavy gauge MS strip galvanized after making the spiral. Both edges of the strip to have interlocking to avoid opening up. Flexible conduits shall be heat

resistant, lead coated steel, water leak, fire and rust proof. The flexible conduit shall be heat resistant at a continuous temperature up to 150 deg. C and intermittent temperature up to 200 deg. C. The flexible conduit shall be corrosion resistant as per IS-3480 & BS-731.

PVC Conduit and Accessories

a) PVC Conduit

Conduits and accessories shall conform to latest edition of IS-9537 part 3. All Vertical conduits in wall shall be Rigid, Medium Strength; all conduits in Slab/Concrete shall be rigid Heavy-duty type. Which are unscrewed without coupling and with plain ends. All conduits used shall be ISI-marked and shall not be less than 20 mm diameter.

PVC conduit shall be used for all concealed / embedded installation. b) PVC Conduit Accessories

Accessories used for conduit shall be of an approved brand and type complying with relevant IS code.

All accessories used shall be of standard white or black colour, identical to conduit used.

Plain conduits shall be joined by slip type of couplers with manufacturer's standard sealing cement.

All conduit entries to outlet boxes, trunking and switchgear are to be made with adaptors female thread and screwed male bushes.

PVC-switch and socket boxes with round knockouts are to be used. The colours of these boxes and the conduits shall be the same.

Standard PVC circular junction boxes are to be used with conduits for intersection, Tee-junction, angle-junction and terminal. For the drawing-in of cables, standard circular through boxes shall be used.

Samples of accessories shall be submitted for approval prior to installation.

All jointing of PVC conduits shall be by means of adhesive jointing. Adequate expansion joints shall be allowed to take up the expansion of PVC conduits.

Bends in Conduit

Where necessary, bends or diversions may be achieved by means of bends and / or circular cast iron boxes with inspection cover and with adequate and suitable inlet and outlet screwed joints. In case of recessed system each junction box shall be provided with a cover properly secured and flush with the finished wall surface. No bends shall have radius less than 7.5 cms or three times the outside diameter of the conduits. For metallic conduits, bends of defined radius shall be made by compactly filling fine sand inside the conduit length, to avoid non-uniform shape, once the bend is done. Proper jigs should be used to ensure that the Enamelling / Galvanising of the Conduit are not damaged.

Fixing of Conduits

All conduits should be installed so as to avoid exposure to steam, hot water or any other process pipes. After the conduits, junction boxes, outlet boxes and switch boxes are installed in position,

their outlets shall be properly plugged in or covered so that water, mortar, rodents and insects, insects or any other foreign matter does not enter into the conduit system. Surface conduits shall be fixed by means of heavy gauge GI saddles secured at intervals not more than 1000mm and on either side of couplers or bends or similar fitting saddles shall be fixed at a distance of 300 mm from center of each fitting. For conduit fixing suitable PVC/Nylon fasteners shall be used.

Recessed conduiting shall be done by making chase in the masonry by chase cutter; the conduit shall be fixed in the chase by means of GI hooks not more than 600 mm apart. After fixing of conduit the chase shall be filled with cement mortar after fixing of chicken mesh and brought to the original finish level of the surface to the entire satisfaction of Owner

PVC Trunking (Casing and capping)

a) PVC Trunking

Providing specified PVC Trunking (Casing capping) and erecting as per approved Method of Construction, on surface of wall / ceiling, etc. including entries made with PVC conduit through walls / slabs / flooring as per requirement with all necessary hardware, accessories such as inner / outer Elbows, Tees, Junction boxes, etc. and duly finishing, removing debris from site.

b) Material:

PVC Trunking (casing capping) shall be ISI mark, 1.2 mm thick, minimum 20 mm width and above depending on No. of wires to be drawn (Refer Table No 1/3 for the size of trunking and number of wires to be drawn); with double locking arrangement, 1.8mm thick push-fit joints/accessories for PVC trunking such as couplers, elbows, internal / external angles, junction boxes of required ways of the same make. All the related hardware shall be Sheet Metal (SM) screws of sizes specified in erection of PVC trunking, washers, rawl / PVC/ fill type plugs, wooden gutties, etc.

c) Erection of PVC Trunking for surface type wiring:

Erection shall be done as per the final approved layout. The Trunking shall be in perfect level and plumb. Screws of minimum 35x8 mm and suitable plugs shall be used for fixing. In case of stonewalls wooden gutties shall be grouted in wall for fixing of screws of Trunking. Distance between 2 screws shall not be more than 600 mm. Size of Trunking shall be correct depending on number of wires to be drawn as per Table No 1/3 but not less than 20mm. Separate Trunking shall be used for each phase in single phase distribution and for power and light distribution and also for wiring of other utilities like data, telephone, TV cabling and distance of 300 mm shall be maintained between the Trunking or antielectrostatic partition to be provided. Double locking shall be checked while fixing capping. Adequate use of accessories shall be made at joints and at required locations.

Switch outlets and Junction Boxes

All outlet boxes for switches, sockets and other receptacles shall be rust proof and shall be As per original equipment manufacturer, having smooth external and internal surfaces to true finish. All outlet boxes for receiving plug sockets and switches shall be fabricated to approved sizes. All

boxes shall have adequate number of knock out holes of required diameter and earthing terminal screws. Outlet boxes shall generally be of 50mm depth subject to maximum depth of 65 mm.

Inspection Boxes

50 mm dia inspection boxes and pull boxes shall have smooth external and internal finish to facilitate removal and replacement of wires, where required.

Fish Wire

To facilitate subsequent drawing of wires in the conduit, GI fish wires of 2.0 mm (14 SWG) shall be provided along with the laying of recessed conduit.

Conductors

All PVC insulated copper conductor flexible, as specified in SOQ, wires shall conform in all respects to Standards as listed under sub-head Indian Standards and shall be IS approved and ISI marked.

Bunching of Wires

Wires carrying current shall be so bunched that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not run in the same conduit. All wires shall have ferrules for identification. Lighting and power circuits shall be separate. Each Power/ Light Circuit,,s Neutral shall be individual per Circuit and shall not be looped from any other Circuit.

Drawing Conductors

The drawing and jointing of PVC insulated copper conductor wires shall be executed with due regard to the following precautions. While drawing wires through conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. There shall be no sharp bends. Wire reel stands to be used for pulling wires to avoid kinks. Care shall be exercised while drawing the wires from reels, by taking appropriate measures to ensure that wires are not spread on ground, causing dust and dirt accumulation on the new wires.

Maximum permissible numbers of 1100 volt grade PVC insulated wires that may be drawn into metallic Conduits are given below:

Size of wires Nominal Cross	Maximum number of wires within conduit size(mm)				
Section Area (Sq. mm.)	20	25	32	40	50
1.5	5	10	14	--	--
2.5	5	8	12	--	--

4	3	7	10	--	--
6	2	5	8	--	--
10	--	3	5	6	--
16	--	2	3	6	6
25	--	--	2	4	6
35	--	--	--	3	5

Maximum permissible number of 1100 volt grade PVC insulated wires that may be drawn into rigid non metallic or PVC Conduits are given below:

Size of wires Nominal Cross	Maximum number of wires within conduit size(mm)				
Section Area (Sq. mm.)	20	25	32	40	50
1.5	7	12	16	--	--
2.5	5	10	14	--	--
4	4	8	12	--	--
6	3	6	8	--	--
10	--	4	5	6	--
16	--	3	3	6	6
25	--	--	2	4	6
35	--	--	--	3	5

Maximum permissible number of 1100 volt grade PVC insulated wires that may be drawn Cable Trunking (Casing and Capping) are given below:

Size of wires Nominal Cross	Maximum number of wires within conduit size(mm)					
Section Area (Sq. mm.)	12/16 x 12 mm	20 x 12 mm	25 x 12 mm	32 x 12 mm	40 x 20 mm	50 x 20 mm
1.5	3	5	6	8	12	18

2.5	2	4	5	6	9	15
4	2	3	4	5	8	12
6	--	2	3	4	6	9
10	--	1	2	3	5	8
16	--	--	1	2	4	6
25	--	--	--	1	3	5
35	--	--	--		2	4

Insulation shall be removed by insulation stripper only. Few Strands of wires shall not be cut/reduced for convenience in connecting into terminals. The terminals shall have sufficient cross-sectional area to take all strands and its connecting brass screws shall have flats ends. All looped joints shall be connected through terminal block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. All light points shall be terminated through a connector.

Conductors having nominal cross sectional areas exceeding 10 sq.mm shall always be provided with cable sockets. At all bolted terminals brass flat washer of large area and approved steel spring washer shall be used. Brass nuts and bolts with brass washers shall be used for all connections.

Only licensed wiremen (Before doing the work or before appointing him on site contractor has to submit his wiring license to Owner) and cable jointers shall be employed to do jointing work. Before entrusting cable jointing work to any technician, or before appointing Cable Jointers or Wiremen on Site, Contractor has to submit such Technicians / Wireman's / Cable Jointer's license to Owner.

All wires and cables shall be embossed with the manufacturer's label with ISI mark and shall be brought to site in original packing. For all internal wiring. PVC insulated wires of 1100 volts grade shall be used.

The sub-circuit wiring for point shall be carried out in loop system, and no joints shall be allowed in the length of the conductors. No wire shall be drawn into any conduit until all defective work of conduit installation of any nature that may cause injury to wire is completed. Care shall be taken while pulling out the wires so that no damage occurs to conduits/wire itself, the conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction. The minimum size of PVC insulated copper conductor wires for all sub-circuit wiring for light points shall be minimum 1.5sq.mm copper. Separate neutral to be pulled for each circuit.

Joints

All joints shall be made at main switches and distribution boards. Socket outlets, lighting outlets and switches boxes only. No joints shall be made in conduits and in junction boxes. Conductors shall be continuous from outlet to inlet.

Mains and Sub-Mains

Mains and sub-mains cables or wires where called for shall be of the rated capacity and approved make. Every main and sub main wires shall be drawn into an independent adequate size of conduit. Earthing shall be in conformity with relevant IS codes and calculations shall be submitted for verification. An independent earth wire of the proper rating shall be provided for every single phase sub-main. For every 3 -phase sub-main, 2 Nos. earth wires of proper rating shall be provided along with the sub-main. The earth wires shall be drawn along with circuit wires through conduit. Where mains and sub-mains cables are connected to switchgear, sufficient extra lengths of cables shall be provided to facilitate easy connections and maintenance. Where ever necessary, powder- coated 1.6 mm thick sheet steel covering (also called trunking) shall be provided to cover the group of conduits and cables entering and exiting the Wall mounted/Floor mounted Sub DBs, DBs, and FDBs, so that the Installation looks neat .The colour of such sheet steel covering (trunking) shall be matching with the colour of the SDBs, DBs and FDBs

Sub main & Circuit Wiring

Sub main Wiring

Sub main wiring shall mean the wiring from one main/distribution switchboard to another.Circuit

Wiring

Circuit wiring shall mean the wiring from the distribution board to the 1st tappingPoint inside theswitch box, from where point wiring starts.

Load Balancing

Balancing of circuits in three phase installation shall be as planned by the Consultants in the tender drawings and shall be checked by the contractor before the commencement of wiring and shall be strictly adhered to.

Colour Code of Conductors

Colour code shall be maintained as indicated by the Consultant for the entire wiring installations. Red, yellow, blue shall be for three phases, black for neutral and green with yellow band shall be for earthing.

Colour Code of Conduits

All the exposed conduits shall be Colour coded at every 1 Mtr as indicated by the Consultant for the entire wiring installations. Red for fire/Emergency system, Blue for ELV system and, Orange for power.

3 SWITCHES, RECEPTACLES (MODULAR), LIGHTING FIXTURES & LIGHTING CONTROL EQUIPMENT

Switches

All switches shall be enclosed with type flush mounted with indicator, suitable for 240 volts AC. All switches shall be fixed inside the switch boxes on adjustable flat M S strips/plates with tapped holes and brass machine screws, leaving ample space at the back and sides for accommodating wires. Switch controlling the light point shall be connected to the phase wire of the circuit and load on each switch shall be restricted to maximum 800 watts & maximum 1500 watts per circuit. All wiring accessories shall be BIS approved. Perfect alignment shall be maintained while fixing the back boxes.

Socket Outlet

Socket outlets shall be of the 6/16A three/Six pin shutter type. The switch controlling the socket outlet shall be on the phase wire of the circuit and not more than two socket outlets of 6/16 amps shall be connected on one circuit. An earth wire shall be provided along with the circuit wires and shall be connected to earthing screw inside the box. All sockets shall be shuttered type.

- a. Every socket outlet shall be controlled by an individual switch unless mentioned otherwise.
- b. The switch controlling the socket outlet shall be on the "Live" side of the line.
- c. Socket outlet shall normally be fixed at any convenient height above the floor level as desired by the Architect. The switch for socket outlet shall be kept along with the socket outlet. However, in special case, if desired by the Architect the socket outlet can be placed at the normal switch level. 16 amps socket outlet in the kitchen shall be fixed at any convenient height above working platform or as specified in drawings / schedule of equipment.

In a room containing a fixed bath or shower, there shall be no socket outlet and there shall be no provision for connecting a portable appliance.

Any stationary appliance connected permanently in the bath room shall be controlled by an isolator switch or circuit breaker having outlets at such location where water / moisture does not effect.

Generally, switches and outlets shall be planned at a minimum distance of 1.5 Metre away from any water supply outlet, so that splashed water may not affect the live installation.

- d. Where socket outlets are placed at lower level, they shall be enclosed in a suitable metallic box with the system of wiring adopted or shutter type sockets shall be provided as specified.
- e. In an earthed system of supply, a socket outlet and plug shall be of three pin type, the third terminal shall be connected to earth.
- f. 3. Conductors connecting electrical appliance with socket outlet shall be flexible twin cord with an earthing cord which shall be secured by connecting between the earth terminal of plug and the metallic body of the electrical appliance.
- g. Use of shutter type of interlocking type of socket is required for any special installation; the items should be separately and specifically listed in the Schedule of Quantities of that work.

Lighting Fixtures & Accessories

The light fixtures and fittings shall be assembled and installed in position complete and ready for service, in accordance with details, drawings, manufacturer's instructions and to the satisfaction of the Project Manager.

a) Scope:

Scope of work under this section shall include inspection at suppliers/manufacturer’s premises at site, Supplying, receiving at site, unloading at site, safe storage, transportation from point of storage to point of erection, erection and commissioning of light fittings, fixtures and accessories including all necessary supports, brackets, down rods and painting etc. as required.

b) Standards:

The lighting and their associated accessories such as lamps, reflectors, housing, ballast etc., shall comply with the latest applicable standards, more specifically the following:

General and safety requirements for Luminaires:

Part-1 Tubular fluorescent lamps	-	IS – 1913 (Part-1)
Industrial lighting fittings with metal reflectors	-	IS - 1777
Decorative lighting outfits	-	IS - 5077
Bayonet lamp holders	-	IS - 1258
Bi-pin lamp holders for tubular fluorescent lamps	-	IS - 3323 Electronic Ballasts for fluorescent lamps
General & Safety requirement	-	IS – 13021 (Part-1) Electronic Ballasts for fluorescent lamps
Performance requirement	-	IS – 13021 (Part-2)
Ballast for HP MV lamps	-	IS - 6616
Tubular Fluorescent lamps	-	IS - 2418 (Part-1 to 4)
Luminaries – General requirement	-	IS – 10322 (Part-1)
Luminaries – Constructional requirement	-	IS – 10322 (Part-2) Luminaries –
Screw and Screw less termination	-	IS – 10322 (Part-3) Luminaries –
Methods of Tests	-	IS – 10322 (Part-4) Particular requirement – General purpose Luminaries
Particular requirement – Recessed Luminaries	-	IS – 10322 (Part-5/Sec-1)
Particular requirement – Luminaries for Road and Street lighting	-	IS – 10322 (Part-5/Sec-2)
Particular requirement – Portable General purpose	-	IS – 10322 (Part-5/Sec-3)

Luminaries	-	IS – 10322 (Part-5/Sec-4)
Particular requirement – Flood Lighting	-	IS – 10322 (Part-5/Sec-5)
High pressure mercury vapour lamps	-	IS – 9900 (Part-1)
Tungsten filament General Electric lamps	-	IS - 418

c) Light Fittings-General Requirements:

Fittings shall be designed for continuous trouble-free operation under atmospheric conditions without reduction in lamp life or without deterioration of materials and internal wiring. Degree of protection of enclosure shall be IP-65 for outdoor fittings except bulkhead fitting. Bulkhead fitting shall be provided with IP-54 protection.

Fittings shall be so designed as to facilitate easy maintenance including cleaning, replacement of lamps/ ballasts.

All fittings shall be supplied completely with lamps. All mercury vapour and sodium vapour lamp fittings shall be complete with accessories like ballast, power factor improvement capacitors, starters, etc. Outdoor type fittings shall be provided with weatherproof junction boxes (IP-55) and IP-54 Control gear boxes. All fluorescent and CFL fittings shall be provided with electronic ballast as per schedule of quantities.

Each fitting shall have a terminal block suitable for loop-out connection by 1100 V PVC insulated copper conductor wires up to 4 sq.mm. The internal wiring should be completed by the manufacturer by means of standard copper wire and terminated on the terminal block.

All hardware used in the fitting shall be suitably plated or anodized and passivated.

Earthing: Each lighting fitting shall be provided with an earthing terminal. All metal or metal enclosed parts of the housing shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing continuity throughout the fixture.

Painting/Finish: All surfaces of the fittings shall be thoroughly cleaned and degreased, and the fittings shall be free from scale, rust, sharp-edges, and burns.

The housing shall be powder coated/stove-enameled or anodized as required. The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90 deg. over 12 mm Dia mandrel.

Metal used in BODY of lighting fixtures shall be not less than 22 SWG or heavier if required to comply with specification of standards. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burns and tool marks. Solder shall not be used as mechanical fastening device on any part of the fixture.

d) Light Fittings – Special Requirements Box Channel Type Industrial Fittings

Box type slim line channel must be in screwless construction manufactured from M.S. CRCA sheet steel powder coated with MS CRCA cover, powder coated white. Light reflection surface in Box/Channel type fittings shall be in a POLYESTER PRECOATED STEEL having a reflection factor of not less than 80%. SCREWLESS DESIGN & CONSTRUCTION Light fixtures shall be preferred due to their ease of maintenance, especially for box/channel for box/channel type

fixtures.

e) Moisture Proof Industrial Fittings

Surface mounted totally enclosed moisture proof fixtures must be in polycarbonate body and diffuser with transparent prismatic interior and smooth exterior and frosted end. Fixture must be completely sealed with polyurethane double gasket to achieve IP 65 protection. Fixture is complete with CRCA steel white powder coated / enameled finish reflector.

18 W / 36 W Fluorescent and 36 W CFL Low Glare Light Fittings/LED Light Fittings/Fixtures/ As mentioned in the BOQ.

Recessed mounted, modular fluorescent lighting fixture made of CRCA Sheet steel powder coated (white) housing, electro chemically brightened and anodized reflector, three dimensional cross louvers with concave contours, Fresnel top at louver saddle to increase efficiency. The luminance of $<200 \text{ cd/M}^2$ at 63 degree viewing angle in all directions to confirm Cat-2 classification of CIBSELG3

Highbay Industrial Fittings

Industrial Highbay luminaries shall be provided with pressure die cast housing along with all accessories, ortho cyclically wound open construction ballast, capacitor & semi parallel ignitor connected to terminal block and mounted on the gear plate. The gear shall have side entry for ease in maintenance. The spun aluminium reflector is suitable for narrow as well as wide beam distribution as specified in schedule of quantities. The luminaire will be suitable for metal halide lamp HPI BU + 250 W which has 25500 lumens or similar 400W lamp and 2.5 minutes restrike time (when operate with son gear).

f) Accessories for Light Fittings - Reflectors

The reflectors shall be made of CRCA sheet steel/aluminum /Silvered glass/Chromium plated sheet copper as specified. The thickness of reflectors shall be as per relevant standards. Reflectors made of steel shall have stove enameled / vitreous enameled/epoxy coating finish. Aluminum used for reflectors shall be anodized/epoxy stove enameled /mirror polished. The finish for the reflector shall be as specified. The reflectors shall be free from scratches / blisters and shall have a smooth and glossy surface having optimum light reflecting coefficient. Reflectors shall be readily removable from the housing for cleaning and maintenance without use of tools.

g) Lamps TLD

Lamps shall be environmentally friendly low pressure mercury discharge lamp with mercury content less than or equal to 5 mg. The lamp shall have minimum lumen maintenance of 85 and CRI of 85. The lamp must comply with ROHS (Restriction of Hazardous substances) and be covered by WEEE. Lamp should be fully recyclable. The lamp should be low on maintenance with life of 40 K hours in case of electromagnetic ballast and 65 K hours in case of HF ballast up to 10% failure. The discharge glass shall be lead free.

TLD Lamps shall be minimum tri-phosphor type and have bi-pin bases. Colour spectrum of light shall be equivalent to "PHILIPS color 84 or color 86 color 82 or "OSRAM color 21 or color 11 or color 41 (as required at site)".

Vibrations & Bump tests	IEC68-2-6 FC
	IEC 9001
Quality Standard	ISO 9001
Environmental	ISO 14001
StandardDC Operation	EN 60924
Emergency Lighting Operation	VDE 0108

Total System consumption (lamps + ballast) for 1 x 36 W TLD, shall not exceed 36 W
 1 x 28 W T-5, shall not exceed 28 W 1 x 35 W T-5, shall not exceed 35 W 1 x 14 W T-5, shall not exceed 14 W
 1 x 18 W CFL, shall not exceed 18 W 1 x 36 W CFL, shall not exceed 36 W

Lighting Control Equipment

General

The lighting control system shall be centralized or decentralized based on a project requirement every device should be microprocessor based, addressable entity

Control System Bus Protocol

The control system protocol shall implement the International Standards Organization (ISO) 'Open Systems Interconnection' seven-layer reference model for communication protocol.

There shall be no visible delay between command being issued and action executed. It shall typically be less than 2mS.

The system protocol should be available to third party companies to develop interfaces to the installed system.

The system should be capable of 'high-level' integration to Building Management Systems and other proprietary control systems.

Addressing Capabilities

The entire system shall consist of bus lines, each consisting of up to 128 devices. System should be capable of connecting more than 128 devices on a single network further by using repeaters and should have a topology supporting more than 57000 devices.

Interfacing the Control System

The system shall allow multiple RS232 or USB access points, typically at every Lighting Control Panel, to perform control, maintenance or reprogramming on the network,

System Control Requirements

The system shall be able to perform control in all of the following ways.

- Centralized control from a PC enabling over-ride control of individual units, groups, zones, buildings, sites.
- Any input device shall be able to be programmed as a master control point. Master over-rides shall be able to be positioned anywhere in the network and control any other unit or units on any connected network.
- The system shall allow unlimited switching configurations. Any number of switches shall be able to be programmed for a common load or loads (i.e. multi-way switching) and all switches shall indicate the load status.
- Over-rides shall be able to be re-programmed at any time without any wiring changes.

Distributed Intelligence

The system shall operate without a computer connected, including the operation of all manual switches, detectors, photoelectric cells, etc. For the logical relationship between input devices and output loads to be fully reliant on a computer being connected shall not be acceptable.

All devices shall be able to communicate directly with each other without the need for a computer or a centrally based processor to receive and transmit signals.

Safety requirements

The bus shall be short circuit protected to ensure that accidental short circuit will not damage any system components.

The system shall have a fail-safe default mode.

The failure of a module on the system shall not affect any other module.

Modules shall be able to be programmed to re-start to 'on', 'off', or resume in previous state after a power failure.

Networking and Expansion Capabilities

The system shall have a software controlled network structure. Any input device shall be able to control any output device, or any group of devices. The devices shall be able to be located anywhere on the network without a direct connection. The relationship shall be able to be changed at any time without re-wiring.

There shall be no requirements for end-of-line bus terminations for impedance matching.

The System shall be able to be easily expanded. Additional units shall be able to be added at any time at any point without re-configuration of any other component or the control devices. An existing system shall not need to be powered down if expansion is being carried out in the future. The system shall be capable of operating on a bus voltage of 21-30V dc.

System modules (input and output devices) shall be able to be located up to 1000m apart on the bus cable. Only one control bus cable shall be required to link any number of rooms, buildings, projects or sites. Localized input devices (e.g., switches or PIR Sensors) shall be able to be added at any time, and shall be able to be programmed to perform any function.

Output relay units shall be able to be connected to different phases or voltage sources, yet be controlled from any location on the network.

3. The system shall have distributed intelligence to allow full control over any module even if on another electrical sub-system.

Input and output Configurations

It shall be possible to provide input control of the system via the following system devices.

- 0-1V, 0-5V, 0-10V and 4-20mA analogue
- Digital Contact Closures (programmable functions)
- Motion detectors
- Temperature sensors
- Electronic Delay Time switches (software imbedded)
- Light Level - analogue and digital

It shall be possible to provide output control of the system via the following system devices.

- 0-10V dc analogue outputs
- DSI outputs
- Relay switch digital outputs
- Phase control leading edge dimmed outputs (incandescent and 12V ELV lighting)
- Configuration and commissioning software The commissioning tool software will be used

to:

- Individually address all control units on an installed system.
- Set the required control relationships between input and output devices.
- Define the Functional Control
- Set dimmer unit fade rates.
- Set photocell unit control points.
- Set temperature sensor unit control points.
- Set Power-Up status of Loads

All the above parameters will be set from within a graphical user interface, with separate configuration templates being provided for each type of control unit.

The software shall have the ability to export and import complete databases from within the software interface.

There shall be the ability to automatically detect and resolve address conflicts between any control units in an installation.

The software shall allow project names, system topology, application names and address names to be setup.

The software shall allow for real-time interrogation of sensor readings from the network, for example light level readings (in lux).

Lighting Control Equipment Product Specifications (Option-1)

Key Input Units

3. Wall mount, programmable 'Key Input Units', designed to control lighting applications and other electrical services shall be available from the manufacturer of the overall control system. The units shall be able to control any system output device including relays, dimmers, and analogue output units to switch or dim loads.

The units shall be available with one, two or four tactile switches.

The unit functions shall be customizable at any time before or after installation. Each key shall be capable of being programmed to achieve various functions including, toggle switch, dimmer control, timer or pre-set. In the event of power failure, a non-volatile memory (NVM) shall retain all programmed information relating to each unit's current operating status.

Key Input Units shall communicate with all other system units and obtain power via the UTP Communication Bus cable.

A Key Input Switch shall be suitable for more than 100,000 operations.

A Key Input Switch shall have an on-board Timer the Timer resolution shall be 1 second. A Key Input Switch shall be capable of dimmer control of about 255 possible levels.

The unit shall be suitable for operating temperatures between 0-50 Degree C.

Multigang Key Input Units Panels

A Multigang Key Input Units Panel, as a standard item from the system manufacturer, shall consist of multiples of four positive feel tactile switches, starting at eight switches, mounted to either a stainless steel or polished and lacquered brass fascia. Each switch shall contain a red light emitting diode and shall be programmed to provide on/off, dimmer or timer functions. Custom variations of multi-gang panels shall be detailed in drawings with respect to layout and functionality.

Specifications for a Multigang Key Input Units Panel shall be as per a Four Key Input Module for each four switch multiple incorporated within the panel.

In the event of power cycling, a non-volatile memory (NVM) shall be incorporated to retain all address and switching information.

Four key and four channel infrared receiver

This unit shall consists of four positive feel tactile switches with a red light emitting diode recessed in each switch and an Infrared receiver is capable of mimicking the functions of each of the switches. Each switch can be programmed to provide on/off, dimmer or timer functions.

A four-key/four-channel infrared receiver shall be suitable for more than 100,000 operations.

A four-key/four-channel infrared receiver shall be having a suitable Operating Temperature range of 0-50 Degree C.

A four-key/four-channel infrared receiver shall be capable of dimmer control of about 255 possible levels.

The Ramp Rate shall be programmable from 0 to 1024 seconds. The Ramp Level shall be programmable from 0 to 100%.

In the event of power cycling, a non-volatile memory (NVM) shall be incorporated to retain all address and switching information.

Four Key Infrared Transmitter

The Four Key Infrared Transmitter shall consist of four push buttons, which are mapped to the four keys on the receiver. The Four Key Infrared Transmitter shall be able to control up to four group addresses from each remote control. The IR codes shall be able to be learnt by propriety Learning Remote Controls for integration into other systems.

The remote control shall be powered by 2, AAA, 1.5V batteries.

Seven Day Cycle Clock

The clock module shall consist of a basic 7-day real time controller with two channels of output for control of up to four group addresses. The 7-day timer shall be able to be programmed from the front of the clock (independent of the installation software) whilst the outputs are configured in software (as per other system components).

The unit shall be capable of issuing on, off, dimming and delay-off timer commands. The clock shall

sustain its settings for 24 hours in the event of loss of supply.

Daylight savings, Holiday and Random modes shall be incorporated on the front of the clock.

In the event of power cycling, a non-volatile memory (NVM) shall be incorporated to retain all address and switching information.

The Seven-Day Cycle Clock shall be having a suitable Operating Temperature range of 0-50 Degree C.

Touch Screen

The touch screen shall provide a touch sensitive LCD screen that displays pages of graphical items to perform a particular function when pressed.

The touch screen shall be programmed via a software based configuration tool. This Configuration Software shall be Microsoft Windows™ based and shall provide the ability to program the appearance and operation of the touch screen.

The touch screen shall have the ability for the following components to be placed on a touch screenpage:

- Buttons (keys) with text and/or images
- Text
- Images
- Shapes (rectangles, triangles, ellipses)
- Sliders
- Clocks
- Percent Indicator
- Backlight control
- Contrast control

The touch screen shall have the ability to action a complete scene. Scenes shall be able to be setups follows:

- Up to 100 system addresses controlled per scene
- Level and ramp rate shall be selectable
- Activated by a particular system Address/Level combination.

The touch screen shall have the ability to action Schedules. Schedule details shall be able to be setup as follows:

- Command (on / off / ramp & ramp rate, pulse or set scene)
- Time of event
- Repeat cycle of event (once / daily / weekly / week days / weekends / monthly and complexcombinations)
- A list of scheduled events shall be displayed in the configuration software.

The configuration software shall support a "simulation mode" where clicking on components on the screen will execute the programmed actions.

PC Interface

The PC Interface shall provide the medium for an external PC to communicate with the control system network, including monitor and control functions. It shall also be used to program all other system units and generate the system clock for synchronized data communications.

Power Supply

The Power Supply shall provide safe extra low voltage (36V dc or as per requirement of supplier) to the control system bus.

The Power Supply shall be capable of supporting about 20 control system units (Key inputs, Relay Units, Dimmer Units etc.). Multiple Power Supplies shall be paralleled to support any system load.

The output current of the Power Supply shall be 320mA (nominal).

Four \ Eight \ Twelve Channel Dimmer

3. The four channel dimmer unit shall be suitable for switching or dimming loads that are controlled by the system. The unit shall be capable of independent control of four \ Eight \ Twelve dimmed active outputs. Electrical isolation between the Extra Low (Bus) Voltage and the Low (mains) voltage side of the unit shall be provided with the use of optical isolators.

As well as controlling 240V loads (e.g., incandescent lighting), the dimmer units shall be capable of controlling Extra Low Voltage (12V) lighting utilizing iron core transformers or electronic transformers implementing leading edge technology (e.g., The 'Osram Mouse' 12V electronic Transformer or equivalent).

The dimmer unit shall incorporate continuous triac drive circuitry. The dimmer unit shall be capable of retaining programmed information relating to operating status.

The dimmer shall have the facility to program (via the software) a minimum level setting.

In the event of power cycling, a non-volatile memory (NVM) shall be incorporated to retain all address and switching information.

3. The load rating shall be 500VA per channel and 4000VA in total. Unless otherwise specified Every

dimmer should have individual MCB for over load protection as part of dimmer rack. The unit shall provide an Electrical Isolation Rating of 3500VAC RMS, 1 minute.

The units" mains voltage terminals shall be suitable to accommodate 4 x 2.5mm square cable.

The unit shall have suitable operating temperatures between 0-50 Degree C.

Four \ Twelve Channel Relay with 10A Voltage Free Contacts

This unit shall allow control of four \ twelve independent loads, with a total capacity of at least 40A, independent from supply. The individual channel load shall be rated at least 10A (inductive and resistive).

In the event of power cycling, a non-volatile memory (NVM) shall be incorporated to retain all address and switching information. The Relay Unit shall have the facility to program (via the software) a minimum threshold setting. The unit shall have an input voltage operating frequency range of 47-53Hz and 57-63Hz.

3. The unit shall provide an Electrical Isolation Rating of 3500VAC RMS, 1 minute.

The units" mains voltage terminals shall be suitable to accommodate 4 x 2.5mm square cable. The unit shall have suitable operating temperatures between 0-50 Degree C.

Scene Master Specification

A wall mounted Lighting Scene Controller shall be provided to allow the user of the lighting system to access the lighting in the area, switch the lighting on and off, ramp the lighting up and down and manually assign a number of preset lighting scenes as required.

Mechanical

3. The Scene Controller shall include facilities for attachment to an International Standard Electrical Wall Box.

The unit shall also allow for mounting the Controller directly to a flat wall surface. This shall be carried out with a supplied mounting bracket. It shall be possible to securing the bracket to the wall first, then the controller to the bracket.

The only cable termination requirements shall be a twisted pair Category 6 data cable. There shall be no additional requirements to terminate 240V or extra low voltage cabling at the Lighting Controller.

For ease of maintenance, the lighting outputs (dimmers, relays, etc) controlled by the unit shall be mounted remotely. Output devices mounted in the wall (either as an integral part of the Lighting Controller or as a separate unit) will not be accepted.

The Lighting Controller shall form an integral part of the lighting system and shall have the capabilities to communicate with other input and output devices attached directly to the systems communication bus, including (but not limited to) Relay Units, Dimmer Units, Wall mounted Switches, Light Level Sensors and Passive Infrared Movement Detectors.

Output Load Control

The controlled lighting loads shall be dependent on the output devices connected to the system, rather than being dependent on the load capacity of the Scene Controller itself. Thus, the scene controller should be able to control various load types including incandescent, Extra Low Voltage Tungsten Halogen Dichroic, Fluorescent (via High Frequency Electronic 0-10V or Digital Ballast"s) on the same group address.

User Interface/Control

The wall-mounted controller shall include separate buttons to allow the user to individually dim up or dim down three separate groups of output loads. A series of LED"s shall be associated with the group to indicate the current lighting ramp level for that group. The controlled output groups shall be programmable via a software assignable addressing system and shall not be limited to any hardwired groups of outputs.

Lighting Preset Scenes

The Lighting Controller shall incorporate a minimum of five programmable scene buttons and five associated LED"s. The LED"s shall indicate which lighting scene is active or inactive. The user shall be able to assign and recall a preset lighting scene directly from the unit. Whilst acceptable for testing and commissioning purposes, Controllers that require the user to attach a separate device (e.g. a PC) to program and re-program scenes on an ongoing basis will not be accepted.

It shall be possible to trigger the preset lighting scenes set in the Controller from an external input device which form part of the control system. These external devices capable of triggering scenes shall include additional Scene Controllers, as well as wall mounted input switches connected to the bus system.

Power-up

If power to the unit is lost, the lighting shall automatically return to a preset level. All scenes, faderates, etc shall be stored in non-volatile memory.

Scene Fade Rate

When programming a Lighting Scene, the user shall also have a button available to manually select the fade (ramp) rate for that scene. .

A second press of each scene button (press on the scene button when that scene is already active) shall cause the pre-programmed fade-in rates to be overridden and the target levels are

established
„instantly“.

Master OFF

A „Master Off“ button shall be available on the Lighting Controller. This Master Off button shall be programmable to allow the user to select controlled output groups. Pressing the Master Off button shall turn off all three of the primary groups.

Night Light function

There shall be provision for a “night light” function on the Controller. This shall be programmable via the installation software to be enabled or disabled. When enabled, if no indicator other than the fade rate is active on the Lighting Controller (all primary groups are off), then all five scene indicators will be dimly lit.

Infra-red Interface

The hand-held Remote-control Scene buttons (1 to 5) shall function as the scene buttons on the Lighting Controller. The IR controller shall effectively mimic the press scene buttons on the unit.

The Remote control „All Off“ button shall function exactly the same as the master off button on the Lighting Controller.

The Master Up/Down buttons shall ramp the 3 primary groups simultaneously. The master up/down buttons on the IR controller shall mimic the functions of the individual up/down buttons on the Lighting Controller.

The level change performed by the Master Up/down buttons on the IR Remote shall only be temporary and should not affect the preset levels.

All the scene button indicators shall flash when the scene controller is receiving valid data from the remote control Lighting Controller.

Self-Testing

A self-test routine shall be also added to help in manual testing. Holding the first UP key during the power-up of the unit shall activate this routine. The self-test routine will help in checking the indicators and keys by activating all indicators and interactively reading all keys in sequence.

8 Channel DSI Gateways

The DSI Gateway is based on the 12 M wide DIN rail enclosures, and shall be available in 110/120Vac and 220/240Vac ratings, 50Hz operation.

The 8 Channel Modules shall be based on a DIN Rail enclosure and shall consist of 8 Channels of output, with each channel sourcing approximately 200mA.

3. Electrical Characteristics

- The DSI interface complies with the DSI standard, and only one channel at any time is sourcing current to the ballast.
- Nominal operating voltage ranges, 110/120Va.c. And 220/240Va.c.,
- Operating frequency ranges, 47 - 53Hz and 57 - 63Hz minimum.
- Outputs are able to withstand continuous short circuit conditions, including short circuit from channel output to common and short circuit from one channel output to any other channel output. Output channels recover automatically following the removal of the short circuit condition.
- The unit is capable of being programmed without the needs for the mains connection. The unit draws no more than 18mA when the unit is being programmed and no mains connection is made.
- If mains power is lost to the unit all channels go to a high impedance state, the ballast behavior depends on ballast type DSI ballasts stay in their current state.
- 3. The low voltage sides and mains input are electrically isolated.
- The equipment is designed to operate from a single-phase supply.
- The quiescent power of the device does not exceed 10 watts.
- The unit shall incorporate the following status indicators.
 - Network status
 - Mains power status
 - Load status indicators (8)
- The unit incorporates 8 momentary switches, which are used to locally control, the state of the outputs, with or without the presence of central unit. The status indicators report the actual state of the output, either OFF or ON.
- The lifetime of the momentary switches exceeds 100,000 operations.

Mechanical Characteristics

The enclosure used shall be based on the DIN Rail Mount enclosure.

2 x RJ45 sockets shall be incorporated a 0.3m patch lead shall be provided with each unit. The cable and plugs shall be suitably rated for its intended use.

- The output terminals shall accommodate 2 x 1.5mm² or 1 x 4.0mm² cable.
- Combination head screws shall be used on the output terminals and mains connections.

Environmental

Operating Temperature Range	0°C - 45°C
Operating Humidity Range	10 – 95% RH
Storage Temperature Range	0°C to 60°C

Transportation and Handling the equipment shall be designed to survive road transportation and warehouse storage.

The equipment packaging shall be developed to protect the equipment during normal factory, warehouse and field handling

EMC Compliance The equipment shall be designed to meet the requirements for marking with the CE and RCM marks.

Light Level Sensor

The Light Level Sensor shall be capable of measuring ambient light levels in the range of 20 to 3000 lux (40 lux to 1600 lux controllable).

The ambient light level shall be measured by the Light Level Sensor and output devices (such as Dimmer Units) shall be controlled to maintain constant luminance in a given area, under varying conditions.

The target luminance level as well as the Margin shall be set using the control system Installation Software.

In the event of power cycling, a non-volatile memory (NVM) shall be incorporated to retain all address and switching information.

The field of View of the light level sensor shall be 180 degrees.

The Supply Voltage to each light level sensor shall be 36VDC @ 18mA. No additional 240V supply shall be required.

The light level sensor shall have an operating temperature range of 0-50 Degree C.

Temperature Sensor

The Temperature Sensor shall be suitable for measuring ambient temperature and issuing on or off commands to one (1) group address for heating or cooling purposes. The unit shall measure in the range 0 - 50 degree C with selectable offset (dead-band) within the installation software

The Temperature Sensor shall have the ability to change its target temperature to a different point (and to reset the target) by receiving bus commands from another system devices.

In the event of power cycling, a non-volatile memory (NVM) shall be incorporated to retain all address and switching information.

The Supply Voltage to each Temperature Sensor shall be 36VDC @ 18mA. No additional 240V supply shall be required.

PIR Occupancy Sensor

3. The PIR Occupancy Sensor shall detect passive infrared energy for control of any number of independent electrical loads. The light level shall be adjustable from the front of the unit and shall be used to disable the Occupancy Sensor. Timer settings shall be adjustable from 1 second to 18 hours, in one-second increments. A weatherproof version shall be available for outdoor or industrial use.

In the event of power cycling, a non-volatile memory (NVM) shall be incorporated to retain all address and switching information.

The Supply Voltage to each PIR Sensor shall be 36VDC @ 18mA. No additional 240V supply shall be required for the unit to operate.

The unit shall have suitable operating temperatures between 0-50 Degree C.

The unit shall be suitable for wall or ceiling mounting, up to mounting heights of 2.4m.

The Indoor unit shall have a field of view of 90 degrees. The outdoor unit shall have a field of view of 110 degrees.

The Indoor unit shall have an effective detection area of 6m x 6m. The outdoor unit shall have an effective detection area of 18m radius x 110 degrees.

The Indoor unit shall have 12 overlapping detection zones. The outdoor unit shall have 18 long range, 16 intermediate range, 10 short range and 4 ultra short-range detection zones.

Ultrasonic Occupancy Sensor

The unit shall be an active device utilizing Doppler wave technology as its means of detection. The unit shall include two air transducers to provide volumetric occupancy detection.

The unit shall be suitable for occupancy detection of larger areas, typically 12m x 12m and 2.7m mounting height. The unit shall include its own independent 240V power supply and shall require a socket outlet adjacent to installation point (typically in the lighting wiring loom). To enable the unit to communicate with the control system network, an Auxiliary Switch Input Unit shall be utilized. Each auxiliary unit will allow control of up to four detectors.

The unit will have easily accessible sensitivity adjustment that can be used to accommodate various room sizes.

The unit will have an indicator LED for walk-testing the unit.

The unit shall be ceiling mounted and a 360-degree field of view. The unit shall utilize an ultrasonic frequency of 32.7 kHz.

The unit shall have suitable operating temperatures between 0-50 Degree C.

Combined Technology Ultrasonic/PIR Occupancy Sensor

The unit shall consist of two air transducers and four PIR detectors with a special lens to provide both volumetric and line of sight detection.

The unit shall be suitable for occupancy detection of larger areas, typically 15m x 15m and 2.7m mounting height. The unit shall include its own independent 240V power supply and shall require a socket outlet adjacent to installation point (typically in the lighting wiring loom). To enable the unit to communicate with the control system network, an Auxiliary Switch Input Unit shall be utilized. Each auxiliary unit will allow control of up to four detectors.

The unit shall be ceiling mounted and a 360-degree field of view.

The unit will have easily accessible sensitivity adjustment that can be used to accommodate various room sizes.

The unit will employ programmable walk-testing LED indicators: Red LED for Passive Infrared and Green LED for Ultrasonic modes.

The unit shall utilize an ultrasonic frequency of 32.7 kHz.

The unit shall have suitable operating temperatures between 0-50 Degree C.

Ultrasonic Occupancy Sensor for Corridors and Hallways

The unit shall be suitable for occupancy detection of Corridors and Hallways, typically up to 4.6m x 30m and 2.7m mounting height. The unit shall include its own independent 240V power supply and shall require a socket outlet adjacent to installation point (typically in the lighting wiring loom). To enable the unit to communicate with the control system network, an Auxiliary Switch Input Unit shall be utilized. Each auxiliary unit will allow control of up to four detectors.

The unit shall be ceiling mounted and a 360 degree field of view. The unit will have an indicator

LED for walk-testing the unit. The Unit shall utilize an ultrasonic frequency of 32.7 kHz.

The unit shall have suitable operating temperatures between 0-50 Degree C.

4 MEDIUM VOLTAGE 1.1 KV GRADE XLPE CABLES

General

The MV cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, Specifications, relevant Standard Specifications and cable manufacturer's instruction.

Material

The MV cables shall be cross linked polyethylene (XLPE) insulated PVC inner sheathed and FRLS PVC outer sheath of 1100 volts grade as asked for in the schedule of quantities. All Cables above up to and including 6mm² shall be with copper conductor and above 6mm² shall be aluminium conductor.

Technical Requirements:

All XLPE Power cables shall be 1100 Volts grade, multi core constructed as per IS : 7098 Part-I of 1988 as follows :

- a) Stranded Copper conductor in case of 10 sq.mm. And above whereas solid conductor in case of 10 sq.mm. And below.
- b) Cores lay up
- c) 3. The inner sheath should be bonded over with thermo-plastic material for protection against mechanical and electrical damage.
- d) Armoring should be provided over the inner sheath to guard against mechanical damage. Armoring should be Galvanised steel wires or galvanised steel strips. (In single core cables used in A.C. system armoring should be non-magnetic hard aluminium Wires/Strips. Round steel wires should be used where diameter over the inner sheath does not exceed 13 mm; above 13 mm flat steel armour should be used. Round wire of different sizes should be provided against specific request.)
- e) The outer sheath should be specially formulated heat resistant black PVC compound conforming to the requirement of type ST2 of IS: 5831-1984 extruded to form the outer sheath.

Conductor shall be of electrolytic Copper/Aluminium conforming to IS : 8130 and are compact circular or compact shaped.

Insulation shall be of XLPE type as per latest IS general purpose insulation for maximum rated conductor temperature 70 degree centigrade.

3. In Inner sheath laid up cores shall be bonded over with thermoplastic material for protection against mechanical and electrical damage.

Insulation, inner sheath and outer sheath shall be applied by extrusion and lapping up process only.

Armoring shall be of galvanised steel wire/flat. Repaired cables shall not be used.

Current ratings of the cables shall be as per IS : 3961.

The XLPE insulated FRLS cables shall conform to latest revision of IS and shall be read along with this specifications. The Conductor shall be stranded Copper circular/ sector shaped and compacted. In multi core cables the core shall be identified by red, yellow, blue and black coloring of insulation.

The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.

Progressive automatic in line sequential marking of the length of cables in meters at every one meter shall be provided on the outer sheath of all cables.

Cables shall be supplied in non returnable wooden drums as per IS : 10418.

Both ends of the cables shall be properly sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation, storage and erection.

The product should be coded as per IS :- 7098 Part-I as follows :-

Aluminium Conductor	A								
XLPE Insulation		2X							
PVC Insulation			Y						
Steel round wire	W								
armour									
Steel strip armour		F							
Steel Double round wire armour	WW								
Steel Double strip armour	FF							Non-magnetic (Al.)	
round wire armour	Wa							Nonmagnetic (Al.) strip armour	Fa
PVC outer sheath									Y

Inspection

All cables shall be inspected by the contractor upon receipt at site and checked for any damage during transit.

Joints in Cables

The Contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoid cable jointing. This apportioning shall be got approved by the Owner’s site representative before the cables are cut to lengths. Where joints are unavoidable heat shrinkable type joints shall be made. The location of such joints shall be got approved from the Owner’s site representative and shall be identified through a marker.

Jointing Boxes for Cables

Cable joint boxes shall be installed with heat shrinkable sleeve and of appropriate size, suitable for XLPE armoured cables of particular voltage rating.

Jointing of Cables

All cable joints shall be made in suitable, approved cable joint boxes and the filling in of compound shall be done in accordance with manufactures' instructions and in an approved manner. All straight through joints shall be done in epoxy mould boxes with epoxy resin.

All cables shall be joined colour to colour and tested for continuity and insulation resistance before jointing commence. The seals of cables must not be removed until preparations for jointing are completed. Joints shall be finished on the same day as commenced and sufficient protection from the weather shall be arranged. The conductors shall be efficiently insulated with high voltage insulating tape and by using of spreaders of approved size and pattern. The joints shall be completely topped up with epoxy compound so as to ensure that the box is properly filled.

Cable End Terminations

Cable end termination shall be done in cable terminal box using crimping sockets and proper size of glands of double compression type with shrouding

Bonding of Cables

Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armour clamp and gland. The clamps must grip the armouring firmly to the gland or casing, so that no undue stress is passed on to the cable conductors.

Cable Installation

Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming kinks.

a) Laying of Cables on Cable Trays

The relative position of the cables, laid on the cable tray shall be preserved and the cables shall not cross each other. At all changes in direction in horizontal and vertical planes, the cable shall be bent smooth with a radius as recommended by the manufacturers. All cables shall be laid with minimum one diameter gap and shall be clamped at every meter to the cable tray. Cables shall be tagged for identification with aluminum tag and clamped properly at every 20M. Tags shall be provided at both ends and all changes in directions both sides of wall and floor crossings. All cable shall be identified by embossing on the tag the size of the cable, place of origin and termination.

All cables passing through holes in floor or walls shall be sealed with fire retardant Sealant and shall be painted with fire retardant paint upto one meter on all joints, terminations and both sides of the wall crossings by "VIPER CABLE RETARD".

b) Laying of Cables in Ground

The width of trench for laying single cable shall be minimum 350 mm. Where more than one cable is to be laid in horizontal formation, the width of the trench shall be workout by providing 60 mm

gap between the cables, except where otherwise specified. There shall be clearance of 60 mm between the end cable and the side wall of the trench. The minimum depth of the cable trench shall not be less than 750 mm for single layer of cables. When the cables are laid in more than one tier the depth of the trench shall be increased by 450 mm for each additional tier.

Excavation of trenches:

The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided. Where gradients and changes in depth are unavoidable, these shall be gradual. The excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench. The bottom of the trench shall be leveled and shall be made free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 100 mm in depth. Prior to laying cables, the cores shall be tested for continuity and insulation resistance. The cable drum shall be properly mounted on jacks, at a suitable location, making sure that the spindles, jacks etc. are strong enough to carry the weight of the drum and the spindle is horizontal. Cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire drum length shall be laid in one stretch. However, where this is not possible the remainder of the cable shall be removed by "Flaking" i.e. By making one long loop in the reverse direction. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted off the rollers beginning from one end by helpers standing about 10 meters apart and laid in a reasonably straight line. Cable laid in trenches in a single tier formation shall have a cover of clean, dry sand of not less than 150 mm. above the base cushion of sand before the protective cover is laid. In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 300 mm shall be provided over the initial bed before the second tier is laid. Finally the cables shall be protected by second-class bricks before filling the trench. The buried depth of uppermost layer of cable shall not be less than 750mm.

Back Filling:

The trenches shall be back filled with excavated earth free from stones or other sharp-edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 300 mm. Unless otherwise specified, a crown of earth not less than 50 mm in the centre and tapering towards the sides of the trench shall be left to allow for subsidence.

Cables inside Building

Cables inside buildings shall be laid on the cable trays. All cables passing through walls shall run through GI Pipes sleeves of adequate diameter 50 mm apart maintaining the relative position over the entire length.

Route Marker

Route marker shall be provided along straight runs of the cables not exceeding 30 meters also for change in the direction of the cable route and underground joints.

Route marker shall be cast iron painted with aluminum paint. The size of marker shall be 100 mm

dia with "Cable" and voltage grade inscribed on it.

Cable Trays

Ladder and perforated type Cable Trays shall be of Hot dip Galvanized type and factory fabricated out of CRCA sheet with standard accessories like tee, bends, couplers etc. for different loads and number and size of cables as given below:

Cable trays shall be galvanized as per Specification given under 4.14.

- a. 1500 mm wide
Runners 25 x 100 x 25 x 3 mm
Rungs 2# 20 x 40 x 20 x 3 mm 250 mm C/C
Suspenders 2 Nos. 40 x 40 x 5 mm GI angle 1500 mm C/C with base support of 40x 40 x 5mm GI angle.
- b. 1200 mm wide
Runners 25 x 100 x 25 x 3 mm
Rungs 2# 20 x 40 x 20 x 3 mm 250 mm C/C
Suspenders 2 Nos. 40 x 40 x 5 mm GI angle 1500 mm C/C with base support of 40x 40 x 5mm GI angle.
- c. 1000 mm wide
Runners 25 x 100 x 25 x 3 mm
Rungs 2# 20 x 40 x 20 x 3 mm 250 mm C/C
Suspenders 2 Nos. 40 x 40 x 5 mm GI angle 1500 mm C/C with base support of 40x 40 x 5mm GI angle.
- d. 750 mm wide
Runners 20 x 75 x 20 x 2.5 mm
Rungs 20 x 30 x 20 x 2.5 mm 250 mm C/C
Suspenders 2 Nos. 32 x 32 x 5 mm GI angle 1800 mm C/C with base support of 40x 40 x 5mm GI angle.
- e. 600 mm wide
Runners 20 x 75 x 20 x 2.5 mm
Rungs 20 x 30 x 20 x 2.5 mm 250 mm C/C
Suspenders 2 Nos. 32 x 32 x 5 mm GI angle 1800 mm C/C with base support of 40x 40 x 5mm GI angle.
- f. 450 mm wide
Runners 20 x 75 x 20 x 2.5 mm
Rungs 20 x 30 x 20 x 2.5 mm 250 mm C/C

Suspenders 2 Nos. 25 x 25 x 4 mm GI angle 1800 mm C/C with base support of 40x 40 x 5mm GI angle.

- g. Supply and fixing of perforated type cable trays of the following sizes of pre-galvanized iron.

600 x 40 x 40 x 2 mm thick

450 x 40 x 40 x 2 mm thick

300 x 40 x 40 x 2 mm thick

150 x 40 x 40 x 2 mm thick

Note: Suitable length of 10 mm dia GI rod suspenders at 1800 mm interval shall be included in the item for perforated type cable tray.

Specification for Hot Dip Galvanizing Process

3. (for Mild Steel Used For Earthing, Cable Trays Or Junction Boxes For Electrical Installation.)

General Requirements

- I. Quality of Zinc

Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS: 209-1992.

- II. Coating Requirement

Minimum weight of zinc coating for mild steel flats with thickness up to 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square meter shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs; rust stains bulky white deposits, blisters.

Mild steel flats / wires shall undergo a process of degreasing pickling in acid, cold rinsing and then galvanizing.

Fire retardant Cable Paint & Fire Barrier

The fire retardant paint / barrier shall be listed by independent test agencies such as UL, FM or OPL and be tested to, and pass the criteria of ASTM E 814 (UL1479) standard test method for fire test through- penetration fire stops and ASTM E 1996 (UL 2079) standard test method for fire resistive joint system

- a) **Fire retardant cable Paint**

The Fire resistant cable coating / painting shall be intumescent / ablative, water based compound, and The coating shall expand up to 10 times, supplied in a manufacturer seal container indicating manufacturing and expiry dates. The coating material shall be non-toxic,

asbestos free, & halogenfree and shall have good mechanical strength. The colour of paint shall be white and density of coating shall be 1.3kg/Ltr, coating shall have a snap time of 30 minutes, the expansion shall begin at 230 Deg.C and it shall have a oxygen index of 41%.

Coating shall be applied by ordinary paint brush after cleaning the cables of dust and oil deposition. A minimum textured finish of 3 mm wet film thickness shall be achieved by applying the material in 2-3 layers leaving intervals of 2 to 8 hours depending upon the moisture and thickness, moisture and temperature hours between each coat.

b) Fire Barrier sheet for floor and wall sealing

The framing & fixing part of fire barrier sheet shall be very simple & directly fixed around walls & floors by help of anchored bolts & washer. For 2 hour fire rating the fire barrier sheet shall be minimum 7.62 mm thick and shall be cut as per the profile of penetration and opening. The small gap left around the penetration shall be closed with fire rated soft & moldable putty. Fire barrier must be design on the intumescent technology to seal larger penetration through the fire rated walls & floors. Fire barrier must be a composite construction with the quality incorporated with organic/ inorganic fire resistive elastomeric sheet with specific gravity of 1.6 gm/ cubic centimeter.

Testing of Cables

Cables shall be tested at works for all routine tests as per IS including the following tests before being dispatched to site by the project team.

- a) Insulation Resistance Test.
- b) Continuity resistance test.
- c) Sheathing continuity test.
- d) Earth test.(in armoured cables)
- e) Hi Pot Test.

Test shall also be conducted at site for insulation between phases and between phase and earth for each length of cable, before and after jointing. On completion of cable laying work, the following tests shall be conducted in the presence of the Owner's site representative.

- a) Insulation Resistance Test(Sectional and overall)
- b) Continuity resistance test.
- c) Sheathing continuity test.
- d) Earth test.

All tests shall be carried out in accordance with relevant Standard Code of Practice and Electricity Rules. The Contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Owner's site representative, results will be noted and signed by all present and record be maintained.

Floor Cable Trunking

General

Trunking and fittings shall comply with BS 2989 or Indian Standard of IS277 with a GI coating thickness of 275GSM.

Trunking shall be Corrosion resistance complying IS 3854:1997 Trunking shall be top accessed. Inverted trunking is not acceptable.

All multi-compartment trunking systems shall maintain the stated segregation throughout, including all accessories.

Trunking shall be manufactured using pre galvanised sheet steel. Trunking shall be spot welded & arc welded throughout its length for better impact resistant and to prevent concrete seepage during installation. The trunking shall normally be supplied in 2500mm lengths with a material thickness of 1.6mm. Lengths of trunking shall be coupled together by means of joint sleeves, made of pregalvanized GI with 275 GSM GI coating. At each joint in the trunking, continuity shall be maintained by means of copper links, not less than 25 x 3 mm to achieve an acceptable earth loop impedance level in compliance with BS 2989, fixed with brass nuts, bolts and serrated washers. Removal of any lid no matter how it is fitted shall not affect the earth continuity of the trunking. Copper cable link with cable lugs may be used, if the proper connection method is provided to avoid long term corrosion and electrolytic action. The cable shall have an equivalent cross sectional area to the copper links. Bonding link shall be fixed on external surfaces.

Manufacturer's standard fittings shall be used for all connections and changes of direction. All vertical bends, Crossover boxes, access outlets, and junction boxes shall be of the same manufacturer as the trunking. Trunking shall not be cut or bent to form bends, flanges or attachments. Gusset bends shall be used wherever necessary to provide sufficient bending radius for the cables. Site fabricated items shall not be accepted.

The minimum size shall be 50mm by 38mm with single compartment. The maximum recommended size for the trunking is up to 300mm by 38mm with triple compartments.

All inside edges of trunking shall be smooth and provision shall be made to prevent abrasion at bends.

Cable retaining straps supplied by the trunking manufacturer shall be fitted at intervals not exceeding 1m. Where trunking passes through walls, floors and ceilings, proprietary fire barriers shall be installed in the trunking. The fire barrier shall have a rating not less than that of the original construction of the opening.

Trunking shall be adequately supported throughout its length. Trunking support and channel shall be quick-fixing type and shall be such as to space the trunking a minimum of 13mm from any part of the wall or bulkhead.

A minimum of two fixings shall be provided between joints in the trunking except where the

distance between is less than the maximum spacing.

Where trunking is cut or drilled, the cut edges of the trunking shall be smoothed to prevent abrasion of the cables and shall be painted with anti-corrosion paint like aluminium coating, to the same colour as the adjacent surfaces, such painting to be carried out as the work proceeds. In no circumstances will rough screw edges and nuts be allowed in the interior of the trunking.

Flush or buried trunking and under floor metal ducts shall comply with BS 2989.

The space factor for cables installed in trunking shall not exceed 35% as per IEE regulations.

All lengths of vertical run trunking in excess of 3000mm shall contain cable supports made of insulating, non-hygroscopic, non-combustible material. The spacing between such supports shall not exceed 1800mm. An additional support shall be provided at the top of all vertical runs exceeding 3000mm, to support the weight of the cable and distribute the cables within the trunking to prevent undue compression of the installation.

Where trunking crosses expansion joints, a trunking fitting shall be used which shall allow for expansion and maintain earth continuity.

Suitable cutout on under floor trunking at ticket barriers shall be provided to suit Automatic Fare Collection System Contractor's requirement. The cutout shall not have a sharp edge or abrasive effect on cables. The location and route for the cutout and under floor trunking shall be according to Working Drawings.

Trunking installed externally shall be manufactured from galvanized sheet steel in accordance with BS 2989 protection Class, or other international standards. Trunking installed internally shall be of Class 2.

Partitions or dividers shall be of the same material and finish as the trunking. The method of fixing shall not cause any long-term corrosion or electrolytic action.

Connections to multiple boxes, switchgear and distribution boards shall be made with multi compartment vertical access boxes. Expansion joints in long continuous runs shall be provided as recommended by the manufacturer.

Access Outlets

Access Outlets are made of very high quality materials to withstand heavy load and corrosion.

Manufactured from high-pressure die cast material for strength & durability.

The trap frame & trap shall be made of flame retardant Engineering Plastic - ABS & Polyamide ratchet for strength & durability.

The Trap Frame should be easily removable by pulling either one of the Nylon Bars to detach & remove the unit for servicing or installation of accessories to save installation & servicing time.

Patented screw less ratchet bar level adjusting system to match with screed / floor height. The

traplid is self-adjustable to any floor finish thickness.

Trap cover must be reinforced with a 2.5mm thick pre-galvanized steel plate to provide rigidity & added strength. Trap lid to have a screw less knob-hinged design for quick mounting on to the frame requiring minimum maintenance.

The Trap cover must have 8 mm recessed for installation of carpet and tiles.

Trap trim design to protect carpet from damages and give the floor area added aesthetics.

Trap lid should be made of Electrostatic Polyester Epoxy Coating to provide excellent and enhanced protection on visible parts against chemical or saline corrosion.

Strong and durable trap lifting handle on the trap cover is made of similar color material and has special design for easy lifting, even with large fingers.

Cables shall be guided by Cable Retainers through generous cable outlet which open automatically and lock into position when cables are present.

Trap cover of Access box should be retained by Cable Grommets with high quality durable foam to prevent the cable damage from exit position & also prevent ingress of dust when closed.

Access Outlet should carry service plates for providing services i.e.: Power, Data & Telecom. The Access outlets must accommodate to have three compartments to run Mains Voltage & Extra Low Voltage cables.

The system must have Positive Double Earthing connections.

Earth wire connector should be provided in all the boxes, and complies with the requirement of current IEE regulation.

Access outlets should be tested to a load bearing of 2 tons on the trap lid for heavy traffic areas

Four side blanks to be made with removable perforations to suit ducts installation.

Standards & Approvals – The system must comply to the relevant specification & IEC 61084 standards.

The outer casing of the floor outlet box must be manufactured from metal & is non-combustible

Crossovers/Junction Boxes

Cross Over's/Junction boxes are made of very high-quality materials to withstand heavy load and corrosion.

Manufactured from high-pressure die cast material for strength & durability.

The trap lid shall be self-adjustable to any floor finish thickness using the leveling screws on all the four corners.

The Trap cover is made of 2.5mm thick pre-galvanized steel plate to provide rigidity & added strength.

The Trap covers to have flexibility for quick mounting on to the base box requiring minimum maintenance.

The Trap cover must have 8mm recessed for installation of carpet and tiles.

The Flyover unit strap frame and traps should be made of Electrostatic Polyester Epoxy Coating to provide excellent and enhanced protection on visible parts against chemical or saline corrosion.

The Cross Over should carry fly-over made of Electrostatic Polyester Epoxy Coating for cables passage to ensure segregation of service

Crossovers are tested to a load bearing of 3.6 tons on the trap lid for heavy traffic areas. The Cross Over should have provision to Power, Data & Telecom services.

The system must be accommodated to run Mains Voltage & Extra Low Voltage cables. The trap cover screws must be made from Stainless Steel for extra protection.

The system must have Positive Double Earthing connections.

Earth wire connector should be provided in all the boxes and complies with the requirement of current IEE regulation.

The complete system must have excellent protection against rust.

Four side blanks to be made with removable perforations to suit ducts installation of up to 38-mm height.

The one-piece base frame design ensures minimum openings to prevent concrete seepage into the box during casting of concrete or screeding.

Standards & Approvals – The system must comply with the relevant specification & IEC 61084 standards.

The outer casing of the floor outlet box must be manufactured from metal & is non-combustible.

The boxes shall be Chemical Resistance i.e. non-corrosive.

Degree of Protection: Enclosure classification IP 20.

Vertical Access Boxes

Vertical access boxes to be made of very high-quality materials to withstand heavy load and corrosion.

Vertical access boxes facilitate the connectivity of floor raceways to the equipments on the wall like the distribution boards, so the product should be designed as “L” shaped

The Vertical access boxes should have provision to carry **Power, Data & Telecom services**

The vertical access boxes should have duct entry knockouts of up to 38mm and also provision for carrying the conduits to the wall

The vertical access boxes are made of electrostatic polyester epoxy coating to prevent the rust accumulation

5 RISING MAINS/ BUSDUCTS

5.1 Sandwiched Construction – Option 1

Scope:

The specification covers design, manufacturing, supply, installation, testing and commissioning of Sandwich type busbar trunking for use as feeder busbars for interconnection between separate electrical equipment / load centers, and for use as plug in busbar risers.

System details:

The busbar shall be suitable for operation in a 600/1000V system, with frequency of 50 Hz having 100% neutral and internal earth.

Standards:

The busbar shall be designed and manufactured in accordance with the following international standards for busbar trunking:

BS 5486 Part 2 : Particular requirements of busbar trunking systems IEC 60439 –2 :

Particular requirements of busbar trunking systems IEC 60529 : Degree of protection

The bus duct shall conform to IEE/NEMA/BUI/JIS for seismic protection certification.

The busbars shall be type tested at a reputed international test laboratory (ASTA or CPRI) for short circuit withstand. The test shall be for a minimum duration of 1 second. Tests shall be performed over a range of current ratings, covering the different frame sizes of the manufacturer.

Degree of ingress protection (IP rating) shall also be tested at any reputed independent laboratory. This test shall be for IP54 for indoor application and IP65 for outdoor application for sandwiched busbars.

Manufacturer:

The manufacturer must have an established track record in design and manufacture of sandwich and cast resin busbar trunking, and must have supplied busbar systems for at least 5-10 years.

The manufacturer must have ISO 9001 certification for design, manufacture and testing of busbar systems.

Design & Construction requirements – Sandwich busbars

The busbars shall be of sandwich construction, non-ventilated design. It shall be possible to mount the busbar system in any orientation, without affecting the current rating.

The bus duct shall consist of three phases and neutral bus bar permanently positioned dust and vermin proof and the degree of enclosure protection shall be IP 55 for indoor installation and shall be IP-68 for outdoor installation.

The busbars shall of high conductivity Copper, or Aluminum, as specified in the tender.

The maximum hotspot temperature rise at any point in the bus duct at continuous rated load shall not exceed 35 Deg.C above a maximum ambient temperature of as per Gandhinagar, Gujarat conditions in any position.

Where an earth conductor is required, it shall be a separate, integral earth conductor, of the same high conductivity material as the phase conductors,

It shall be possible to provide a 200% Neutral where specified.

Insulation:

The busbars shall be insulated throughout their length by epoxy coating / Mylar. The insulation material used shall be of minimum Class F (155 deg. C). The insulation must comply to UL 94 V-O. It shall be Halogen Free.

Housing:

The housing shall be made of extruded Aluminum case duly enameled/ electro-galvanized sheet steel, with an epoxy powder coated paint finish. The housing shall be profiled, to provide higher strength and efficient heat dissipation. The width of the housing shall preferably be the same for all ratings of busbars, in order to provide interchangeability of tap off boxes.

The joints between sections shall be made so as to provide flexibility during installation and expansion / contraction of busbar during operation. The joints shall be of the single bolt type

The joint construction must have the following features.

- Heat expansion of at least 3mm per joint.
- The joint insulation must be of one piece molded design and not have any cut edges which can absorb moisture.
- The joint construction must allow a +/- 14mm adjustment at the time of installation, for ease of adjusting to site measurement variations.
- The joint bolt must be insulated with a bolt insulator. The bolt insulator must be of molded one piece.
- The joint system must be designed in a way that the installer cannot insert the bus duct length too far and damage the bolt insulator.
- The busbar ends shall not have holes or slots at the joints – the electrical continuity shall be through pressure plates, achieving a high area of joint cross section and expansion capability.
- It shall be possible to install and remove the joints without disturbing the busbar run.

Tap off units:

Where specified, tap off locations shall be provided for insertion of plug in tap off units. The tap off locations shall be covered by hinged plates.

Tap off unit"s safety features:

- When the door cover is open, it should not be possible to turn the MCCB on. This should be by means of mechanical safety locking system and not by the rotary handle of the MCCB.
- The door shall be provided with a lock and keys.
- When the lever is in „on" position, even with the key unlocked, the operator should not be able to remove the box or open the tap off location cover.
- During insertion, the earth conductor shall make contact first before the phase conductors. This should follow the sequence of first in last out concept.
- The tap off unit handle shall be flexible in the sense that the „on/off" handle can be attached to the left or right side of the box or in front, depending on the site situation.
- When the box is open the live conductors shall be safe guarded by a transparent insulator plate which allows for visible inspection but does not allow touching of the live conductors.
- In the event of a MCCB requiring maintenance or changing, the mechanical interlocking must allow easy access by removing only the front plate and not interrupting the adjacent linkages.
- For IP65 bus-trunking, the tap off unit arrangement also must achieve IP65 without requiring any additional sealing at site. The complete arrangement with the tap off unit shall be tested for IP rating by an independent test authority.
- The tap off boxes will be suitable for accommodating MCCBs or other accessories, as required. The tap off units should allow the flexibility of accommodating different, reputed MCCB makes, to be mutually agreed depending on the tender requirements.

Accessories

A full range of accessories like bends, end flanges, end feed units, and support brackets etc. shall be available

Installation

Bus ducts running along the wall shall be supported at intervals not exceeding 1.5 m. In case of branching, there shall be support on all branches at a distance of 300 mm from the point of branching, Support shall not be less than 40 x 40 x 6 mm MS angle secured in an approved manner. Supports may also be provided in the form of brackets fixed to walls where the duct runs along

the wall. In case of ceiling suspended bus ducts, supports made out of 40x40x6 mm MS angle iron shall be provided. The horizontal distance between two such supports shall not be more than 1200 mm. The ducts supports shall be suspended from suitable approved suspension devices provided in the ceiling. Fire barrier shall be provided at each floor/wall crossing as per relevant IS code

Test at Site

The following tests shall be carried out at site and test results to be recorded:

- Insulation resistance shall be tested with 1000 V megger and shall be not less than 100 mega ohms.
- Earth continuity test

6 DISTRIBUTION PANELS/BOARDS

Main Distribution Panels, Sub-Distribution Panels and Final Distribution shall be covered under this section. Panels/Boards shall be suitable for operation on 3 Phase/single phase, 415/240 volts, 50 cycles, 4 wire system with neutral grounded at transformer. All switchgears shall be fully rated at an ambient of 40 Degree C.

The scope of supply covers design, manufacture, testing and supply of L V PCC Panels up-to 1000 V. Panels must conform to Totally Type Tested (TTA) as per IS 8623-1 / IEC 439-1 / EN 60439-1. Type Test Certificates for short circuit withstand of 65kA 1 sec along with ACB mounted in the Switchboards is mandatory for submission. Switchboard shall be suitable for Seismic Zone III / IV. The same shall be tested at ERDA / CPRI for seismic test.

Panels manufactured by System House/System Partner/channel Partner/Consortium/Joint venture will not be acceptable.

The equipment's covered under this specification shall conform to the latest revisions of relevant Indian and International Standards some of which are listed below.

IS 13947	1993 :	General requirements of Switchgear and Control Gear for Voltage not Exceeding 1000 / 1200V AC
IS 11353	1985 :	Guide for uniform system of marking Identification of Busbar and Terminals.
IS 13703	1993 :	Low voltage fuses
IS 2705	1992 :	Current transformers
IS 694	1990 :	PVC insulated cables for voltages including 1100 V with Copper and Aluminum conductor).

IS 1248	1983	:	Direct Acting Electrical Indicating Analog
IS 8623	1993	:	Low voltage Switch gear & control gear assemblies
IS 5082	:	:	Electrolytic Aluminum Busbar, Trunking system, Rod tubes & sections for Electrical purposes.
IS 13779	1999	:	AC Electric Meters / Static Meters.

Construction Features

The switch board shall be metal clad sheet steel enclosed cubicle, fully compartmentalized, floor mounting type suitable for indoor installations and extensible type.

The switch board shall be metal clad sheet steel enclosed cubicle, fully compartmentalized, floor mounting type suitable for indoor installations. All the doors and covers shall be fully gasket to prevent any ingress of dust. The enclosure shall be for Indoor type and completely dust, damp and vermin proof. Gasket used for all doors shall be of double lip type.

The switchboard cubicles shall have structural steel frame work enclosed on all sides and top by CRCA sheet steel of minimum thickness.

The switchboard shall have integral base frame.

Removable undrilled gland plates shall be fitted for bottom cable entry.

All fixing bolts, screws etc. appearing on the panel shall be so arranged as to present a neat appearance.

Door hinges shall be concealed type.

Front access shall be available to all components in each cubicle which require adjustment, maintenance or replacement.

Unless otherwise approved, incomer and bus section panels or sections shall be separate and independent and shall not be mixed with sections required for feeders.

Overall height of the panel shall not exceed 2.4 meters. Operating levers, handle etc. of highest unit shall not be higher than 1.7 meters.

Distribution panels shall be of adequate size as indicated in layouts with a provision of spare switchgear as indicated on the Single Line Diagram. Feeders shall be arranged in multi-tier. Knockout holes of appropriate size and number shall be provided in the Distribution panels in conformity with the location of cable/conduit connections. Removable sheet steel plates shall be provided at the top/Bottom to make holes for additional cable entry at site if required.

Every cabinet shall be provided with Trifoliate or engraved metal name plates. All panels shall be provided with circuit diagram engraved on PVC sheet. All live accessible connections shall be shrouded and shall be finger touch proof and minimum clearance between phase and earth shall be 20 mm and phase to phase shall be 25 mm.

Cubicle panels with more than 1000 Amps BUS shall be made of tested structural modular Sections.

Bus Bar & insulating materials

The busbars connections and bus taps to individual feeders shall be by means of electrolyte aluminium / copper bus bar. Busbars shall be colour coded for ready identification of phases. The Busbar sizes shall be determined taking into consideration the continuous rating and fault level of 65 KA (1 sec) without exceeding the final temperature of 105o C under rated current.

Auxiliary busbars each of minimum 25 sq. mm thick electrolytic tough pitch copper shall be provided for following applications. Exact number of busbars shall depend on various controls, metering and auxiliary power distribution requirements.

Panel / Motor space heater supply – 230 V AC (2 wires).

AC / DC control supply for breaker tripping closing and indication circuits. Control supply for breaker spring charging motors, closing coil & indication. Control supply for motor starter control circuits.

Neutral Busbar shall be provided in a separate compartment other than main Busbar compartment.

The busbars shall be supported of regular intervals using SMC or DMC insulators It should have Very high Comparative Tracking Index (CTI > 600 as per IS 2824). Only zinc passivated high tensile strength steel bolts, nuts & washers etc ... shall be used for all bus-bar joints & supports. The busbars shall be colour coded using identifying colour rings at regular interval. Red, Yellow & Blue colour shall be used for phases & Black for neutral. The earth Busbar shall be identified with Green colour rings at regular intervals. Minimum clearance between phases / live parts shall be 25 mm and phases / live parts / neutral to ground shall be 19 mm except on the equipment terminals.

Spare contacts shall be wired up to terminal block. Auxiliary contacts in the „trip“ circuit shall close before the breaker main contacts close and shall open after the main contacts have opened. All other contacts shall operate simultaneously with the main contacts.

Small Wiring

All small wiring for Controls, Indication etc. shall be of FRLS (Flame retardant Low Smoke) copperconductor cables. Minimum size of conductor for power circuits shall be 2.5 sq. mm copper or 6 sq. mm aluminum. All control wiring except CT secondary wiring shall be carried out with minimum 1.5sq. mm copper conductor. CT secondary wiring shall be carried out with 2.5 sq. mm copperconductor. All wiring shall be securely fixed and neatly arranged to enable easy tracing of wires. All terminal blocks and wires shall be tagged/ Ferruled at both the ends for identification in accordance with IS 11353. All wiring for external connections shall be brought out to the individual terminals on a readily accessible Terminal block; all terminal block shall be shrouded or provided with transparent covers. Clamp type control terminal blocks shall be provided for outgoing control cables. Minimum 10% spare terminals shall be provided for future use. **Control terminal block shall be separated from power terminal blocks by means of an insulating barrier**

Earthing

Earthing - Two earth terminals shall be provided on each side of switchboard. An earth bar size must be at least 50 x 10 mm Aluminium suitable for 30kA for 1 sec. shall be provided. The earth bar shall be electrically continuous and shall run the full extent of each board. This earth bar shall be on the same side as the cable entry. Each unit shall be constructed to ensure satisfactory electrical continuity between all metal parts not intended to be alive and earth terminals of the unit. Suitable holes with bolts and nuts shall be provided at each end of earth bar of switchgear for connection to a main Earthing grid. The earth bar shall be accessible in each cable entering compartment either directly or through a branch extension to ground the cable armour and shields. 10 mm \varnothing holes shall be drilled and hardware for connection provided through the earth bus.

Cable Terminations and Marshalling Box

Cable entry to switchgear shall be from top/bottom of the switchgear or as specified in the technical particulars. Ample space shall be provided in the cable compartment to accommodate XLPE insulated aluminum conductor cable as specified in the technical particulars.

Removable undrilled gland plate shall be provided for termination of Cables

Painting and Finishing

All metal works and metal parts of the switchboards shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphatising, passivating and then sprayed with a high corrosion resistant primer. The finishing treatment shall be by application of synthetic Light Grey Shade.

Name Plates & Label

One name-plate giving designation of the switchboard shall be affixed prominently on top. Details of designation shall be specified. Labels giving following details shall be affixed on each feeder panel

- Feeder No - As per feeder list
- Equipment tag Number and Description
- Rating (KW/KVA/AMP)

All components whether mounted inside the switchboard or on the door shall be permanently and clearly labeled with reference number and/or letter of their function. Labels for feeder panel designation shall be fixed on the front side of respective panels with Special rivet made of nylon. These labels shall be identical size to permit interchange.

Testing and Inspection

The following tests shall be carried out at manufacturer's works and intressed by Buyer:

- All routine tests specified in relevant Indian Standards and witnessed by buyer.
- Vendor shall submit all following type test report which are less than 5 years old and as per latest IS & IEC Standards:
 - Short Circuit withstand test for main Busbar and neutral Busbar
 - Temperature rise test

- IP test
- Seismic test
- Operation of all meters.
- Secondary wiring continuity test with a low voltage (6 volts) tester.
- Insulation test with 1000 volts megger, before and after H. V. test.
- H. V. test at 2.5 kV for 1 mte.
- Earth continuity test with a low voltage (6 volts) tester.
- Simulating control circuits for various operations of feeders
- C. T. Polarity Test.

Technical Requirements - PCC

General Requirements

Service	:	Indoor
Enclosure	:	CRCA sheet steel
Min Degree of Protection	:	IP 42
Execution	:	Double front
3. Incomer ACBs & Bus Couplers	:	Electrical Operated - Draw out
3. Outgoing ACBs	:	Electrical Operated - Draw Out
Outgoing / Motor Feeders	:	Non Draw-out
Extensibility	:	Extensible on both sides

Enclosure

Sheet steel thickness (mm)	:	Base frame/channel – 2.5 mm Load Bearing member - 2 mm Internal partitions - 1.6 mm
Surface treatment	:	7 Tank surface treatment.
Painting	:	Epoxy painted.
Paint shade	:	Light Grey

Main Busbar

3. Material	:	Electrical grade Aluminium Rated
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continuous current	:	As per TTA design certification
Maximum operating Rated short time current (kA- RMS)	:	65 kA sym for 1 Sec. Rated dynamic short
circuit withstand (Pk)	:	140 kA peak
Heat shrinkable sleeving	:	Yes with Shrouds for Joints Current
rating of vertical busbar	:	As per requirement droppers in vertical section
Busbar support	:	SMC/DMC

Earth Bus

Material	:	Aluminium 50 x 10 Sq.mm size (min.)
Short circuit capacity (KA)	:	39kA current for 1 Sec.

Air Circuit Breakers (ACB)

The ACB shall conform to the requirements of IEC 60947-2 / IS 13947-2 ,VDE 0660 Part 101, IEC 68 Part 2-30 (climate –proof) .The circuit breaker shall be suitable for 415 V + 10%, 50 Hz supply system and ambient temperature of 50 Deg C without any deration. Air Circuit Breakers shall be with moulded housing flush front, draw out type and shall be provided with a trip free manual operating mechanism or as indicated in drawings and bill of quantities with mechanical "ON" "OFF" "TRIP" indications.

3. The ACB shall be 3/ 4 pole with modular construction, draw out, manually or electrically operated version as specified. The circuit breakers shall be for continuous rating and service short Circuit Breaking capacity (Ics) shall be as specified on the single line diagram and should be equal to the Ultimate breaking capacity(Icu) and short circuit withstand values(Icw) for 1 sec.

All ACB shall be suitable for reverse fed without compromising on the performance.

Circuit breakers shall be designed to „close' and `trip' without opening the circuit breaker compartment door. The operating handle and the mechanical trip push button shall be at the front of the breakers panel and shall be integral part of ACB. Inspection of main contacts should be possible without using any tools. The ACB shall be provided with a door interlock. i.e. door should not be open when circuit breaker is closed and breaker should not be closed when door is open. The control panel of ACB along with its operating device shall project through cutout in the door. The door cutout shall be provided with suitable gasket for IP40 protection.

All current carrying parts shall be silver plated and suitable arcing contacts with proper arc chutes shall be provided to protect the main contacts.

3. All electrical closing breaker shall be with electrical motor wound stored energy spring closing

mechanism with mechanical indicator to provide ON/OFF status of the ACB. Electrical operating mechanisms shall be suitable for remote operation

The auxiliary contacts blocks shall be so located as to be accessible from the front. The auxiliary contacts in the trip circuits shall close before the main contacts have closed. All other contacts shall close simultaneously with the main contacts. The auxiliary contacts in the trip circuits shall open after the main contacts open. Minimum 2 NO and 2 NC auxiliary contacts shall be provided on each breaker for external purpose. It shall be possible to add 2 more NO and 2 NC contacts later.

All ACBs shall have Rated Impulse withstand voltage of the main circuit of not less than 8kV (Uimp) & Rated Insulation Voltage of not less than 1000 V.

3. All ACBs shall have their Electrical Life with maintenance = Mechanical Life. Minimum no. of operational life shall be as follows:

- 3. For Ratings up to 2500A: 16,000 mechanical & 10000 electrical Operations;
- 3. For 3200A & 4000A : 12,000 mechanical & 4000 electrical Operations;
- For 5000A & 6300A : 5,000 mechanical& 2000 Operations

3. The ACB (draw out or non-draw out) shall provide as a standard feature the following mechanical or electrical indicator on the front panel:

- Contact position indicator (ON / OFF)
- Stored energy status indicator
- Connected / Test / Disconnected position. (DO version)
- Trip indication on fault
- 3. OK Indicator (Mechanical) on the front panel of the Circuit breaker when the trip or OFF conditions are cleared and The Circuit breaker can be closed on "ON" command (Manual or Electrical)

Operating Mechanism:

3. The ACB shall be either manually or electrically operated as specified. Stored energy mechanism shall be provided in all cases to ensure independent closing of the breaker. Electrical operating mechanisms shall be suitable for remote operation.

ACB shall be provided with mechanical anti-pumping feature.

a) **Cradle**

The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. The movements shall be free from jerks, easy to operate and shall be on steel balls/rollers and not on flat surfaces.

There shall be 4 distinct and separate position of the circuit breaker on the cradle. Racking Interlock in Connected/Test/Disconnected Position.

Service Position : Main Isolating contacts and control contacts of the breaker are engaged.

Test Position : Main Isolating contacts are isolated but control contacts are still engaged.

Isolated Position : Both main isolating and control contacts are isolated.

There shall be provision for padlocking the breaker in any or all of the first three positions. The following safety features shall be incorporated:

- Withdrawal or engagement of Circuit breaker shall not be possible unless it is in open/OFF condition.
- Operation of Circuit breaker shall not be possible unless it is fully in service, test or drawn out position.
- All modules shall be provided with safety shutters operated automatically by movement of the carriage to cover exposed live parts when the module is withdrawn.
- All Switchgear module front covers shall have provision for locking.
- Switchgear operating handles shall be provided with arrangement for locking in „OFF“ position.
- Mechanical „ON“ pushbutton shall have suitable locking arrangements for carrying out maintenance of downstream load.
- “OK” signal (on breaker front panel) interlocking to ensure the breaker shall get closed only when vital interlocking are checked & found OK.

The ACB shall have trip free mechanism which prevents the operating mechanism from interfering with the tripping or opening action. Castell key lock if asked for shall be provided on the ACB itself. It should be possible to remove Castell key only when breaker is in OFF condition. All the vital accessories like Shunt, Motor, and Under Voltage coils shall be accessible from the front and should not need removing of the breaker from its panel for the replacement.

b) **Protections**

The ACB shall be equipped with an integral self-powered microprocessor based current release, which works on true R.M.S values for ensuring accurate protection. The microprocessor-based release should have integral LCD display of phase and neutral currents and also the maximum loaded phase. The display should be visible with a minimum 20% loading of the phase currents. Henceforth in this document the release shall be referred to as the Over current release.

The protection unit should meet the EMI/EMC requirement as per latest standard.

Integral Test facility to test healthiness of release and the trip circuitry shall be provided on the Overcurrent release.

3. The breaker shall offer complete over current protection to the electrical system in the following four zones:

- Long time protection.
- Short time protection with intentional delay.
- Instantaneous protection.
- Ground fault protection.

The protection release shall generally have following features and settings **however for exact**

requirement of protection releases, reference shall be made to SOQ:

Thermal Memory

When the breaker shall reclose after tripping on overload, then the thermal stresses caused by the overload if not dissipated completely, shall get stored in the memory of the release and this thermal memory shall ensure reduced tripping time in case of subsequent overloads. Realistic Hot/Cold curves shall take into account the integrated heating effects to offer closer protection to the system.

Defined time-current characteristics:

A variety of pick-up and time delay settings shall be available to define the current thresholds and the delays to be set independently for different protection zones thereby achieving a close-to-ideal protection curve.

Trip Indication

Trip indicators shall be provided to display the exact nature of fault (i.e. O/L, S/C, and E/F) that caused tripping of circuit breakers. The circuit breaker will have to be necessarily with mechanical re-closing lockout. The trip indication shall need no external power supply for display.

Self powered

The release shall draw its power from the main breaker CTs and shall require no external power supply for its operation.

It should be possible to carry out testing of release without tripping the breaker. The setting range of release shall be generally as follows:

Type of Protection	SETTING RANGE OF RELEASE	
	PICK-UP CURRENT	TIME DELAY
Long Time	40% to 100% of the nominal current rating of the breaker in steps of 5% of nominal current rating of breaker.	0.5 to 30 sec at 6 I _r Steps 2-3.5-5.5-8-10-14-17-21-25-30 s.
Short Time	125% to 1200% of the nominal current rating of circuitbreaker. Short Circuit protection shall have standard phase failure protections for motor application.	M-100-200-300-400 ms

Instantaneous	150% to 1200% of the nominal current rating of the breaker.	
Ground Fault	Have adjustable current setting in absolute values	100 ms to 400 ms There should be provision to disable the Earth Fault Protection if required.

Neutral Protection shall be provided for 3P as well as 4P ACB. The Neutral protection shall be dependent on the phase current and typical protection range shall be either 50% or 100%. It shall be possible to change the release settings on-line.

All **incomer** ACBs shall have following additional protections other than mentioned above.

- Under voltage
- Undercurrent, (for DG set only)
- Reverse power (for DG set only)
- Phase sequence reversal (for DG set only)
- Load shedding and reconnection thru programmable contacts.
- Release should be self powered.

All **O/G** ACBs shall have following functions.

Protection

The ACB control unit shall offer the following protection functions as standard:

- Long-time (LT) protection with an adjustable current setting and time delay;
- Short-time (ST) protection with an adjustable pick-up and time delay;
- instantaneous (INST) protection with an adjustable pick-up and an OFF Position.
- Current and time delay setting shall be indicated in amperes and seconds respectively on a digital display.
- Earth-fault protection with an adjustable pick-up and time delay shall be provided if indicated on the appended single-line diagram.

Safety Features

- The safety shutter shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle.
- It shall not be possible to interchange two circuit breakers of two different thermal ratings. For Draw-out breakers, an arrangement shall be provided to prevent rating mismatch between breaker and cradle.
- There shall be provision of positive earth connection between fixed and moving portion of the ACB either thru connector plug or sliding solid earth mechanism. Earthing bolts shall be provided on the cradle or body of fixed ACB.
- The incoming panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, digital voltmeter and ammeter of size not less than 96 mm x 96 mm, selector switches, MCB for protection circuit and measuring instrument circuits.
- It shall be possible to bolt the draw out frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration and shocks.
- Draw out breakers should not close unless in distinct Service/Test/Isolated positions.
- The insulation material used shall conform to Glow wire test as per IEC60695.
- 3. The ACB shall provide in built electrical and mechanical anti-pumping.
- All EDO ACB's Shall have Ready to Close Contact to ensure that the ACB gets a command only when it is ready to close for applications of Remote Control, AMF, Synchronization and Auto Source Change Over Systems.

Moulded Case Circuit Breaker (MCCB)

The MCCB should be current limiting type with trip time of less than 10 msec under short circuit conditions. The MCCB should be either 3 or 4 poles as specified in BOQ. MCCB shall comply with the requirements of the relevant standards IS13947 – Part 2/IEC 60947-1&2 and should have test certificates for Breaking capacities from independent test authorities CPRI / ERDA or any accredited international lab.

The MCCB shall be rated at operational voltage of 415V, 50/60Hz supply system, and 40°C ambient temperature. In case of deration due to operating temperature the same should be indicated and should be done in line with the required ratings of MCCB

MCCBs shall be available in fixed or plug-in/withdrawable versions as well as in 3-pole and 4-pole versions. For plug-in/withdrawable versions, a safety trip shall provide advanced opening to prevent connection and disconnection of a closed circuit breaker.

3. MCCBs shall be designed for both vertical and horizontal mounting, without any adverse effect

on electrical performance. It shall be possible to supply power either from the upstream or downstream side.

MCCB shall comprise of Quick Make -break switching mechanism, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses

Beyond 300Amps capacity MCCBs shall have positive isolation and preferably double break / contact repulsion & double insulation features.

The breaking capacity of MCCB shall be as specified in the schedule of quantities. The rated service breaking capacity (Ics) should be equal to rated ultimate breaking capacities (Icu).MCCBs for motor application should be selected in line with Type-2 Co-ordination as per IEC-60947-2, 1989/IS 13947-

1. The breaker as supplied with ROM should meet IP54 degree of protection.

a) **Current Limiting & Coordination**

The MCCB shall employ maintenance free minimum let-through energies and capable of achieving discrimination up to the full short circuit capacity of the downstream MCCB. **The manufacturer shall provide relay co-ordination document through power distribution software equivalent to SIMARIS design or Amtech.**

Protection Functions

MCCBs with ratings up to and including 160 A shall be equipped with thermo magnetic trip units in order to ensure the protection against overload and short-circuit.

The ratings above 160A shall be equipped with electronic trip unit which should be interchangeable in line with the requirement of the application.

Electronic and thermal-magnetic trip units shall be adjustable and it shall be possible to fit lead seals to prevent unauthorized access to the settings

MCCBs, the current ratings of which are identical with the ratings of their trip units, shall ensure discrimination for any fault current up to at least 16 kA rms

Protection settings shall apply to all circuit breaker poles

Thermal-magnetic trip units (up to and including 160 A) shall have adjustable thermal protection from 0.8 to 1.0 times the current rating, Adjustable magnetic protection for current setting values from 10 to 15 times of rated current. It shall be possible to ensure neutral protection. The tripping threshold shall be equal to that of the phases or to a reduced value (generally half of that of the phases). Thermal magnetic MCCBs shall be provided with identification facility for short circuit fault. Electronic trip units (above 160 A) shall be modular offering the flexibility of replacement at site as per the requirement of the load shall have Long time protection (LT), Selectable Ir threshold settings from 40% to 100 % of the trip unit rating, Short time protection (ST) and Ii threshold shall be adjustable from 4 to 8 times the thermal setting Ir.

electronic trip units shall have integral LED for load indication, indicating (Green indication) 70

%

,80% , 110% , & above 110% of I_r , and trip condition with (Red indication), a test connector shall be installed for checks on electronic and tripping mechanism operation using an external device.

In the event of repeated overloads, the electronic trip unit shall optimize protection of cables and downstream devices by memorizing temperature variations.

Microprocessor and thermal-magnetic trip units shall be adjustable and it shall be possible to fit leadseals to prevent unauthorized access to the settings

Protection settings shall apply to all poles of circuit breaker.

Additional details for individual accessories

a) Internal Accessories

Functions

3 different types of auxiliaries shall be available:

Auxiliary Switch Signalling Switch Lading contact

Shunt Trip - continuous rated, with wide band site selectable voltage (24-48V AC/DC or 110V DC or 230-500V AC or 230V DC)

Under voltage Release- continuous rated, with wide band site selectable voltage (24-48V AC/DC or 110V DC or 230-500V AC or 230V DC)

3. Mounting electrical auxiliaries should not affect the performance of the breaker. Each auxiliary shall be provided with a proper packaging and instruction notice.

b) Mounting and IP

3. The electrical auxiliaries shall be field installable.

3. Electrical auxiliaries shall be easily and rapidly snapped inside the breaker without any tool, behind the auxiliary cover.

Lead-wires shall not affect the mounting of the breakers side by side. When auxiliary cover is opened:

- Auxiliaries are held in place by themselves,
- When auxiliaries are mounted, protection against electric shock must be IP20 or IP30.

c) External accessories

Mounting accessory on the breaker shall not affect its performances. Accessories shall be field installable.

Each accessory shall be provided with a proper packaging and instruction notice.

d) Phase barriers

Phase barriers shall be mounted without any tool and hold in place firmly. They Mounted between phases of a breaker and between breakers mounted side by side. The phase barriers shall be made of an isolating material and should be flexible.

e) Terminal shields

Terminal shields shall be mounted without any tool and hold in place firmly. They shall be made of an isolating material. There shall no requirement of special tool to replace the terminal covers.

f) Direct rotary handle

Standard

The rotary handle mounted on the breaker shall meet the IEC60947-2 requirements and will not affect the performance of the breaker. The rotary handle shall meet IEC60447. When the breaker is mounted with a rotary handle, the isolation function remains and fulfils IEC60947-2.

Installation

The direct rotary handle shall be mounted easily and rapidly on the breaker on site without removing any part of the breaker or external accessories. The rotary handle shall be mounted easily on 2, 3 and 4 pole breakers.

Operation. The rotary handle shall indicate the position of the breaker: OFF, TRIPPED or ON.

Door should have a door defeat facility to open when the circuit breaker is ON in case of emergency. The door cannot be open if the breaker is ON.

g) Extended rotary handle

Standard

The rotary handle mounted on the breaker shall meet the IEC60947-2 requirements and will not affect the performance of the breaker.

The rotary handle shall meet IEC60447.

When the breaker is mounted with a rotary handle, the isolation function remains and fulfils IEC60947-2.

Installation

The mounting of the rotary handle should be done without removing the breaker if mounted on its back plate.

The rotary handle shall be mounted easily on 3 and 4 pole breakers.

The rotary handle shall have pad locking facility in OFF position to take care of the lock outs

The rotary handle shall also provide door defeat facility to open the door for emergency requirement in ON position. Operation

The rotary handle shall indicate the position of the breaker: OFF, TRIPPED or ON.

h) Plug-in mounting Standard

When the breaker is mounted on a plug-in, the system remains and fulfils IEC60947-2. Installation

The device shall include the complete accessories for assembling the circuit breaker in plug-in

design.

Interlocking connecting rod shall be provided ensuring automatic switching off the circuit breaker for handling –inserting & removal.

The plug in device and circuit breaker shall be provided with a keying set, which prevents inserting any other circuit breaker into the plug-in device.

The plug-in device shall be provided with position signalling switch

i) With draw able mounting

When the breaker is mounted on a with draw able mounting, the system remains and fulfils IEC60947-2.

Installation

The device shall include the complete accessories for assembling the circuit breaker in with drawable mounting design.

Interlocking connecting rod shall be provided ensuring automatic switching off the circuit breaker for handling –inserting & removal.

The with draw able mounting and circuit breaker shall be provided with a keying set or locking facility, which prevents inserting any other circuit breaker into the plug-in device.

The with draw able mounting shall be provided with position signalling switch and also the visual indication indicating for inserted, withdrawn & removed positions.

j) 4.1.11 Mechanical interlocking

The mechanical interlocking facility shall have following options

- front mounting mechanical interlocking and parallel switching
- Bowden wire interlock

k) 4.1.12 Motorised drive

The motorised drive with stored energy arrangement shall be available for remote operation requirements

The motorised drive shall have following features

- Auto /Manual selection switch with locking facility
- ON/OFF indication contacts
- Spring charging indication

l) Testing

- Original test certificate of the MCCB as per IEC 60947-1 & 2 or IS13947 shall be furnished.
- Pre-commissioning tests on the switch board panel incorporating the MCCB shall be done as per standard specifications.

Multifunction meters

a) Multifunction Meters (For Incomer ACB & MCCB Feeders)

The meters shall conform to IEC 61557-12, IEC 62053-22, and IEC 62053-23 standards General Requirements

- The meter shall be suitable for operation in single - or multi- phase networks, balanced as well as unbalanced load
- It shall be possible to use the multifunction meter directly in 690V networks
- The current inputs shall be configurable at site for measuring on x/1 A or x/5 A current transformers
- The multifunction meters shall be suitable for operation up to 55 Deg C
- The meters shall be suitable for operation with AC auxiliary power and shall have wide tolerance band of 95V to 240 V ($\pm 10\%$)
- The multifunction meters shall have high degree of protection (IP65 from the front) against ingress of dust & water
- The multifunction meters shall have backlit LCD display with adjustable contrast
- The meter shall be tamper-proof (password protected) to avoid mishandling by unauthorized person
- The entire multifunction meter should be IP based and can be hooked up to existing Intranet.

Technical Requirements

- All meters should be with accuracy class 0.2 at least.
- Meters must have an Ethernet port onboard for communication over Modbus TCP/IP protocol.
- All Gateways or converters shall be avoided for sending the data to SCADA Server.
- 3. All basic electrical parameters (Current, Voltage, Power, Frequency, Power factor) should be

available on display as well for communication with EMS software.

- All Meters should have inbuilt and / or expandable Digital input, output for reading the breakerstatus (Trip / ON / OFF) on inputs and remote ON/OFF of breakers.
- Power Monitoring Device must have Battery back up to save data in inbuilt memory (i.e. DailyEnergy Counters and Event log reports) which can be retrievable in excel Format
- Digital inputs shall be self wet or by external 24V DC / AC safety extra low voltage power supply.
- Digital outputs shall be able to drive contactor or a relay contact. Also outputs shall be usable with limit or Boolean logic of multiple limits overflow or underflow and limit function shall be parametrical for value, parameter, underflow or overflow and hysteresis.
- All meters shall have possibility of remote parameterization & monitoring using the software apart from front fascia programming using soft keys
- All metered values will be in "true RMS" values. The monitor shall include a keypad allowing for the viewing of different selected values. The monitor shall display the following values

Voltages	Phase-phase / phase-neutral
Currents	Per phase
Apparent, active and reactive power	Per phase and total
Power factor	Per phase and total
Frequency	45...64 Hz
THD for voltage and current	Per phase
Min. / max. values	Voltage - phase-phase, phase-neutral, Current / Power / Power factor / THD per phase, Frequency, Three phase average voltage and current
Average values	Voltage - phase-phase, phase-neutral Voltage min. / max. : for phase-phase, phase-neutral Current: Current min. / max.
Active energy	Import / export; high / low tariff
Reactive energy	Positive / negative; high / low tariff
Apparent energy	High / low tariff

Energy demand per measuring period	Three phase average rating for active and reactive power: 1 to 60 min.
Min. / max. rating values within the measuring period	Should be possible to be measured
Meter running counter	Uptime in hours
Universal counter	Pulse counting of external devices likewater, gas, etc.

b) Multifunction Meters (For Outgoing ACB & MCCB Feeders)

The meters shall conform in all respects to International standards – IEC 61557-12, IEC 62053-22, IEC62053-23 or the relevant Indian standards with latest amendments thereof.

General Requirements

- The meter shall be suitable for operation in 3 - phase networks, balanced as well as unbalanced load
- It shall be possible to use the multifunction meter directly in 480V networks
- The current inputs shall be configurable at site for measuring x/5 A current transformers
- The multifunction meters shall be suitable for operation up to 55 Deg C
- The meters shall be suitable for operation with AC auxiliary power and shall have wide tolerance band of 100V to 240 V (±10%)
- The multifunction meters shall have high degree of protection (IP65 from the front) against ingress of dust & water
- The multifunction meters shall have backlit LCD display with adjustable contrast
- The meter shall be tamper-proof (password protected) to avoid mishandling by unauthorized person
- All metered values will be in "true RMS" values. The monitor shall include a keypad allowing for the viewing of different selected values. The monitor shall display the following values

Voltages	Phase-phase / phase-neutral
Currents	Per phase / neutral
Apparent, active and	Per phase and total

reactive power	
Power factor	Total
Frequency	45...65 Hz
Min. / max. values	Voltage - phase-phase, phase-neutral/ Current/ Neutral current/ Power/ Power factor/ Frequency
Active energy	Import/ export/ net
Reactive energy	Import/ export/ net
Energy demand per measuring period	Three phase average rating for active and reactive power: 1 to 60 min.
Min. / max. rating values within the measuring period	Should be possible to be measured

c) Measurement Accuracy

The multifunction meters shall be of high accuracy type and shall have the following levels of accuracy. (Accuracy class in accordance with IEC 61557-12:2007-08)

Voltage	Class 1
Current	Class 1
Power	Class 1
Power factor	Class 2
Active energy	Class 1 in accordance with IEC 62053-22:2003-01
Reactive energy	Class 3 in accordance with IEC 62053-23:2003-01

The meter shall have at least 2 Digital Input and 2 Digital Output as standard

d) Communication

The meters shall have inbuilt RS485 MODBUS RTU. It shall be possible to parameterize the device either by the keys on the device or through parameterization software.

Analogue Meters

All voltmeters and ammeters shall be flush mounted of size minimum 96 mm conforming to class 1.5 of IS:1248 for accuracy.

- All voltmeters and indicating lamps shall be through MCB's.

- Meters and indicating instruments shall be flush type.
- All CT's connection for meters shall be through Test Terminal Block (TTB).
- CT ratio and burdens shall be as specified on the Single line diagram.

Current Transformers

Current transformers shall be provided for Distribution panels carrying current in excess of 60 amps. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondary's for operation of associated metering.

The CTs shall conform to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class I.

Potential Free Contacts

Potential free contacts shall be provided for connection to Building Automation System in panels indicated in Schedule of Quantities.

Indicating Panel

All meters and indicating instruments shall be in accordance with relevant Indian Standards. Meters shall be flush mounted type. Indicating lamps shall be of low burden, and shall be backed up with 2 amps MCB/MPCB as per relevant fault level and toggle switch.

On all the incomers of panels, ON/OFF indicating LED lamps shall be provided and shall be suitable for operation on AC supply. Phase indicating LED lamps shall be associated with necessary ON/OFF toggle switch

Motor Protection Circuit Breaker (MPCB)

Motor circuit breakers shall conform to the general recommendations of standard IEC 947 -1,2 and 4 (VDE 660, 0113 NF EN 60 947-1-2-4, BS 4752) and to standards UL 508 and CSA C22-2 N°14.

The devices shall be in utilization category AC-15, conforming to IEC 947-2 and AC3 conforming to IEC 947-4. MPCB shall have a rated operational and insulation voltage of 690V AC (50 Hz) and MPCB shall be suitable for isolation conforming to standard IEC 60947-2 and shall have a rated impulse withstand voltage (Uimp) of 6 kV. The motor circuit breakers shall be designed to be mounted vertically or horizontally without derating. Power supply shall be from the top or from the bottom. In order to ensure maximum safety, the contacts shall be isolated from other functions such as the operating mechanism, casing, releases, auxiliaries, etc, by high performance thermoplastic chambers. The operating mechanism of the motor circuit breakers must have snap action opening and closing with free tripping of the control devices. All the poles shall close, open, and trip simultaneously. The motor circuit breakers shall accept a padlocking device in

the “isolated” position.

The motor circuit breakers shall be equipped with a “PUSH TO TRIP” device on the front enabling the correct operation of the mechanism and poles opening to be checked. The auxiliary contacts shall be front or side mounting, and both arrangements shall be possible. The front-mounting attachments shall not change the breaker surface area. Depending on its mounting direction the single pole contact block could be NO or NC. All the electrical auxiliaries and accessories shall be equipped with terminal blocks and shall be plug-in type. The motor circuit breakers shall have a combination with the downstream contactor enabling the provision of a perfectly co-ordinated motor-starter. This combination shall enable type 1 or type 2 co-ordination of the protective devices conforming to IEC

60947-4-1. Type 2 co-ordination shall be guaranteed by tables tested and certified by an official laboratory: LOVAG (or other official laboratory). The motor circuit breakers, depending on the type, could be equipped with a door-mounted operator which shall allow the device setting. The motor circuit breakers shall be equipped with releases comprising a thermal element assuring overload protection and a magnetic element for short-circuit protection. In order to ensure safety and avoid unwanted tripping, the magnetic trip threshold (fixed) shall be factory set to an average value of $12 I_r$.

All the elements of the motor circuit breakers shall be designated to enable operation at an ambient temperature of 55°C without derating. The thermal trips shall be adjustable on the front by a rotary selector. The adjustment of the protection shall be simultaneous for all poles. Phase unbalance and phase loss detection shall be available. Temperature compensation (-20°C to $+55^{\circ}\text{C}$). It shall be possible to add accessories like short circuit signaling contact, shunt release, under voltage release and auxiliary contact.

Miniature Circuit Breaker (MCB)

Miniature Circuit Breaker shall comply with IS-8828-1996/IEC898-1995. Miniature circuit breakers shall be quick make and break type for 240/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall be classified (B, C, D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values. MCB shall ensure complete electrical isolation & downstream circuit or equipment when the MCB is switched OFF.

The housing shall be heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP, TPN and 4 Pole miniature circuit breakers shall have a common trip bar independent to the external operating handle.

List of Approved Make- Electrical Works		
Sr. No.	Product	Make
1	Wires (PVC Insulated copper conductor cable FRLS – ISI marked)/ Telephone cables / Submersable cables/ Co- axial/TV cables	Havells / Finolex / KEI / L&T / RR Kabel
2	PVC Conduits (ISI marked)	Precision / AKG / BEC / GM / Sudhakar
3	Steel Conduit (ISI marked)	BEC / Bharat / Gupta / AKG / Precision
4	MCB DBs/ Industrial Socket outlets/	Lauritz Knudsen / SIEMENS / Schneider / M/s ABB/
5	MCBs/RCBO/ Isolators	Lauritz Knudsen / SIEMENS / Schneider /M/s ABB/
6	MCCBs	Legrand / Hager / Lauritz Knudsen / SIEMENS / Schneider / Havells (STADX)/ M/s ABB/
7	LAN cable (Structured Cabling)	Panduit / Belden / Schneider / Systimax(COMMSCOPE) / Molex / Legrand / Extreme
8	Fibre Management System	Panduit / Belden / Schneider / Systimax(COMMSCOPE) / Legrand
9	Modular Switches/ Sockets/ TV Socket/ Telephone sockets/ Data sockets/ Electronic Regulators/ AC Starter Switch etc.	Legrand (Myris) / MK (Blenze plus) / Panasonic (Vision) / Havells(Crabtree) / Wipro: Northwest : Stylus+
10	Celing rose	Antex / Leader / Emperor / Anchor
11	PVC batten/ Angle Holders	Aristo / Antex / Prakash / Kinjal / Anchor
12	Exhaust fans	Havells / Crompton / Orient / Bajaj / Almonard / Atomberg / Havells / Crompton / Orient / Bajaj / Almonard / Atomberg
13	Fans	Orient / Crompton / Havells / Atomberg / Khaitan : MERLIN HI SPEED / Almonard / Crompton: Wmhiflo wave (Hi Speed) / Orient: Snow Fall 16WA01
14	LED Luminaries including Street light fittings (ISI Marked)	Phillips / Wipro / Crompton greaves / Bajaj / Havells / K Lite
15	Decorative street light pole	Philips / K Lite / Bajaj / Disano / Twinkle / Utkarsh
16	HT & LT cables	M/s Finolex, M/s Universal, M/s KEI, M/s havells, M/s polycab

17	Raising mains , Bus Trunking (Sandwich / Air insulated)& Tap- Off boxes	Schneider / Legrand / C&S / SIEMENS
18	Glands / Lugs	Dowells / Comet / Jaison
19	GI pipes	Tata / Jindal / Zenith / Surya / SAIL
20	High Volume low speed fans	Kelley / Kale Brayan / EcoAir / Macroair / Big Ass
21	Weather proof boxes	Obo Betterman / Hensel / Legrand / C & S Electric
22	DWC Pipes	TeleRex / Dutron / Duraline / CPE
23	Day light/ Occupancy Sensor	Legrand / Schneider / Johnson Control / ABB / Lutron / Hager / Wipro / Bajaj / Philips
24	Water Purifier	Eureka Forbes / Kent / Ion Exchange / LG
25	Electrical Geyser	Racold / A.O. Smith / Crompton / Bajaj / V Guard
26	Emergency lightning system, components and Fixtures	Hochiki / Cooper / Tecknoware / ASM / TM
27	Lighting Control System	ABB / Schneider / Siemens / Philips
28	Starter	LEGRAND / L&T / SEIMENS/ / C&S Electric
29	6 mtr. Long Octogonal Pole	Laasma / BAJAJ / Utkarsh / Valmount / Crompton/ K lite
30	Openwell submersible pumpset I.E4	TEXMO / KSB / KIRLOSKAR
31	Flat Submersible cable	Havells / KEI / Gloster / Finolex/ / RR Kabel
32	Starter	LEGRAND / L&T / SEIMENS / / Eaton / BCH /C&S Electric
33	UPS SYSTEM	NUMERIC / SCHNEIDER / ABB / LEGRAND / SOCOMEC
34	SMF BATTERIES	AMARA RAJA / ROCKET(MADE IN MALAYSIA/ VIETNAM) / EXIDE / PANASONIC / AMCO / HBL
35	Transformers	ABB / Areva / Kirloskar/ Schneider/ M/s Voltamp Electricals & Voltamp Vadodara/ M/s Telawane
36	HT Panels	ABB / Siemens / L & T / Schneider / System control / Kirloskar
37	MV/ LT Panels	TTA/ CPRI Fabricators with panels cleared by CPRI/ M/s Swati switchgear/ M/s Active Power/ M/s Astek Electrical/ M/s Shiv shakti/ M/s Soham Elec Infra/ M/s G sons power/ M/s Pragati switchgear/ M/s Lauritz Knudsen/ M/s Hi-Tech Engineers
38	Selector Switches	Kaycee BCH / L&T Salzer / Siemens / HPL / C&S Electric
39	Contactors	Siemens / C&S Electric / L&T / Schneider
40	CT/PT	AE / L&T / Gilbert / Kappa / Schneider

41	Digital Panel Meters including Multi Function meter	Secure /Siatec or equivalent approved by GIFT
42	Glands / Lugs	Dowells / Comet / Jainson
43	Indication Lamps (LED type), Push Buttons	Siemens / BCH / L&T / Telemecanique / Vaishnav / Emco / Kaypee
43	Connectors/ Terminal Blocks	Elmex / Connectwell / Essen
44	AB Switch	ABI / Jaysree / Hemraj Udyog / Power grid Switchgears
45	1.1KV/ 11 kV grade aluminium conductor. XLPE insulated armoured UG cables	Havells / KEI/ Finolex / Universal/ polycab
46	GI pipes	Tata / Jindal Hissar / SAIL / Surya
47	M.V. Power Capacitors	Schneider / L & T / Siemens / Neptune Model LLM / Epcos / Eaton
47	Change over Switches	L & T / Schneider / Socomec / C&S Electric
48	APFC Relay	L&T / Beluk / Siemens / Epcos / Schneider / Neptune
49	Angle iron /Channel Iron	SAIL / TATA / HSL / Jindal(Hissar) / Zenith
50	11 KV AB Switch	SAHAL / PACTIL / GEC / SEW
51	11 KV Horn Gap Arrestor	SAHAL / PACTIL / GEC / SEW
52	11 KV Pin & Disc Insulators	BHEL / Bharat Industries
53	H T Jointing kit / End termination joint	3M / Tropolin / Densons / Raychem / M Seal / CCI Xicon / Mahindra
54	Power Relays	SEGC / Crompton / Siemens / Schneider / L & T / C&S Electric
55	Electric Insulation mat with ISI mark	Dozz / Padmini / Raychem / Jyothi Rubber Udyog
56	DWC Pipes	TeleRex / Dutron / Duroline / CPE
57	Manufactures of Solar PV Cells and Modules	Approved as per prevailing OM/ Almm list of MNRE Approved by Engineer in / charge as per tender specifications.
58	Power Conditioning Unit/ Grid Tied Inverter	SMA (America)/Kaco/Delta/ Siemens/ ABB – Fimer/ Emerson/ Havells/ Hitachi
59	Accessories/Connecters	MC/ Tyco/ Solarlok
60	Data logger/System performance	ABB/KACO /Energy Recommerce / /Energy Tracking Ilc/SMA America/ Schlumberger
61	Indicating Lamps LED type	Schneider / L&T/Siemens/Vaishno
62	Digital Meters	Conzerv / L&T / AE / MECO
63	LT Jointing Kit / Termination	Raychem /Mahindra/ M – Seal /3M
64	Cable Glands Double	COMET/DOWELLS / JAINSONS
65	Bimetallic/Copper/ Aluminium Cable Lug	Comet/ Dowell"s/ Jainsons
66	MCB DBs/ MCB.s / MCCBs/ ACBs	Siemens/ Schneider/ ABB / L & T
67	UTP Data Cable	Legrand / Systimax/Commscope
68	GI pipes	SAIL / Jindal Hissar/ TATA

69	Phenolic laminated sheet	Hylam/ Greenlam
70	GI Race way	OBO/ Legrand/ MK/ Schneider / Electric/ Profab
71	Surge Protection Device	Schneider Electric/ OBO/ L&T/Legrand
72	XLPE aluminum / copper conductor cables	Universal / Finolex/Havells/KEI/ Polycab
73	Solar Cables(XLPO)	Havells / KEI / Gloster / Finolex / Universal / Fortuneart/ polycab/ Apar
77	Earthing	M/s Cape Earthing, M/s JEF Earthing, M/s Soham Elec. Infra
78	Insulating Mats	DL Miler & Co.Ltd.,Premier poly film Ltd., RMG Polyvinyl India Ltd.
79	Cable Trays (Factory fabricated)/ Raceways	Indiana/ Profab Engineer/ Rico Steel/ RR Ispat/ BEC
80	HDPE underground cable duct	Rex Polyextrusion/ TirupatiPlasomatics/ Duraline
81	Lightning Protection	Indele/ LPI/ Furse
82	EPBAX	Siemens/ Coral Teleco/ Matrix
83	Co-Axial Cables	Finolex/ Delton/ Clipsal/ Polycab
84	Cat6 Cable	Legrand/ Schneider/ Amp/ Siemon/ Systemax
85	Telephone Cable	Havells/ Polycab/ Finolex/ RR cable
86	Telephone Tag Blocks	Kronr/ ITL/ AMP
87	Patch Cords, Patch Panels, Cross Connect Outlet	Amp/ Beldon/ Clipsal/ Krone communication/ Molex/ Panduit/ Systemax
88	Solar PV System	Waree/ Tata Power/ KRYFS/ Solair Energy System
89	Exit Signages	Gevis/ Legrand/ MK/ PHILIPS/ Prolite

32.0 DETAILED TECHNICAL SPECIFICATIONS OF BMS WORKS

GENERAL

Fire Fighting systems and other services in the various buildings and can be common for the entire complex. Building Automation System (BMS) will help in conserving energy by making it possible to plan and execute various energy conservation control schemes ; also help in reducing scarcity of trained man-power requirement for operating and maintaining the building services without compromising on quality of services. It shall also act as a Management Information System (MIS) by keeping the management informed about the critical operation of various building services and make available data required for analyzing the working of any system, and possibilities of conserving the energy. The system shall be based on Micro Processor Control System, using the various Energy Management Programmes to save the energy with the latest techniques of controlling the environment.

1.1 SUMMARY

Furnish all labor, materials, equipment, and service necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings, as in attached Input/Output Summary and as described herein. Drawings are diagrammatic only.

All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Client.

Client shall be the named license holder of all software associated with any and all incremental work on the project(s)

1.2 SYSTEM DESCRIPTION

The entire Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating via Bacnet/Sedona communication protocols to a Network Area Controller (NAC) / Router.

The entire Integrated Control and Monitor Management System (IBMS) shall be comprise of a network of interoperable, stand-alone digital controllers communicating on an open protocol communication network to a host computer within the facility (when specified) and communicating via the Internet to a host computer in a remote location. The IBMS shall communicate to third party systems such as Chillers, Boilers, Air-Handling Systems, Energy metering systems, Lighting Management System & other energy management systems, Fire-Life safety systems and other building management related devices with open, interoperable communication capabilities.

The IBMS framework shall utilize JAVA based automation products and services with built-in Internet connectivity to a broad range of distribution partners in the building automation, energy services, power/utility, and industrial sectors. The Framework shall bring together the computerization of control applications under the umbrella of single integrated system architecture. The suite of component software applications shall support true plug-and-play, multi-vendor interoperability, resulting in lower automation and information infrastructure costs. The Network Area Controllers (NAC's) shall run a JAVA Virtual Machine (JVM) platform and use a common set of tools for accessing and integrating multiple protocols.

The Building Management System (BMS) shall be comprised of Network Area Controller or Controllers (NAC) / Routers. The NAC / Router shall connect to the local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each NAC shall communicate to Bacnet/Sedona and/or BACnet Direct Digital Controllers (DDC) and other open protocol systems/devices.

The following software packages shall be loaded into the system as minimum standard :-

- a. Complete system operational software
- b. Site specific data manipulation software
- c. Active graphics software
- d. Energy management system software
- e. Alarm indication software
- g. Data Visualization Package
- h. Internet Enabled Remote Monitoring Package.

1.3 SUBMITTAL

Copies of shop drawings of the components and devices for the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions for all controllers, valves, dampers, sensors, routers, etc. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation shall also be included with the submittal package. BMS contractors supplying products and systems, as part of their packages shall provide catalog data sheets, wiring diagrams and point lists to other contractors for proper coordination of work.

Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media and protocol. BMS contractors shall provide these diagrams for their portions of work; the Systems Integrator shall be responsible for integrating those diagrams into the overall trunk cable schematic diagrams for the entire Wide Area Network (WAN).

Submittal shall also include a complete point list of all points to be connected to the BMS.

Upon completion of the work, provide a complete set of 'as-built' drawings and application software on compact disk. Drawings shall be provided as AutoCAD™ compatible files. Eight copies of the 'as- built' drawings shall be provided in addition to the documents on compact disk. BMS contractors shall provide as-built for their portions of work. The BMS contractor shall be responsible for as-built pertaining to overall BMS architecture and network diagrams. All as-built drawings shall also be installed into the BMS server in a dedicated directory.

1.4 SPECIFICATION NOMENCLATURE

Acronyms used in this specification are as follows:

FMCS	Facility Management and Control System
BMS	Building Management System
NAC	Network Area Controller
DDC	Direct Digital Controller
IBC	Interoperable BACnet Controller
GUI	Graphical User Interface
WBI	Web Browser Interface
PMI	Power Measurement Interface
LAN	Local Area Network
WAN	Wide Area Network
OOT	Object Oriented Technology
PICS	Product Interoperability Compliance Statement

1.5 DIVISION OF WORK

The BMS contractor shall be responsible for all controllers (DDC), control devices, control panels, controller programming, controller programming software, controller input/output and power wiring and controller network wiring.

The BMS contractor shall also be responsible for the Network Area Controller(s) (NAC), software and programming of the NAC, graphical user interface software (GUI), development of all graphical screens, Web browser pages, setup of schedules, logs and alarms, Sedona/Bacnet network over IP management and connection of the NAC to the local or wide area network.

1.6 AGENCY AND CODE APPROVALS

All products of the BMS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.

1. UL-916; Energy Management Systems
2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 "signal Equipment"
3. CE
4. FCC, Part 15, Class A Computing Devices.
5. RoHS Compliant

1.7 SOFTWARE LICENSE AGREEMENT

The CLIENT shall agree to the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application

software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

The CLIENT shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, CLIENT shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, BMS Server(s), and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the owner. The owner shall determine which organizations to be named in the SI organization ID (“orgid”) of all software licenses. Owner shall be free to direct the modification of the “orgid” in any software license, regardless of supplier.

1.8 DELIVERY, STORAGE AND HANDLING

Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.9 JOB CONDITIONS

3. Cooperation with Other Contractors: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

2 MATERIALS

2.1 GENERAL

The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein. All systems and software within BMS shall be Year 2000 compliant and shall be supported by compliance documentation from the manufacturer.

The installed system shall provide secure password access to all features, functions and data contained in the overall BMS.

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed

control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, LonWorks technology, MODBUS, OPC, Sedona-Sox Network and other open and proprietary communication protocols in one open, interoperable system.

The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards, BACnet and Sedona-Sox Network to assure interoperability between all system components is required. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet/ Sedona-Sox Network devices shall be via Ethernet (BACnet/Sedona over Ethernet/IP,) and/or RS-485 (BACnet MSTP) as specified.

All components and controllers supplied under this Division shall be true “peer-to-peer” communicating devices. Components or controllers requiring “polling” by a host to pass data shall not be acceptable.

The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer’s internal Intranet network. Systems employing a “flat” single tiered architecture shall not be acceptable.

Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

3.1 NETWORKS

The Local Area Network (LAN) shall be a 100 Megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

Local area network minimum physical and media access requirements:

1. Ethernet; IEEE standard 802.3
2. Cable; 100 Base-T, UTP-8 wire, category 5
3. Minimum throughput; 100 Mbps.

3.2 NETWORK ACCESS

Remote access For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The CLIENT shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN

line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

3.3 NETWORK AREA CONTROLLER (NAC) / ROUTER

The BMS contractor shall supply one or more Network Area Controllers (NAC) / Router as part of this contract. Number of area controllers required is dependent on the type and quantity of devices provided in IO Summary.

The Network Area Controller (NAC) / Router shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC / Router. It shall be capable of executing application control programs to provide:

1. Calendar functions
2. Scheduling
3. Trending
4. Alarm monitoring and routing
5. Time synchronization
6. Integration of LonWorks controller data and BACnet controller data
7. Network Management functions for all LonWorks based devices

The Network Area Controller must provide the following hardware features as a minimum:

1. One Ethernet Port – 10/100 Mbps
2. One RS-232 port
3. One Lon Works Interface Port – 78KB FTT-10A
4. One RS-485 ports
5. Battery Backup
6. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
7. The NAC / Router must be capable of operation over a temperature range of 32 to 122°F
8. The NAC / Router must be capable of withstanding storage temperatures of between 0 and 158°F
9. The NAC / Router must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

The NAC / Router shall provide multiple user access to the system and support for ODBC or SQL.

A database resident on the NAC / Router shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

The NAC / Router shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.

Event Alarm Notification and actions

1. The NAC / Router shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
2. The NAC / Router shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
 - a. To alarm
 - b. Return to normal
 - c. To fault
4. 5. 3. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: Electricals, HVAC, Fire, etc.
5. Provide timed (schedule) routing of alarms by class, object, group, or node.
6. Provide alarm generation from binary object "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

Control equipment and network failures shall be treated as alarms and annunciated. Alarms shall be annunciated in any of the following manners as defined by the user:

1. Screen message text
2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - a. Day of week
 - b. Time of day
 - c. Recipient
3. Pagers via paging services that initiate a page on receipt of email message
4. Graphic with flashing alarm object(s)

5. Printed message, routed directly to a dedicated alarm printer The following shall be recorded by the NAC / Router for each alarm (at a minimum):
 1. Time and date
 2. Location (building, floor, zone, office number, etc.)
 3. Equipment (air handler #, accessway, etc.)
 4. Acknowledge time, date, and user who issued acknowledgement.
 5. Number of occurrences since last acknowledgement.

Alarm actions may be initiated by user defined programmable objects created for that purpose.

Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

A log of all alarms shall be maintained by the NAC / Router and/or a server (if configured in the system) and shall be available for review by the user.

Provide a "query" feature to allow review of specific alarms by user defined parameters.

A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

3.4 Data Collection and Storage

The NAC / Router shall have the ability to collect data for any property of any object and store this data for future use.

The data collection shall be performed by log objects, resident in the NAC / Router that shall have, at a minimum, the following configurable properties:

1. Designating the log as interval or deviation.
2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

All log data shall be stored in a relational database in the NAC / Router and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.

All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

All log data shall be available to the user in the following data formats:

1. HTML
2. XML
3. Plain Text
4. Comma or tab separated values

Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.

The NAC / Router shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC / Router on the network. Provide the ability to configure the following archiving properties, at a minimum:

1. Archive on time of day
2. Archive on user-defined number of data stores in the log (buffer size)
3. Archive when log has reached it's user-defined capacity of data stores
4. Provide ability to clear logs once archived

3.5 AUDIT LOG

Provide and maintain an Audit Log that tracks all activities performed on the NAC / Router. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC

/ Router), to another NAC / Router on the network, or to a server. For each log entry, provide the following data:

1. Time and date
2. User ID
3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

3.6 DATABASE BACKUP AND STORAGE

The NAC / Router shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.

Copies of the current database and, at the most recently saved database shall be stored in the NAC / Router. The age of the most recently saved database is dependent on the user-defined database save interval.

The NAC / Router database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

3.7 DIRECT DIGITAL CONTROLLERS (DDC)

IP Based Building Automation Controllers, Sedona Framework

The Controller should have the ability to have true open source standards, using IP Based Ethernet connectivity. These include Modbus Server and Client at TCP and RS485 level, and also the BMS leading protocol BACnet, supporting both Client and Server at the TCP/IP and mstp levels.

Controller should have Sedona Framework , which is an open source development framework , should provide a complete software platform for developing, deploying, integrating, and managing pervasive device applications at the lowest level. The Sedona Framework distributes decision making control and manageability to any device and brings intelligence and connectivity to the network edge, and back.

DDC controller should be an open system that allows products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system. DDC Controls, to embrace the conversion of IT, Infrastructure, internet, intranets, and to adopt the open source implementation of an Ethernet based DDC Framework. It is required that Manufacturers that embrace the Sedona open source standard, do so, in a way that ensures that programs (Objects and Kits) can be deployed across all manufacturers platforms, without changes, and different engineering tools having to be deployed, to achieve the same result.

DDC Features available as standard at the IP embedded Controller level, shall incorporate the following:

- Utilizes the industry standard Niagara AX Workbench tool, with no need for special licenses
- Can also be programmed with 2 other independent tools from the Sedona Ecosystem Community
- Ability to store onboard 80 Million history records
- Built in SQL Lite Database and Management Tool
- Ethernet Client/Server Peer to Peer
- Built-in html5 Graphics, multi lingual display to Smartphone or browser
- Email alarms
- Built in BACnet Server and Client, Onboard IP and mstp (up to 31 external devices) levels
- Built in Modbus Server and Client, at the TCP and RS485 (up to 31 external devices) levels
- Web Services, for REST interfaces, and push data to cloud data services
- Web based, using Open Web Server and built-in SQL Lite Server, and, PHP5 and html5.
- No Browser Plugins are allowed, this includes proprietary plugins, Flash and JAVA
- Two 32 bit Processors, one for the main engine and one for the I/O and BACnetmstp port
- On-board Logging with graphical and tabular format, synchronized to the Niagara Framework

- Supports Modbus, BACnet and Sedona, concurrently
- Ability to read Modbus Meters and count pulses on every UI input at 20Hz.
- Totalizer points would support Math resolution of 15 digits, or 999,999,999,999,999
- On board RTC
- Optimization for Heating and Cooling
- Psychometrics Calculations
- Degree Days Calculations
- Ability to write and compile custom programs, and utilize in other manufacturers controls.
- Minimum of 20 point I/O controller Other Capabilities/Features required as below :

Language:

This is a general purpose component oriented programming language very similar to Java or C#. The Sedona language is used to write custom functionality.

Sedona Virtual Machine:

The Sedona virtual machine is a small interpreter written in ANSI C and designed for portability. It allows code written in the Sedona programming language to be written once, but run on any Sedona device. The VM itself is designed to be highly portable to new microprocessors and operating systems.

Java Support:

The Sedona compiler also generates standard Java byte code, which allows the Sedona code to run on the Java VM, too.

Component Oriented Programming:

Sedona enables a style of programming where pre built components are assembled into applications. Components can act as services or be explicitly linked together to create data and control flow. This model is especially suited to graphical programming tools.

Networking:

Several protocols are bundled with Sedona to provision, program, and communicate with Sedona-enabled devices over various network topologies. The Controllers can remotely add, remove, and modify the components in the application, in real-time. All Sedona networking is designed to work over any IP network including 6LoWPAN.

Open Source Ecosystem:

The core Sedona technology is licensed under a flexible academic styled license. This makes it easy for manufacturers to Sedona enable their devices. Tools and applications written in Sedona are guaranteed portable to any Sedona device.

The Ethernet port should give connection to IP networks and it should utilize the Sedona-SOX protocol or TCOM for communication with the Niagara AX Framework®. It should seamlessly integrate with an associated JACE®(Network controller) to provide management functions such as

site-wide control strategies, histories, schedules and alarming.

The RS485 port, when used in conjunction with the controller operating in IP mode, can read and control other Mod bus devices, such as VSD's and Power Meters. In the IP mode, the Controller concurrently, supports BACnet IP, SOX, Modbus and IP and Mod bus Slave.

3.8 GRAPHICAL USER INTERFACE SOFTWARE

Operating system:

The GUI shall run on Microsoft Windows Server .

The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:

Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.

Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.

Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.

Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.

- a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
- b. Holidays shall be set by using a graphical calendar without requiring any keyboard entry from the operator.

Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.

System Configuration: At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:

- a. Create, delete or modify control strategies.

- b. Add/delete objects to the system.
- c. Tune control loops through the adjustment of control loop parameters.
- d. Enable or disable control strategies.
- e. Generate hard copy records or control strategies on a printer.
- f. Select points to be alarmable and define the alarm state.
- g. Select points to be trended over a period of time and initiate the recording of values automatically.

On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

System Diagnostics: The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

Programming software shall be same as GUI. The Same GUI can be used to configure the DDCs & NAC.

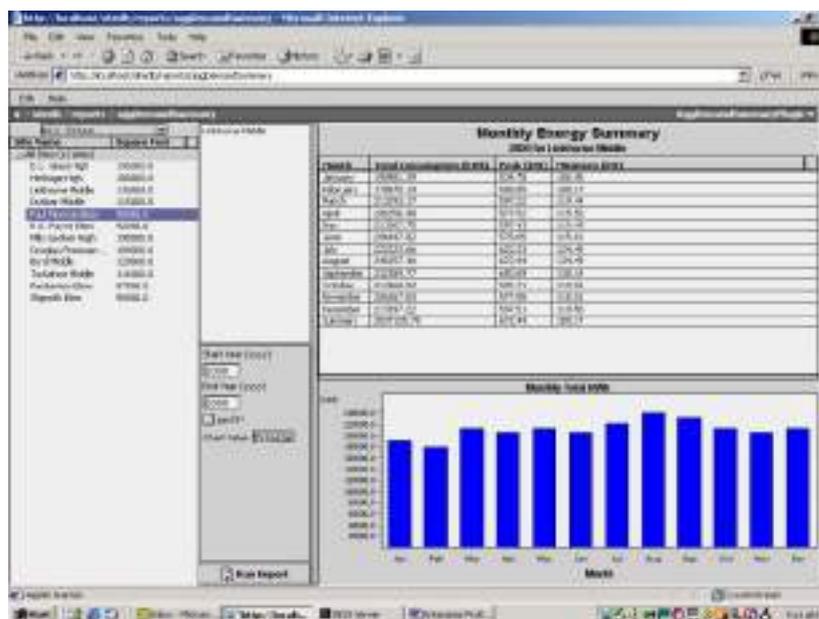
Alarm Console

1. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.
2. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

SPECIAL ENERGY MANAGEMENT REPORTING AND PROFILING APPLICATIONS

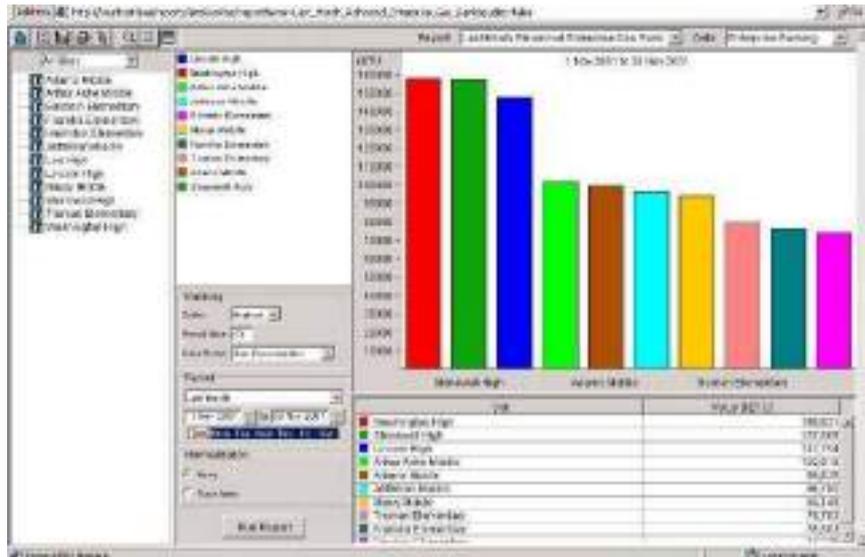
These reports are defined below.

1. **Aggregate Demand Summary** - This report aggregates (totalizes) multiple points (meters) and shows the peak, minimum, average, and total consumption as well as computes load factor. By reducing peak consumption and leveling the total load, volatility is reduced and energy customers can make significant improvements in their energy procurement. This report will help identify favorable aggregation combinations and unattractive peaks. Once the user selects this report, they define parameters such as sites, meters, time period, and commodity. The following screen shot is an example of Aggregate Demand Summary.

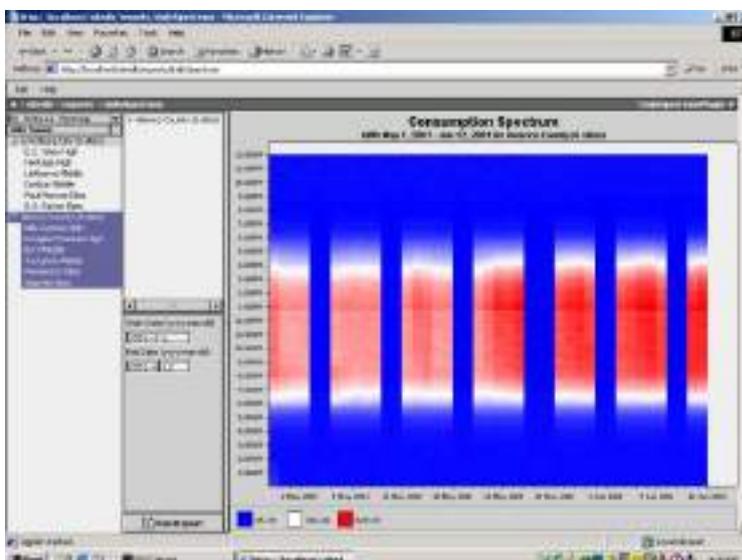


2. **Summary Ranking Reports** - By selecting this report, the user can identify the 10 worst or 10 best sites in the database. Once the report type has been selected, parameters to define before the report can be generated will include the following:

- a. Measurement unit – KW, therms, CCF gallons, PSI, etc. The database will search for all values matching the request.
- b. Compare an entire facility or normalize by square foot
- c. Time periods to compare
- d. Highest values or lowest values – Will be able to view either the best or worst 10 points matching the defined parameters
- e. Cost or consumption in future revisions

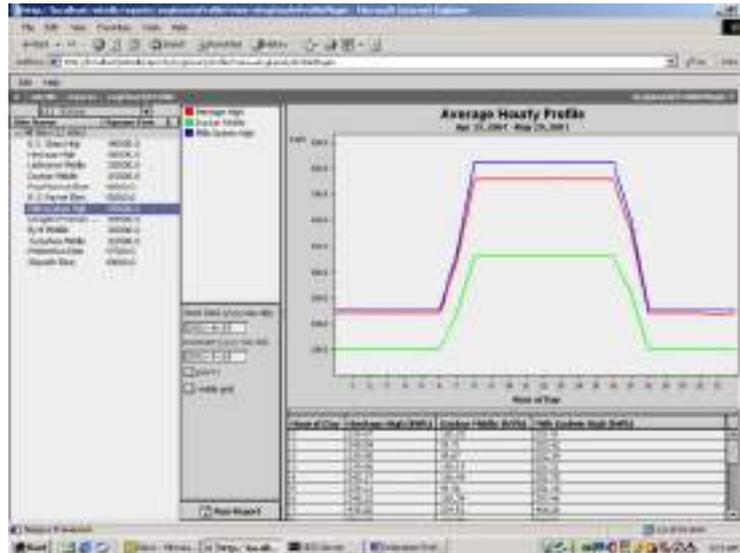


3. **Spectrum Summary Report** – A quick view of any point or aggregated point with color coding identifying the reasonableness of the data value. The chart can report on up to one year of data, with the ability to zoom to a higher definition. As data values approach and/or exceed historical ranges, the color on the graph will change to identify such. If all data values are within historical ranges, the user can move on to other functions. In the following screen shot, the Spectrum Summary Report is reporting on total electricity for an aggregated point, which consists of 6 schools. The reporting period is six weeks, with the blue identifying low loads overnight and on weekends. The fourth weekend in the report was a three day weekend which is identified by a larger blue gap. A user can also see rising consumption (red) as temperatures rise going into the summer season. When the user clicks on an area of the graph, the data value along with time stamp will appear. The colors and associated data value ranges are user definable. The following screen shot is an example of the Spectrum Summary Report.

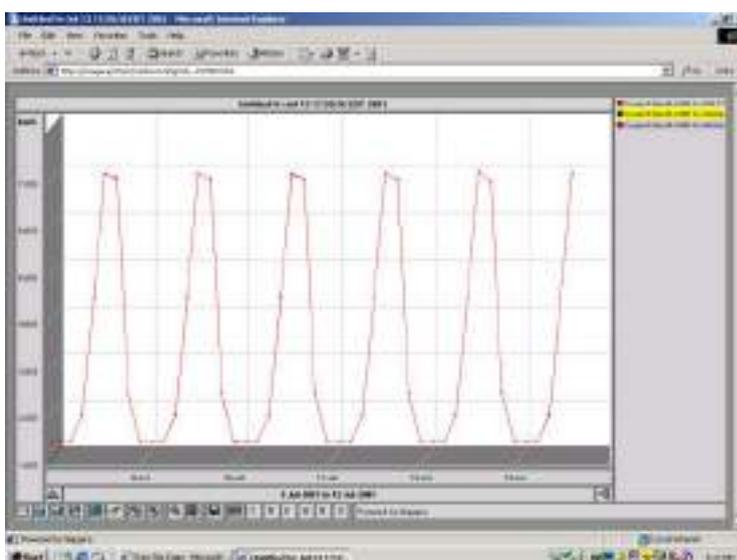


4. Equipment Operation Reports - Users will have the ability to analyze digital points and identify run times. Comparisons between sites or points can be made and run times can be graphed. For example, comparing lighting or HVAC run hours in a group of stores or comparing HVAC run hours in June for Store 1 versus Store 2. Data will be displayed in time and percentage.
5. Relative Contribution Report – This pie chart report will give users the ability to identify how individual points contribute to a total from a point group. The user would select a group of points, calculate the aggregate consumption of the group, and report on the individual contribution of each. Data will be displayed both graphically in a pie chart as well as in tabular format. Users could identify that HVAC is 48% of the building load; lighting is 42%, or Building 1 accounts for 14% of the total enterprise load and Building 2 contributes 19%. This report will allow users to identify inefficiencies and help perform budgeting.
6. **Average Profile** – The report will allow the user to average the load for a single load across time periods and give the average load, and/or aggregate multiple meters (loads) and view the average aggregated load. This report will be very beneficial when negotiating with energy service providers because it includes the load profile and consumption totals. With the ability to filter by time periods, measurement units, points or point groups, weekdays, and weekends, load profiles with associated data will allow the user to procure exactly the amount of energy required. This reduces risk for the energy provider and therefore reduces cost for the end-user.

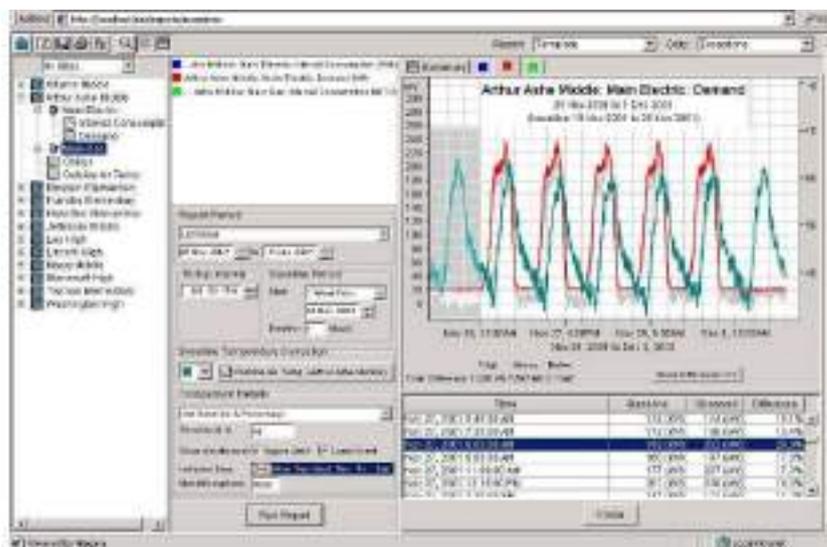
The user will be able to manipulate between 1-minute intervals and hourly intervals. In addition, users will be able to choose between auto scale and manual scale. For example, if the minimum value is 100KW and the maximum is 500 kW, the user can have the chart automatically scale between those values or they can select any range to scale the 400kW range. When printing charts, this may be useful. This will be useful for sophisticated users who need a higher resolution of data. The following screen shot is an example of the Average Profile Report.



7. **Point Trending** – This report will allow the user to choose a single or multiple points and trend the values over a specified time period. Either analog or digital points can be trended and multiple variables can be selected to be report. For a visual representation of several point values, the user will view all points on the left Y-axis. If the user would like to perform a statistical analysis identifying correlation coefficient and standard deviation between variables, they will have the ability to select a single point for each Y-axis. If a point group has been created, it would be presented as a single point value. The same auto scale/manual scale feature discussed in Average Profile Report is available in Point Trending. The following screen shot is an example of the Point Trending Report.



8. **Exception Report** – This report will identify all data values for the specified period that does not fall in a user-defined range. Although the range will be user definable, the benchmark or baseline to be compared against will be historical data. Users can get to this report by selecting it among the library of report templates, or can automatically be taken here from the Average Profile Report or Point Trending Report by clicking on an “Exception” button once a profile is being viewed.



3.9 WEB BROWSER CLIENTS

The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Google Chrome. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.

The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall not be acceptable.

The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

The Web browser client shall support at a minimum, the following functions:

1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
5. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
 1. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 2. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 - b. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 - c. View logs and charts
 - d. View and acknowledge alarms
 - e. Setup and execute SQL queries on log and archive information
7. The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

3.10 SERVER FUNCTIONS AND HARDWARE

A central server shall be provided. The server shall support all Network Area Controllers (NAC) / Router connected to the customer's network whether local or remote.

Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1 or dial-up connection.

It shall be possible to provide access to all Network Area Controllers via a single connection to the server. In this configuration, each Network Area Controller can be accessed from a remote Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.

The server shall provide the following functions, at a minimum:

1. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
2. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any NAC / Router in the network, local or remote.
3. The server shall include a master clock service for its subsystems and provide time synchronization for all Network Area Controllers (NAC) / Routers.
4. The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.
5. The server shall provide scheduling for all Network Area Controllers and their underlying field control devices.
6. The server shall provide demand limiting that operates across all Network Area Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.
7. The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers / Routers. Systems not employing this prioritization shall not be accepted.
8. Each Network Area Controller / Router supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.
9. The server shall provide central alarm management for all Network Area Controllers / Routers supported by the server. Alarm management shall include:
 1. Routing of alarms to display, printer, email and pagers
 2. View and acknowledge alarms

3. Query alarm logs based on user-defined parameters
-
10. The server shall provide central management of log data for all Network Area Controllers / Routers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:
 1. Viewing and printing log data
 2. Exporting log data to other software applications
 3. Query log data based on user-defined parameters

Server Hardware Requirements

The server hardware platform shall have the following minimum requirements:

Operator Work Station and OS

Client workstation with Intel i5 processor with minimum 320Gb HDD, 4 GB RAM, 19" TFT Monitor, DVD Writer, two serial(one for mouse and one for Serial data acquisition RS converter) and one parallel port (for Printer), multimedia speakers, infrared mouse;

Work station shall be preloaded with requisite MS Windows Licensed software compatible with the BMS platform as well as with anti-virus software. Workstation PC shall not have USB port. Workstation PC shall be loaded with client software if required.

Server with xeon dual core processor 2.13 GHz, 500Gb SATA HDD, 4 GB RAM, RAID 1 built in, 3.5 simple swap DVD ROM , OS & firewall software loaded with lifetime license. Server PC shall not have USB port. Server software shall be loaded on server.

The Servers and Operator work stations required for the system shall have latest hardware configuration; the minimum configuration requirements for servers and clients are mentioned in the Bill Of Materials provided elsewhere in this tender.

Servers and Clients shall be loaded with vendor's latest version BA System Monitoring and control Software along with its compatible Operating Systems Software with antivirus package.

3.11 SYSTEM PROGRAMMING

The Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.

A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for

future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to

provide “real-time” data updates. Any real-time data value or object property may be connected to display its current value on a user display.

Programming Methods

1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user’s application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.
2. Configuration of each object will be done through the object’s property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
4. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.
5. The system shall support object duplication within a customer’s database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

3.12 OBJECT LIBRARIES

A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

The objects in this library shall be capable of being copied and pasted into the user’s database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

In addition to the standard libraries specified here, the supplier of the system shall maintain an

on- line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.

All control objects shall conform to the control objects specified in the BACnet specification. The library shall include applications or objects for the following functions, at a minimum:

1. Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.
2. Calendar Object. . The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical “point-and- click” selection. This object must be “linkable” to any or all scheduling objects for effective event control.
3. Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals
4. Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.
5. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building’s “flywheel” effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day’s performance.
6. Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message shall be displayed on the

users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet specification.

1. Analog Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
2. Analog Output Object - Minimum requirement is to comply with the BACnet standard for data sharing.
3. Binary Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.
4. Binary Output Object - Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BACnet method of contention resolution shall not be acceptable.
5. PID Control Loop Object - Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.
6. Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.
7. Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.

8. Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.
9. Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.
10. Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an "On" state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.
11. Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the "contained" application that are represented on the graphical shell of this container.
12. For BACnet devices, provide the following objects at a minimum:
 - a. Analog In
 - b. Analog Out
 - c. Analog Value
 - d. Binary
 - e. Binary In

- f. Binary Out
 - g. Binary Value
 - h. Multi-State In
 - i. Multi-State Out
 - j. Multi-State Value
 - k. Schedule Export
 - l. Calendar Export
 - m. Trend Export
 - n. Device
13. For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.
14. For BACnet devices, provide the following support at a minimum
- a. Segmentation
 - b. Segmented Request
 - c. Segmented Response
 - d. Application Services
 - e. Read Property
 - f. Read Property Multiple
 - g. Write Property
 - h. Write Property Multiple
 - i. Confirmed Event Notification
 - j. Unconfirmed Event Notification
 - k. Acknowledge Alarm
 - l. Get Alarm Summary
 - m. Who-has
 - n. I-have
 - o. Who-is
 - p. I-am
 - q. Subscribe COV

- r. Confirmed COV notification
- s. Unconfirmed COV notification
- t. Media Types
- u. Ethernet
- v. BACnet IP Annex J
- w. MSTP
- x. BACnet Broadcast Management Device (BBMD) function
- y. Routing

3.13 DDE DEVICE INTEGRATION

The Network Area Controller / Router shall support the integration of device data via Dynamic Data Exchange (DDE), over the Ethernet Network. The Network Area Controller shall act as a DDE client to another software application that functions as a DDE server.

Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of these devices into the BMS. Objects provided shall include at a minimum:

1. DDE Generic AI Object
2. DDE Generic AO Object
3. DDE Generic BO Object
4. DDE Generic BI Object

3.14 MODBUS SYSTEM INTEGRATION

The Network Area Controller / Router and the DDC controller shall support the integration of device data from Modbus RTU, Ascii, or TCP control system devices. The connection to the Modbus system shall be via an RS-232, RS485, or Ethernet IP as required by the device.

Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the Modbus system data into the BMS. Objects provided shall include at a minimum:

1. Read/Write Modbus AI Registers
2. Read/Write Modbus AO Registers
3. Read/Write Modbus BI Registers
4. Read/Write Modbus BO Registers

All scheduling, alarming, logging and global supervisory control functions, of the Modbus system devices, shall be performed by the Network Area Controller.

The BMS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment utilizing Modbus shall provide documentation of the system's Modbus interface and shall provide factory support at no charge during system commissioning

3.15 OPC SYSTEM INTEGRATION

The Network Area Controller / Router shall act as an OPC client and shall support the integration of device data from OPC servers. The connection to the OPC server shall be Ethernet IP as required by the device. The OPC client shall support third party OPC servers compatible with the Data Access 1.0 and 2.0 specifications.

Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the OPC system data into the BMS. Objects provided shall include at a minimum:

1. Read/Write OPC AI Object
2. Read/Write OPC AO Object
3. Read/Write OPC BI Object
4. Read/Write OPC BO Object
5. Read/Write OPC Date/Time Input Object
6. Read/Write OPC Date/Time Output Object
7. Read/Write OPC String Input Object
8. Read/Write OPC String Output Object

All scheduling, alarming, logging and global supervisory control functions, of the OPC system devices, shall be performed by the Network Area Controller / Router.

The BMS supplier shall provide an OPC client communications driver. The equipment system vendor that provided the equipment utilizing OPC shall provide documentation of the system's OPC server interface and shall provide factory support at no charge during system commissioning.

3.16 OTHER CONTROL SYSTEM HARDWARE

3.16.1 FIELD DEVICES

ELECTRIC AND ELECTRONIC CONTROLS RELATED EQUIPMENT

General Requirements

All controls shall be capable of operating in ambient conditions varying between 0-55 deg. C and 90% R.H. non-condensing.

All Control devices shall have a 20 mm conduit knockout. Alternatively, they shall be supplied with adaptors for 20 mm conduit.

Ancillary Items

When items of equipment are installed in the situations listed below, the BAS contractor shall include the following ancillary items :

(i) Weather Protection

All devices required to be weatherproofed are detailed in the Schedule of Quantities. IP ratings for the equipment is mentioned in the respective section.

(ii) Pipework Immersion

Corrosion resisting pockets of a length suitable for the complete active length of the device, screwed 1/2" (13 mm) or 3/4" (20 mm) NPT suitable for the temperature, pressure and medium.

(iii) Duct Mounting (Metal or Builders Work)

Mounting flanges, clamping bushes, couplings, locknuts, gaskets, brackets, sealing glands and any special fittings necessitated by the device.

Additional features

(i) Concealed Adjustment : All two position switching devices shall have concealed adjustment unless detailed otherwise in the Schedule of Quantities.

(ii) Operating Voltage : All two position switching devices shall operate on 230 v a.c and all accessible live parts shall be shrouded. An earth terminal shall be provided.

TEMPERATURE SENSOR

Temperature sensors for space, pipes and ducts, shall be of the Resistance Temperature detector (RTD) type or thermistor. These shall be two wire type and shall conform to the following specifications :

- 1) Immersion sensors shall be high accuracy type with a high resistance versus temperature change. The accuracy shall be atleast ± 0.33 degrees F and sensitivity of atleast 2 ohm/F.
- 2) Immersion sensors shall be provided with separate stainless steel thermo well. These shall be manufactured from bar stock with hydrostatic pressure rating of atleast 10 kgf/cm².

- 3) The connection to the pipe shall be screwed $\frac{3}{4}$ inch NPT (M). An aluminum sleeve shall be provided to ensure proper heat transfer from the well to the sensor. Terminations to be provided on the head. Flying leads shall not be acceptable.
- 4) The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections.
- 5) Duct temperature sensors shall be with rigid stem and of averaging type. These shall be suitable for duct installation.
- 6) Outdoor air temperature sensor shall be provided with a sun shield.
- 7) 3. The sensors shall not be mounted near any heat source such as windows, electrical appliances etc.

The temperature sensors may be of any of the following types :

- PT 100, PT 1000, PT 3000
- NI 100, NI 1000
- Balco 500.
- Thermistor

HUMIDITY SENSOR

3. Space and duct humidity sensors shall be of capacitance type with an effective sensing range of 10% to 90% RH. Accuracy shall be + 3% or better. Duct mounted humidity sensors shall be provided with a sampling chamber. Wall mounted sensors shall be provided with a housing. The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections. The sensors shall not be mounted near any heat source such as windows, electrical appliances etc.

FLOW METER

Water flow meters shall be either Ultrasonic type or electromagnetic type. For electromagnetic flow meter, teflon lining with 316 SS electrodes must be provided. The housing shall have IP 55 protection. Vendors shall have to get their design/ selection approved by the Consultant, prior to the supply.

The exact ranges to be set shall be determined by the contractor at the time of commissioning. It should be possible to 'zero' the flowmeter without any external instruments, with the overall

accuracy of at least $\pm 1\%$ full scale.

PRESSURE TRANSMITTER FOR WATER

Pressure transmitters shall be piezo-electric type or diaphragm type. (Bourdon Tube type shall not be acceptable). Output shall be 4-20mA or 0-10V DC and the range as specified in the data sheet depending on the line pressure. Power supply shall be either 24 V AC, 24 V DC or 230 V AC. Connection shall be as per manufacturer's standards. The pressure detector shall be capable of withstanding a hydraulic test pressure of twice the working pressure. The set point shall fall within 40%-70% of the sensing range and detector shall have sensitivity such that change of 1.5% from the stabilized condition shall cause modulation of the corrective element. The sensor must be pressure compensated for a medium temperature of -10°C to 60°C with ambient ranging between 0°C to 55°C .

DIFFERENTIAL PRESSURE SWITCH FOR PIPE WORK

These shall be used to measure pressure differential across suction and discharge of pumps. The range shall be as specified in the data sheet. Switch shall be ON with increase in differential. Housing for these shall be weather proof with IP 55 protection. The pressure switch shall be capable of withstanding a hydraulic test pressure of 1.5 times the working pressure. The set point shall fall in 40-70% of the scale range and shall have differentials adjustable over 10%-30% of the scale range. The switches shall be provided with site adjustable scale and with 2 NO/NC contacts.

DIFFERENTIAL PRESSURE SWITCH FOR AIR SYSTEMS

These shall be diaphragm operated. Switches shall be supplied with air connections permitting their use as static or differential pressure switches.

The switch shall be of differential pressure type complete with connecting tube and metal bends for connections to the duct. The housing shall be IP 54 rated. The pressure switches shall be available in minimum of 3 ranges suitable for applications like Air flow proving, dirty filter, etc. The set point shall be concealed type. The contact shall be SPDT type with 230 VAC, 1 A rating.

The switch shall be supplied suitable for wall mounting on ducts in any plane. It should be mounted in such a way that the condensation flow out of the sensing tips. Proper adaptor shall be provided for the cables.

The set point shall fall within 40%-70% of the scale range and shall have differentials adjustable over 10%- 30% of the scale range.

The switches shall be provided with site adjustable scale and with 2 NO/NC contacts.

AIR FLOW SWITCHES

Air flow switches shall be selected for the correct air velocity, duct size and mounting attitude. If any special atmospheric conditions are detailed in the Schedule of Quantity the parts of the switches shall be suitably coated or made to withstand such conditions. These shall be suitable for mounting in any plane. Output shall be 2 NO/NC potential free. Site adjustable scale shall also

be provided.

AIR PRESSURE SENSOR

The pressure sensor shall be differential type. The construction shall be spring loaded diaphragm type. The movement of the membrane in relation to the pressure should be converted by an inductive electromagnet coupling which would give an output suitable for the controller. The pressure sensor shall be in a housing having IP 54 ratings in accordance with IEC 529. Suitable mounting arrangement shall be available on the sensor. The sensor shall come complete with the PVC tubes & probes.

WATER FLOW SWITCH

These shall be paddle type and suitable for the type of liquid flowing in the line. Output shall be 2NO/2NC potential free.

3. TRANSDUCERS FOR ELECTRICAL SERVICES

3. Electrical transducers shall be integrated electronic type and rack mounted on the field. These shall work on 230 V supply with the output being standard type i.e. 4-20 mA, 0- 10 Volts etc.

Power factor, Voltage, Current, Frequency and Kilowatt transducers shall have standard output signal for measurement for the specified variable.

Kilowatt-Hour metering (if any) shall be poly-phase; three- element with current transformer (CT) operated type. The metering shall feature high accuracy with no more than +/- 1% error over the expected load range. The coils shall be totally encapsulated against high impulse levels.

LEVEL SWITCH

The level switches shall have to meet the following requirement :

- Type : Float Type/Capacitance type/Conductivity type
- Mounting: To suit application.
- Connection : Flanged ANSI 150 lbs RF Carbon steel
- Float material : 316 SS
- Stem Material : 316 SS
- Output : 2 NO, 2 NC potential free
- Switch Enclosure : IP 55

DIGITAL THERMOSTATS

Thermostats for FCU's should be Digital on/off OR Modulating Type for Actuating 2 way or 3 way Valves (On-off/Modulating)

Thermostats should display Room Temp and Setpoint simultaneously which is easy to read from atleast 6-8 feet distance.

Thermostats should have Fan Speed Control Switch (Low-Med-High-Auto). Auto Mode should be

able to save energy by automatically reducing the Fan Speed when Room Temp Achieves Set Point. LCD Display should be available in Blue or Green Backlit for ease in viewing the Room Temperature and Setpoint.

Thermostats should work on 230V PS for on-off models and 24V for Modulating Thermostats The User Settings should be retained in Thermostat Memory in case of Power Failure

The Switching Relays should be separately wired and should be mounted inside the Junction Box, so

that the Thermostat front is sleek in mounting. Thermostat Thickness should be 17mm or less

Thermostats should have Energy Savings Feature with dual setpoint which can be interlocked with Occupancy Sensor or Hotel Key Card input. This should be indicated in the LCD Display in the mode it is being operated. This Programming should be possible by Hotel maintenance Staff.

Thermostats should be similar or equivalent to Honeywell Halo Series Digital Thermostats Model T6861(on/off) or T6865(modulating) version.

Pressure Independent Dynamic Balancing Valve (ranges from 25mm to 150mm)

The Valve should have self Dynamic Flow Control Valves that are pressure independent, two way, Modulating to accept digital/analog input BMS/Controller signals and should provide position feedback signal to the control system. The Feedback signal should have the feedback feature of the Valve/Actuator itself without any need of any additional accessory/instrument/device.

- **PICV should be capable of maintaining the max flow rate atleast +/-4% Accuracy**
- The PICV Should be capable of maintaining **Linear Temperature Control, Pressure Independence and Electric Modulation in one Valve body.**
- The Flow rates should be **field settable electronically upto 60% of the valve Max set Flow rate**
- The Differential Pressure Ranges for which the valve can maintain the flow rates should be mentioned in the Product literature
- Valve Actuator housing shall be rated to **IP54**
- Actuator shall be driven by a 24Vac power supply and shall accept universal Input signals like 0/2-10Vdc or 4-20mA signal
- Actuator shall be capable of providing feedback Signal of 0/2-10Vdc to the Control System/BMS
- PICV should have an **option for adjusting the Flow Characteristics as per AHU in every PICV to ensure Linear TempControl.**
- PICV should have an option for changing the Max Flow Rates in future and no additional

Instrument should be required. Flow Values can be changed by entering in LCD Display only and not by any DIP Switches or Setting Dial to improve accuracy.

- PICV shall provide **full valve Authority**
- PICV Valve body shall be rated at least **PN16**
- **Max Close off Pressure** shall be mentioned in the Product Datasheet.
- Min Working Differential Pressure shall be **30Kpa**
- Valve shall be Internal BSP Threaded from DN25 to DN50 and Flanged end Connection for DN65 to DN150
- Min Stroke Length of the Valve shall be **20mm**
- Media Temperature : **0-130 deg C**
- Valve shall be of Brass/Bronze Construction upto DN50 and Cast Iron upto DN150
- Shut off Leakage shall be **0.1 Kvs**

Motorized Butterfly Valve

Valve Body

Type of Valve : Butterfly Valve
 Body Material : Cast Iron or Ductile Iron Body
Disc Material : Nickel plated Ductile Iron
 Stem : SS416
 Liner Material : EPDM Nominal
 Static Body Rating :PN16

Tightness : Bubble Tight

Medium Temperature :-10 deg C to 120 deg C

Pipe Connection : ISO7005-2

Actuator

Type : Electric
 Motor Supply : 230 Vac, 50hz/60Hz
 Travel Angle : 90 deg +/- 5 deg
 Enclosure : IP67 Waterproof
 Indicator : Continuous Position Indicator
 Space Heater : 15W 220V Anti Condensation
 Stall Protection : Built-in thermal protection Cut off at 125 ± 5 Reset at 95 ± 5
 Manual Override : By Handwheel, nonclutch design
 Torque Limit Switches: 2 nos
 ExternalCoating : Dry Aluminium Alloy in Painted Black

Make : **Honeywell**

7.17 On/Off type FCU valves

Two way on/off type FCU valve

The two way FCU valve should be design in such a way that it can withstand a **static pressure of 20 bar** and a burst pressure of 100 bar.

The ports are designated in such a way that flow through the two way valve can be in either direction.

The valve shall be designed to handle the fluid temperature from 1degreeC to 95degreeC It can withstand the **differential pressure upto 4 Bar**.

The valve is of bronze body with stainless steel stem and Noryl cover.

The FCU valve shall have a minimum stroke length of 10mm so that it has the sufficient distance to travel.

The hydronic FCU valves shall been designed to meet the European standard **EN 60730-2-8**.

The actuator shall require the power supply of 220 Volts AC so that no transformer is required.

The actuator is easily removable from the valve so that in case the actuator fails at site it can be easily replaced without affecting the integrity of the water system.

The actuator shall have the provision to operate manually.

The actuator shall meet the **low voltage directive 73/23/EEC**. The actuator shall be selected in such a way that the maximum power consumed by the actuator is 6 Watt.

The valve should be similar or equivalent to Honeywell VC6013 version.

Snap Acting Digital Thermostats

Thermostats for FCU's should be Digital on/off for Actuating 2 way or 3 way Valves (On-off/Modulating)

Thermostats should display Room Temp and Set point simultaneously which is easy to read from at least 6-8 feet distance.

Thermostats should have Fan Speed Control Switch (Low-Med-High-Auto). Auto Mode should be able to save energy by automatically reducing the Fan Speed when Room Temp Achieves Set Point.

LCD Display should be available in Blue or Green Backlit for ease in viewing the Room Temperature and Set point.

Thermostats should work on power supply of 230V for on-off models.

The User Settings should be retained in Thermostat Memory in case of Power Failure

The Switching Relays should be separately wired and should be mounted inside the Junction Box, so that the Thermostat front is sleek in mounting. Thermostat Thickness should be 17mm or less

Thermostats should have Energy Savings Feature with dual set point which can be interlocked with Occupancy Sensor or Hotel Key Card input. This should be indicated in the LCD Display in the mode it is being operated. This Programming should be possible by Hotel maintenance Staff.

Thermostats should be similar or equivalent to Honeywell Halo Series Digital Thermostats Model T6861 (on/off) version.

VARIABLE FREQUENCY DRIVES:-

Variable frequency drives shall be UL listed and sized for the power and loads applied.

Drives shall include built-in radio frequency interference (RFI) filters and be constructed to operate in equipment rooms and shall not be susceptible to electromagnetic disturbances typically encountered in such environments. Similarly, the drives must not excessively disturb the environment within which it is used.

All VFDs over 3 horsepower shall be provided with an AC choke.

VFDs shall be installed in strict conformance to the manufacturer's installation instructions, and shall be rated to operate over a temperature range of 14 to 104 F.

VFD automatic operation shall be suitable for an analog input signal compatible with the digital controller output.

Each VFD shall be fan cooled and have an integral keypad and alphanumeric display unit for user interface. The display shall indicate VFD status (RUN motor rotation, READY, STOP, ALARM, and FAULT), and shall indicate the VFD current control source (DDC input signal, keypad, or field bus control). In addition to the alphanumeric display, the display unit shall have three pilot lights to annunciate when the power is on (green), when the drive is running (green, blinks when stopping and ramping down), and when the drive was shut down due to a detected fault (red, fault condition presented on the alphanumeric display).

Three types of faults shall be monitored, "FAULT" shall shut the motor down, "FAULT Auto-reset" shall shut the motor down and try to restart it for a programmable number of tries, and "FAULT Trip" shall shut the motor down after a FAULT Auto-reset fails to restart the motor. Coded faults shall be automatically displayed for the following faults:

Over current Over voltage Earth ground Emergency stop

System (component failure) Under voltage

Phase missing

Heat sink under temperature Heat sink over temperature Motor stalled

Motor over temperature Motor underload Cooling fan failure

Inverter bridge over temperature Analog input control under current Keypad failure

Other product unique monitored conditions

In addition to annunciating faults, at the time of fault occurrence the VFD shall capture and make available to the user certain system data for subsequent analysis during fault trouble shooting, including duration of operation (days, hours, minutes, seconds), output frequency, motor current, motor voltage, motor power, motor torque, DC voltage, unit temperature, run status, rotation direction, and any warnings. The last 30 fault occurrences shall be retained as well as the fault

data listed in the previous sentence of each fault. New faults beyond 30 shall overwrite the oldest faults.

The display unit keypad shall allow setting operational parameters including minimum and maximum frequency, and acceleration and deceleration times. The display shall offer user monitoring of frequency, unit temperature, motor speed, current, torque, power, voltage, and temperature.

PORTABLE OPERATORS TERMINAL (POT)

They shall permit the project operating staff to:

- Display point values
- Display parameters
- Change time schedule elements
- List and acknowledge alarms
- Monitor points in the system
- Command points (manual overrides) of points
- Override input points (put inputs in test)
- Read and check variables on the network
- Password protected
- Node configuration for Fan Coil, Rooftop Unit TCUsetc
- Liquid Crystal Display
- Minimum 4x20 character
- Permanent mount or portable connection.

ENCLOSURES FOR CONTROLLERS AND ELECTRICAL PANELS

All the controllers shall be housed in Lockable Vandal proof boxes which shall either be floor mounted or wall mounted. These shall be free standing, totally enclosed, dust and vermin proof and suitable for tropical climatic conditions.

The panel shall be metal enclosed 14 SWG CRCA sheet steel cubicle with gaskets between all adjacent units and beneath all covers to render the joints dust proof. All doors and covers shall be hinged and latched and shall be folded and braced as necessary to provide a rigid support. Joints of any kind in sheet metal shall be seam welded with welding slag grounded off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and secured with the frame and holes in the panels correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with nuts. Self threading screws shall not be used in the construction of control panels. Knockout holes of approved size and number shall be provided in the panels in conformity with the location of incoming and outgoing conduits/cables. Lamps shall be provided

to support the weight of the cables. The dimension of the boxes shall depend on the requirement with the colour decided in consultation with the Architect/Consultant.

Note: All panel enclosures used in plant room spaces and external to building shall be suitable for outdoor application (IP 54 protection) and UL listed.

CONDUITS AND WIRING

Prior to laying and fixing of conduits, the contractor shall carefully examine the drawings indicating the layout, satisfy himself about the sufficiency of number and sizes of conduits, sizes and location of conduits and other relevant details. Any discrepancy found in the drawings shall be brought to the notice of Architect/Engineers Any modifications suggested by the Contractor shall be got approved by the Architect /Engineers before the actual laying of conduits is commenced.

CONDUITS / TRUNKER

Conduits and accessories shall conform to relevant Indian Standards. PVC conduits of required dia shall be used as called for in the schedule of quantities. Joints between conduits and accessories shall be securely made, with help of adhesive.

The conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer.

CONNECTIONS

All jointing methods shall be subject to the approval of the Architect/Engineer. Separate conduits shall run for all power wiring.

The threads and sockets shall be free from grease and oil. Connections between conduit and controller metal boxes shall be by means of brass hexagon smooth bore bush, fixed inside the box and connected through a coupler to the conduit. The joints in conduits shall be smooth to avoid damage to insulation of conductors while pulling them through the conduits.

BENDS IN CONDUIT

Where necessary, bends or diversions may be achieved by means of bends and/or circular inspection boxes with adequate and suitable inlet and outlet screwed joints. In case of recessed system each junction box shall be provided with a cover properly secured and flush with a finished wall surface. No bends shall have radius less than 2-1/2 times the outside diameter of the conduit.

SIGNAL CABLING & COMMUNICATION CABLING

The signal cable shall be of the following specifications:

Wire:	Annealed Tinned Copper
Size :	1.5 sq. mm, 7 strands
No. of conductors :	Two (One pair)
Shielding:	Overall beld foil Aluminium polyester shield.

	Jacket:	Chrome PVC
	Nominal DCR:	17.6 ohm/km for conductor 57.0 ohm/km for shield
	Nominal OD:	8.5 mm
	Nominal capacitance:	130 pF/m between conductors at 1 KHz 180 pF/m between one conductor and other conductors connected to shield.
	Colour :	Black and Red

COMMUNICATION CABLE

The communication cable shall be of the following specifications :

- a. Wire : Annealed Tinned Copper
- b. Size : Minimum 24 AWG stranded
- c. No. of conductors: One pair (2 conductor)
- d. Shielding : Overall beld foil Aluminium polyester shield.
- e. Jacket : Chrome PVC
- f. Nominal DCR : 78.7 ohm/km for conductor, 55.8 ohm/km for shield
- g. Nominal OD : 5.64 mm
- h. Nominal capacitance : 131 pF/m between conductors at 1 KHz 243 pF/m between one conductor and other conductors connected to shield.
- i. Colour : Black and Red, Black and White

List of approved makes - BMS Work		
Sr.no	System	Make
1	BMS Software	Easy IO / Honeywell Desigo /Saurter Trend /ALC / Siemens / Johnson Control (Metasys)
2	DDC Controllers	Easy IO / Honeywell Desigo /Saurter Trend /ALC / Siemens / Johnson Control (Metasys)
3	POT	Easy IO / Honeywell Desigo /Saurter Trend /ALC / Siemens / Johnson Control (Metasys)
4	Room Humidity Sensor	Honeywell/Siemens/Dwyer/Fipro/GreyStone/ / Trane / Sontay / Greystone
5	Pressure Transmitters	Honeywell/Siemens/Dwyer/Fipro/GreyStone/ / Trane / Sontay / Greystone
6	Differential witches Pressure	Honeywell/Siemens/Dwyer/Fipro/GreyStone/ / Trane / Sontay / Greystone
7	Water Flow Switches	Honeywell/Siemens/Dwyer/Fipro/GreyStone/ / Trane / Sontay / Greystone
8	CO2 Sensor	Honeywell/Siemens/Dwyer/Fipro/GreyStone/ / Trane / Sontay / Greystone
9	Level Switches	Honeywell/Siemens/Dwyer/Fipro/GreyStone/ / Trane / Sontay / Greystone
10	Level Transmitters	Honeywell/Siemens/Dwyer/Fipro/GreyStone/ / Trane / Sontay / Greystone
11	Flame Proof Level Switch	Honeywell/Siemens/Dwyer/Fipro/GreyStone/ / Trane / Sontay / Greystone
12	Hydrogen Sensor	Honeywell/Siemens/Dwyer/Fipro/GreyStone/ / Trane / Sontay / Greystone
13	Static Pressure Sensor	Honeywell/Siemens/Dwyer/Fipro/GreyStone/ / Trane / Sontay / Greystone
14	Current Relay	Honeywell/Siemens/Dwyer/Fipro/GreyStone/ / Trane / Sontay / Greystone
15	DDC Panel	Atlas CATV/Arrow Engineers/Valrack/Rittal
16	Indoor CCTV	Sony/Pelco/Mobotix/Avigilon
17	PTZ CCTV	Sony/Pelco/Mobotix/Avigilon
18	POE Switches	Dlink/Cisco/Panduit
19	Management Server	HP/Dell/IBM/Dell/EMC
20	Recording Server	HP/Dell/IBM/Dell/EMC

21	LCD	Samsung/LG/Sony
22	VESDA	FAAST/System Sensor/Minimax
23	Seamless Pipe	Jindal/Astral/Zenith
24	NOVEC1230	Minimax/UTC/Chemtrol/Fenwal
25	ACS Controller	HID V2000/DDS/LENEL/Cardax
26	Access Card Reader	HID/DDS/LENEL/Cardax
27	Biometric Reader & Controller	-Kronos/Lenel/Invixium
28	EM Locks	Algatec/Adit/Bell
29	Push Button	Algatec/Adit/Bell
30	PAS	Bosch/Ateis/Schrack
31	UVSS	Comport/Elgoteam/Gate Keeper
32	Signages Board	Autoglo/Prolite/Glowmax/Technoware
33	Tripods & P Gates	Kabba/Elka/Automatic
34	Boom Barrier	Magnetic/Automatic/Kabba/Elka
35	Baggage Scanner	Rapiscan/Autoclear/Smith/Hyundai
36	2cx1.5sq.mm Cable armoured shielded multistrand	Polycab/RR Kabel/Caliplast/Lapp
37	4cx1.5sq.mm Cable armoured shielded multistrand	Polycab/RR Kabel/Caliplast/Lapp
38	8cx1.5sq.mm Cable armoured shielded multistrand	Polycab/RR Kabel/Caliplast/Lapp
39	8cx1.5sq.mm Cable armoured shielded multistrand Twisted	Polycab/RR Kabel/Caliplast/Lapp
40	CAT-6 Cable armoured	BEC/KEC/Precision
41	PVC Conduit	BEC/KEC/Precision
42	GI Conduit	BEC/KEC/Precision
43	CableTray	Profab/Indiana

Notes :If any of the make for above materials is not available, then Architect/ Client reserves the right to suggest/ approve the alternate make for the same.

Note:- Besides the above makes, Banks Engineer / Architect has the right to permit use of any equivalent brand / material matching the specified criteria / quality standards.

ANNEXURE – 1

AUTHORIZATION FORM (To
be submitted by OEMS)

ANNEXURE-1: AUTHORIZATION FORM

(Letter to be submitted by OEMs ON FIRM'S LETTER HEAD to System Integrator or Bidders on all Products covered under this contract)

To
Assistant General Manager,
Premises & Estate Department, 2nd Floor,
Local Head Office, Plot No-53a,
SBI Tower, Gift City, Gandhinagar – 382355

Dear Sir,

Ref: Tender for Residential Twin Towers at GIFT CITY & its operations

We _____ who are established and reputed manufacturers of _____ (name & descriptions of goods offered) having factories at (Address of factory) do hereby authorize M/s (Name and address of Agent) to submit a bid, and sign the contract with you for the goods manufactured by us against the above Tender.

We hereby extend our full guarantee and warranty for the Solution, Products and services offered by the above firm against this Bid Invitation for a period of 18 Months from the date of contract. We also undertake to provide any or all of the following materials, notifications, and information pertaining to the Products manufactured or distributed by the Supplier:

1. Such Products as the Bank may opt to purchase from the Supplier, provided, that this option shall not relieve the Supplier of any warranty obligations under the Contract; and
2. In the event of termination of production of such Products:
 - a) Advance notification to the Bank of the pending termination, in sufficient time to permit the Bank to procure needed requirements; and
 - b) Following such termination, furnishing at no cost to the Bank, the blueprints, design documents, operations manuals, standards, source codes and specifications of the Products, if requested.

We duly authorize the said firm to act on our behalf in fulfilling all installations, Technical support and maintenance obligations required by the contract.

SIGN & SEAL OF BIDDER

We hereby extend our full comprehensive guarantee and warranty as per Conditions of Contract for the goods and services offered for supply by the above firm against this tender, and will provide the contracted services if M/s _____ is not able to perform the obligations as per the contract.

Yours faithfully (Name)
(Name of manufacturers)

SIGN & SEAL OF BIDDER

33.0 TECHNICAL SPECIFICATIONS OF FA & PASWORKS

PART-1, GENERAL

1.1 DESCRIPTION:

The work shall consist of furnishing, installation, testing & commissioning of a complete high quality advanced technology early detection Intelligent Analogue Soft Addressable fire alarm system as shown on the drawings and specified herein.

1.2 REFERENCES FOR INSTALLATION

- a) German Standards VDE (Verband DeutscherElectrotechniker) DIN VDE14675 and VDE 0833 Fire Alarm Systems
- b) NFPA- National Fire Protection Association
- c) NFPA 72
- d) British Standard Institute / European Standards
- e) All Applicable codes and standards including BS EN 54
- f) Under Laboratories Standard (UL)

1.3 SUBMITTALS

Product data for fire alarm system components including dimensioned plans, sections, and elevations showing minimum clearances, installed features and devices, and list of materials and data.

Shop drawings

- a) System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs. Description shall cover this specific project.
- b) Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with any one of the referenced standards, completely with specifications and Vds/UL approval or equal.

1.4 TRANSPORTATION, HANDLING AND STORAGE

- a) All the components of fire alarm system shall be provided in manufacturer's original new and unopened packing bearing manufacturer's name and label.
- b) Store materials, not in actual use, in covered and well ventilated area and protect them from dirt, dust, moisture, direct sunlight and extreme temperatures.
- c) For further requirements follow manufacturer's written instructions regarding storage and handling.

1.5 WARRANTY

Submit written guarantee signed by the contractor, manufacturer and installer of fire alarm system for the **period of 1 year from the date of substantial completion**. The guarantee shall cover the repair and replacement of material with manufacturing defects and workmanship as directed

by the Fire Engineer.

1.6 QUALITY ASSURANCE

- a) **Manufacturer's Qualifications:** Firms regularly engaged in manufacture of fire alarm systems and components, whose products have been in satisfactory use in similar **services for not less than 05 years period, and be subject to approval of Fire Engineer.**
- b) **Installer Qualifications:** **A minimum 05 years experienced specialist** sub-contractor who is authorized by the system manufacturer, and subject to approval of the Fire Engineer.
- c) All the components and installations shall comply with the requirements of DIN VDE 14675 & VDE 0833/NFPA for design & installation.
- d) Provide system and components specified in this section that are listed and approved by Vds/UL & conform to equivalent FM standards.
- e) **Single source responsibility:** All components and accessories shall be product of single manufacturer.

2 **PRODUCTS**

2.1 SYSTEM DESCRIPTION

The fire detection and alarm system shall comprise of Automatic Soft Addressable Modular design main fire alarm control panels, optical smoke & heat Sensors , manual call points, electronic wall mounted Alarm **sounder cum** flasher devices, Transponder interface units, each with its own short circuit built-in isolators. All loop cabling and any other components and accessories deemed necessary for a safe, reliable and satisfactory system shall conform to the relevant and applicable requirements and recommendations of DIN EN 54. The system shall be fully programmed to accommodate fire alarm zones. The system shall be configured to allow on site modifications with the minimum of disruption using the PC based software to facilitate future changes or alterations to existing buildings/network on site.

The fire alarm and detection system shall provide the following facilities as a minimum:

- a) The system shall be intelligent in operation with advanced decentralised intelligence technology. Each detector shall have its own processor with algorithms built in the device to take a fire or fault decision. System with centralised intelligence by providing signal levels to the control panel is not acceptable.
- b) The system will be capable of providing fire, fault disablement and supervisory monitoring facilities as required by DIN EN 54 Pt 2. All devices on a loop shall have built in SHORT CIRCUIT LINE ISOLATORS for wiring fault isolation to protect the system. "Group Circuit Monitors" which isolate/protect sections of a loop circuit, i.e. a group of field devices are not acceptable. In case the component is not having Inbuilt Isolators then the Isolator Modules should be implemented before and after every individual Detectors and Devices as per NFPA 72 **CLASS -A wiring and Style 7 wiring.**
- c) All system components and devices shall be connected to two-wire loop circuits (as shown in the typical schematics) with each component having its own individual built-in isolator.

Removal or disconnection of any component from the loop shall not affect the functioning and performance of other components and the system.

- d) System shall be of automatically addressable type i.e. all the devices on the loops of the FACP shall be allocated addresses automatically from the PC / panel at the time of system power. The loop devices shall also be able to commission by using PC interface without the need of FACP.
- e) And also given an address during commissioning of the value of which shall be stored in non-volatile memory, within the electronic modules of the outstation. This value shall be read during loop allocation and provided it is valid shall be used to setup the outstations primary address.
- f) Automatic Addressing shall cover the benefits of Soft Addressing and also overcome the limitations of Hard Addressing. This means that if the devices are inserted or removed all the existing devices shall keep the same address and programmed activations and use labels remain unchanged. The panel with PC shall allocate the address to ensure that it is impossible for two devices to have the same address. Fire Detection and Alarm Systems, which rely only on Coding, Programmer or hard addressing techniques are not acceptable.

Facilities shall be provided to constantly monitor and check the following circuits and fault conditions:

- a) The power supply to the loop /s;
- b) For open-circuit, short-circuit, earth fault and any other fault condition in the loop wiring; For communication failure and errors in all cards and loops
- c) For faults in keyboard and printer circuits
- d) All devices, etc. shall be installed on the same loop.
- e) Any event i.e. Fire, fault or warning shall be recorded with time, date and place of occurrence in the memory of FACP. These events can either be displayed on LCD Display of the FACP or printed, as required. Provision shall be done at the fire alarm control panels to silence the loop powered alarm sounders but the visual indication shall remain until the system is reset. The detectors shall have auto learn sensitivity adjustments. The main fire alarm control panels shall be located as shown on the schematics and the floor drawings.

2.2 GENERAL

- a) All major component of fire alarm system shall be product of a single manufacturer and shall conform to the requirement of EN54, Vds/UL/UL,UL approved and be designed accept to DIN VDE14675 and VDE 0833/NFPA Fire Alarm Systems CODE OF PRACTICE FOR SYSTEM DESIGN, INSTALLATION AND SERVICING.
- b) The power supply breakers for FDA system shall be marked "DO NOT DISCONNECT, FIRE ALARM SUPPLY"

2.3 ADDRESSABLE FIRE ALARM CONTROL PANEL (FACP)

In the event of a fire being reported from the smoke/heat Detectors, activation of manual call

points or sprinkler operation the sequence of alarm operation shall be as follows:

- a) If a fire condition is reported from a smoke detector then the evacuation will be done initially by the local integral sounder. Then after a certain delay (to be agreed at the time of commissioning) the evacuation Alarm shall be sounded on that fire zone only. If after 3 minutes the alarm has not been acknowledged, the Alarm shall also be executed on the other adjacent zones. All other zones shall be given the Alarm. The evacuation of the building shall be staged in phases to allow orderly movement of people.
- b) If a Manual Break Glass Unit is activated or a sprinkler flow switch is operated, then the evacuation shall be transmitted immediately to the affected fire zone plus the adjacent zones.
- c) Activation of the fire alarm system shall directly initiate some or all of the following to be agreed as a part of the overall Fire Engineering policy.
 - i) Signal to all elevator machine rooms indicating fire status (to control lifts)
 - ii) Release doors normally locked by magnetic devices.
 - iii) Release doors normally held open by magnetic devices
 - iv) Shutdown mechanical equipment ventilation plant
 - v) Shutdown general exhaust fans
 - vi) Start up smoke extract fans Start up exhaust make up fans
 - vii) Start up stair vestibule pressurization fans
 - viii) Automatically operate fire dampers
 - ix) Initiate alert signals to panels in the adjacent office tower.
 - x) Sprinkler valves, flow switches and other monitored valves shall be directly supervised by the fire alarm systems
 - xi) These shall include but not limited to the following:
 - xii) Building automation system
 - xiii) Repeater Panel.
 - xiv) Security system etc.

3 FIRE ALARM SYSTEM COMPONENTS AND DEVICES

FIRE ALARM CONTROL PANEL

The panel shall be modular Multifunctional computer controlled having hot Swappable Modular cards that functions as CPU / Loop card Galvanically Isolated and Network Card respectively

De-centralised control and monitoring functions to be realised on the loop and spur.. The panel shall be complete with, but not limited to, the following elements:

- TFT Visual display of 5.7" with Capacitive Keyboard for Touch Sensitive Operation
- Built-in full numeric keyboard with function keys.
- USB Port
- Input Power Supply can be at 230V AC or 110V AC
- Loop expandable from Single Loop to 18 Loops (without additional PANEL Mainframe hardware)
- RS485 and NO/NC free programmable contacts
- Key switch to prevent unauthorised operation of keypad.
- Integral sealed lead acid battery and charger, with 96AH Battery Back up
- For a failsafe power supply back up there shall be one more additional Power Supply

accumulator , each accumulator shall have maximum capacity of 24V/48AH and the Power Supply Modules should be internally connected over ring shaped wiring so that if one of the Power Supply fails the other shall still perform

Essential controls – Delay, panel reset, Audible alarm off, Disconnect master box, additional messages, verify/cancel fault buzzer. Fire, Pre-Alarm, Trouble, Disconnection lamps. Each lamp shall also have appropriate indication (Releasing Systems activated, Master box, Delay , Verify, CPU failure, In operation normal condition & failure of power supply / battery) Simple menu driven function keys with password protection shall allow users to an extensive range of software based features such as:

Overview

Service

Time functions

Informations

Last 10000 system events

Current fault and warning logs.

Interrogation of sensor cleanliness

On/Off, Enable/ disable sensors, zones, sounders, interface unit channels.

Status of detectors

Alarm counters

Printer on, off, line feed and test facilities.

All control buttons and keyboard shall be enclosed behind a lockable cover, device capacity per 3.5km loop and a TTY/ RS 485 communication option. Up to 127

- In addition to the above, all other necessary controls, elements and accessories shall be included to provide a complete and efficient panel conforming to the requirements of DIN EN 54/UL/ Vds/UL/UL.

LOOP PARAMETERS

Individual loop circuits will be capable of accommodating the following.

- Up to a maximum of 127 addressable devices on 3.5 kms loop length
- Shall be able to load Addressable Sounders cum Speech Device directly on Loop.
- Shall be able to load Addressable Detector cum Sounders cum Speech Device directly on Loop.
- Up to 127 loop powered (Input/output) modules.
- Should have the ability to spur off the detection loop without using ‘T’ breaker devices, without any degradation.

REPEATER PANEL

High-quality remote display and operating unit for Flexes FACP. System operation is Interoperable and intuitive with a touch-sensitive 7" colored display. Individual access levels can be activated with a key code. Software addressing allows using the operating unit on the RS 485.

FIELD DETECTION DEVICES

- a) All analogue detectors and bases shall be provided by the same manufacturer of the

control system. No other make of detectors will be permissible.

- b) All analogue detectors shall have real intelligence itself. This means even without control panel the detector can make decision, adapt to different environmental condition and diagnose itself. They shall have decentralized intelligence, automatic function self-test, CPU failure mode, alarm and operating data memory and integrated short circuit line isolators. The detector bases for interfacing between the loop wiring and the detector head shall be manufactured by means of injection moulded ABS plastic colored white and shall not contain any electronics for addressing. The base fixings should be suitable for any industry standard BESA or conduit boxes. All bases (if required) shall include the option to provide a programmable relay output for interfacing, providing a dry contact for third party.
- c) All bases shall be provided with a plastic removable dust cover for protection during site construction as well as an IP rated sealing gasket to prevent dirt and moisture from entering through from the fixing surface.
- d) Each base shall include a lock and removal of locked detectors shall be achievable only through the use of the appropriate removal tools as specified by the manufacturer of the detectors. Detectors removal tools are to be handed over on completion of the contract as part of the spare parts to the client.
- e) Removal of a detector from its associated base shall not affect the continuity of the detection loop.
- f) The Fire alarm manufacturer shall have the complete range of following analogue ADDRESSABLE detectors with decentralised intelligence as standard so as to meet the specific applications of the site.
 - a) Heat Detectors (fixed & ROR temperature)
 - b) Multi criteria Detector
 - c) Dual angle Optical/Heat Detector or Multi criteria detector
 - d) Manual Call Points
- g) All of the above shall be compatible with the aforementioned base providing interchangeability between detector heads, without the requirement for switch settings. All detectors shall also have an integral short circuit isolator, which in the event of a single cable fault will isolate the "culprit" piece of cable and retain all devices on the loop operationally.
- h) Each detector shall possess two integral LED giving a red flashing indication for fire and green for normal operation. For remote locations, each detector shall be capable of connection to a remote LED unit by **means of 2 core wire connection**.
- i) Detectors shall be white in colour and manufactured from ABS plastic. All electronics and associated sensing elements will be housed within this unit, these components being hermetically sealed to prevent their operation from being impaired by dust, dirt and humidity.

- j) The sensitivity of all detectors shall be adjustable from software. It shall be possible to programme detector sensor sensitivity directly on the loop using interface with a laptop PC and appropriate programming software from manufacturer.
- k) For MULTI SENSOR detectors, disablement of each sensor element shall be possible individually or for whole loop. Also this disablement feature shall be possible to have manually or time / event controlled.
- l) All detectors shall be provided with a plastic removable dust cover for protection during site construction.

HEAT DETECTORS

Install as shown in the drawings. These shall comply with the requirements of EN 54: Part 5 and shall be Vds/UL approved. This shall be a dedicated heat only detector to provide fixed temperature heat as well as rate of rise sensing. It should be fully compliant with EN54 part 5 to provide grades of A1.

DUAL ANGLE OPTICAL/HEAT DETECTOR or MULTICRITERIA Detector having Different Sensitivity Level

- a) Install as shown in the drawings. These shall comply with the requirements of EN 54: Part 5 & 7 and shall be Vds/UL approved. This device shall combine two individual sensing elements to provide excellent cover for both "types" of fires. (Slow smouldering and fast free burning).
- b) OPTICAL SENSING: Shall be carried out by 2 infra-red LED transmitters across 2 separate Optical detection angles. This sensor shall process both the forward and backward scattered Light caused by entering the detection chamber of device, allowing the detector to differentiate between real smoke and non-smoke particles e.g. Steam & Dust. Primarily to be used inside the Hotel Rooms

Blue-light OPTICAL SMOKE / HEAT DETECTOR

- a) Install as shown in the drawings. These shall comply with the requirements of EN 54: Part 5 & 7.
- b) The optical measurement chamber shall be provided with latest developed blue LED sensor technology, enabling the detection of open fire, smouldering fires and fires with high heat generation (Invisible smoke sensing). These detectors shall be capable of identifying the TF1 & TF6 test fires described in EN 54-9 specifications.
- c) These detectors shall be intelligent with time related signal analysis, signal correlation of sensor data & decentralised.
- d) To be used in Control rooms / Data Centre

MANUAL CALL POINTS

- a) 3. Install as shown in the drawings. The manual initiation devices shall be electrically compatible with all of the aforementioned detector types and shall be complete with all-electronic components and circuitry for an automatic safe addressable device. The manual call point shall have an inbuilt short circuit isolator and an inbuilt microprocessor to ensure a response time of less than 1 second.

- b) The MCP unit shall also handle all communication to the control panel. All electronic devices contained within the MCP shall be hermetically sealed so as to prevent damage from hostile environment conditions: e.g. dust with minimum rating of IP43.
- c) The MCP operating voltage shall be 8-42 volts DC, RED similar to RAL 3020. If the MCP is located in public areas a transparent cover shall be provided as a protection to prevent inadvertent activation. MCP shall be available in two designs Large & small for aesthetic purposes to architects.
- d) The MCP shall have an input facility to connect conventional devices. It should have an option of using either frangible glass allowing for complete removal upon operation or plastic
- e) Panel resettable function. There shall be no text but SYMBOLS on the MCP (burning house / press to break).
- f) The device can be tested functionally without the need to either remove the front cover and/or breaking the glass, with a special test key (supplied as standard). The key shall insert the underside of the MCP ensuring easy access of the key at all times. These devices will comply fully with EN 54 part 1.

FIELD ALARM DEVICES

- a) 3. Electronic sounders, combined sounder/strobe and standalone strobes shall be loop powered for direct connection to the 2 core detection loop shall be electrically compatible with all initiation devices. These wall mounted units shall be available in red or white and suitable for both indoor and outdoor applications with an ingress protection rating of IP31 and IP65 respectively.
- b) All electronic sounders, sounder/strobe and strobe only versions shall have alarm signals Synchronised across all the detection loops of the fire alarm control panel.
- c) All alarm devices shall have a short circuit isolation device provided as an integral component of the device.
- d) All sounders shall have a 'soft start' feature controlled by the fire alarm panel, whereby a low initial volume can be set and then increased at a defined rate upto a maximum volume setting.
- e) All alarm devices shall be provided by the same manufacturer of the control system. No other make of detectors will be permissible The Fire alarm manufacturer shall have the complete range of following alarm devices with built in short circuit line isolators so as to meet the specific applications of the site.

INPUT/OUTPUT Modules (Type B)

- a) Module shall offer Monitored Activation of external device whilst the correct activation is monitored within Programmable response time of 0-600 Sec. If activated external device does not respond within this time then a Fault is reported, otherwise in case of correct function no message is present in the System.
- b) Maximum contact rating of 30V DC or AC/1 A

Features:

- A. Flexible input Power Supply as 12V-24V DC or 230V AC
- B. Ext Devices such as Dampers / Roller doors/Lifts / Machine pumps etc can be activated or De-activated with 0-600Sec as programmable response time

C. Compact Housing with IP65 Protection

D. 2 Programmable relays with switching capacity of 230V AC/4A Relay

BATTERIES

Batteries shall be provided and shall be the dry sealed lead-acid maintenance free (SMF) type. The batteries shall have ample capacity. With primary power disconnected, to operate the fire alarm system for a **period of 48 hours**. Following this period of operation via batteries. The batteries shall have ample capacity to operate all components of the system, including all alarm signalling devices in the total alarm mode for a **minimum period of 30 minutes**.

WIRING

All cables associated with Fire Alarm installation shall be of fire **resistant copper 2 core** 1.5 sq. mm **armoured cable**. Cables shall comply with BS 6207 Part 1. The cable is to BS 6207: Part 1 having, Typically no more than 2 cores each core having 1.5 sq. mm cross sectional area, A red cover sheath (preferred for alarm applications), Having continuous metal sheath encapsulation, Fire resistant tested to BS6387 categories CWZ.

4 EXECUTION

INSTALLATIONS

The entire fire alarm system shall be installed in accordance with DIN / BS EN54 / NFPA Standards and manufacturer's approved shop drawings, written instructions and recommendations.

TESTING

Fire alarm system shall be tested in accordance to Local Civil Defence regulations and put into operation by the manufacturer or his authorized representative in the presence of Fire Engineer. Fault and alarm conditions shall be simulated and all data and alarm indicators checked with full events recorded on system printer according to the testing procedure.

5 PUBLIC ADDRESS SYSTEM

IP Network Controller

- a) The Network Controller shall be TCP/IP Based 2x2 audio matrixes and shall handle minimum two independent 100V monitored line with 120W Class-D Digital Amplification per line/zone. The controller shall have Colour touch screen interface for IP Address settings, programming, monitoring and fault indication. Controller shall have inbuilt monitored loudspeaker to listen different audio signal.
- b) IP Network Controller shall have inbuilt memory for MP3 or WAVE file and it should support minimum 100MB storage or 200min messages. The Controller should have Dry contacts for Integration with Fire Alarm Control Panel for Automatic Voice Evacuation.
- c) The unit shall be powered by 230V AC or 24V DC source.
- d) Switching between two supplies shall take automatically in case of failure of any one. Controller should be fully monitored for Power faults, Contact, and amplifier (gain) and 100V loudspeaker line (open, short-circuit impedance, leakage). Unit should support Automatic gain control function by connecting external microphone. IP Network controller should be

directly connected on Ethernet LAN/WAN & should simultaneously decode two audio streams from IP / Ethernet network. The unit should support direct paging from remote IP microphone console over Ethernet. A single unit should work as IP Based Public address, Voice Alarm, Background Music, Message Scheduling with inbuilt amplification. System should support networking of minimum 400 IP Network

Controllers

Approved make:-Ateis , Bose , Bosch Presideo , Amplifiers : -

The amplifier will be class D and should have the following minimum Specifications as below.

1. Should be inbuilt along with the controller and should support redundancy.
2. If the amplifier is not in built then the system should have the provision wherein external amplifier supplied should have provision for redundant amplifier in the ratio 1:1.
3. System using amplifier switching not allowed.
4. Minimum wattage per zone would be around 100 watts.
5. No other category of amplifier except for class D would be accepted.
6. The amplifier should have 3 band parametric EQ, if not the same should be available in the digital controller. Systems using only basic power amplifier will not be allowed.

Rated Output Voltage (RMS) -	2x120W
Class	: Class-D Digital Battery Voltage 24VDC (max 10% deviation)
Frequency Response	: 50Hz to 15 KHz Impedance : 10KOhm
S/N Ratio	: >82 dB
Sensitivity	: Max 300mV (set at 1V)
Total Harmonic Distortion	: Less than 0.5% @ 1kHz
Approved make	: Ateis/Bose/Bosch/Presideo Paging Microphones

The system shall comprise of TCP/IP desk Intercom/Paging station with colour touch screen the screen shall be TFT colour screen 4.3 inches, including touch panel 16 buttons / page 100 pages Directory list, Microphone mute feature

Technical specifications:-

- Ethernet interface including POE (Power on Ethernet)
- 24 VDC power supply (if no POE available)
- Monitored high quality gooseneck microphone
- Automatic gain control on microphone input
- Monitored built in loudspeaker
- SPEEX/MP3 audio encoding/decoding
- Memory space for pre-recorded messages
- RJ9 plug for optional headset
- LED Power (green)
- 2 monitored input contacts on Euro block screw terminals
- Output contacts NO/NC
- Speaker: Power 4 W rms, Bandwidth 200 Hz-10 kHz
- Microphone: Length 250 mms, bandwidth 100 Hz-10 kHz
- Contact inputs: Active to ground, voltage 3.3 VDC
- Relay outputs: 48 VDC / 2A

- Housing: Polystyrene shock, UL94 self extinguishable,
- Power consumption (24 VDC): 1.7 W standby, 7 W max

Speaker

6 W Ceiling Mounted Meta Speakers with Fire Dome

The speaker shall be suitable for flush mounting to a false ceiling of any configuration. It shall be equipped with a multiple tapping matching transformer to provide easy control of speaker sound volume. Supporting brackets to mount the speaker onto false ceilings of different configurations shall be provided. The speaker shall not have any screw fixing arrangement on its grill. The speaker must comply with BS5839 part 8 and having the EASE, CATT, ULYSSES files for sound acoustic calculation and sound modelling. All tapping shall be made to obtain SPL as per BS5839 part8 the speakers shall be complete with fire dome and thermal fusible link.

It shall satisfy the following performance characteristics;

- 6” two way speakers
- Effective frequency range according to BS6840 shall be 80-20,000Hz
- SPL @ 1m, 1Watt, dB, Test Signal Bandwidth 100Hz-10 KHz shall be 92dB
- SPL @ full power Octave Bandwidth shall be dB102
- Rated Power, Watts 10 @ 10/5/2.5/1.25 tapings
- Acoustic Power (dB-PWL @ 1watt) 1 KHz/2KHz, 89/88dB
- Directivity Axial Q factor, 1 KHz/2KHz shall be 2.3/4.2
- Dimensions, diameter 239mm
- Material shall be steel, white, RAL9016

Approved make :- Ateis , Bosch , JBL, BOSE (In case OEM does not manufacture speakers they can take form any of the four approved makes but the speaker selected should be EN 54 -24 / BS 5829 part 8 compliant .

20 W Horn Type Speakers

The Horn speaker unit shall have a 100-volt transformer sealed inside its high-strength, lightweight; ABS housing that is protected against the elements by moulded-in UV inhibitors. Its wire enters the housing through a gland nut designed to keep the moisture out. Horns must have lightweight high-density, phenolic-resin diaphragms and ceramic magnets.

Mounting shall be using epoxy-coated, stainless steel U bracket held in place by stainless steel hardware allowing its position to be maintained despite unusually high wind velocity.

The Horn speaker should be tested in accordance to IEC60268 Part 5 for high quality intelligibility & shall comply to BS5839 part 8, hence fitted with ceramic terminals and thermal fuse. Unit shall consist of a weather-resistant ABS housing, high density phenolic resin diaphragm, internal 100-volt transformer; epoxy coated stainless steel mounting bracket, stainless steel hardware and 17 inches five conductor wire.

Technical Specifications

Rated power, Watts	20 W
Tappings 100 volt line	20/10/5/2.5 W
Transformer Impedance, Ohms, 100V	500k/1k/2k/4k

Effective frequency range, Hz (BS6840)	250–8,000
S.P.L. @ 1m, 1 watt, dB, Test Signal Bandwidth	101 dB
S.P.L. @ Full power Octave Bandwidth, dB	114 dB
Dispersion at 1 k/2kHz, Degrees	130 / 70
Directivity Axial Q factor, 1 k/2kHz	4.90 / 13.60
Dimensions, front & depth, mm	Ø203 x 254
Colour/Finish	Grey RAL7035
Material	ABS plastic housing with UV inhibitors
Mounting	Stainless Steel U Bracket
IP Rating	66

Approved make: - Ateis , Bosch , JBL, BOSE (In case OEM does not manufacture speakers they can take form any of the four approved makes but the speaker selected should be EN 54 -24 / BS 5829 part 8 Compliant.

Moulded cabinet wall-mount loudspeakers

The enclosure shall be ported and treated with UV inhibitors. The bowed grille will be manufactured from mild steel construction with an epoxy coated finish. The assembly of the speaker shall comprise of a 160mm diameter bass/midrange treated coned loudspeaker. It shall have in addition a 25mm Mylar dome tweeter complete with neodymium magnet and a factory fitted 6watt / 100 volt line transformer. The loudspeaker shall have wide-angle dispersion of 160° and a smooth extended frequency response of 160Hz ~20 kHz. Sensitivity shall be a minimum of 96dB @ 1metre, 1watt test signal bandwidth 100Hz ~10 kHz. Transformer shall be 100 volt line with 3dB power taps of 6, 3, 1.5, 0.75 and 0.25watts to be clearly marked on the assembly. The speaker shall be compliant to BS5839 part 8 (Voice Alarm Standard) to include all the above features with the addition of thermal fuse and ceramic terminals to take 2 x2.5mm² cables. Fire Rated cable tail must be fitted for full compliance to BS5839

Part 8.All units to be tested to BS6840 Part 5.

Approved make: - Ateis , Bosch , JBL, BOSE (In case OEM does not manufacture speakers they can take

Form any of the four approved makes but the speaker selected should be EN 54 -24 / BS 5829 part 8

Compliant. **Entertainment Rack**

The equipment panel shall consist of 1 no. CD player & 1 no., AM/FM tuner. All music transmitted from This position will be routed through the Central Equipment rack to the zone / zones selected though Complete windows based programming.

The equipment components shall comply with the following requirements:

FM/AM tuner

The tuner shall contain provision for up to six preset stations, two of which shall be dedicated to MW or LW. It shall have the following characteristics:

Sensitivity	:	3uV for FM channels	
	:	20uV for 26dBSNR for AM section	
Distortion	:	1% THD IF rejection	:
70db Nominal output	:		
100mV Antenna Impedance	:		
75 ohms			
Tuning method	:	Electronic, onsite adjustable with LED on station Indicator	

CD/DVD Player

The CD/DVD player shall be capable of loading up to six discs into a magazine to provide many hours of repeated play. All discs could be played sequentially or randomly by the use of a remote signal and also capable to play with pen drives.

Frequency response	:	20 Hz to 20,000 Hz
Signal to Noise Ratio	:	90dB
Distortion	:	0.008 % THD @ 1 kHz
Channel Separation	:	82dB
Quantization	:	16-bit twin DAC

Equipment Rack

- a) The equipment shall be housed in a standard rack of suitable height, with Plexiglas door or metal mesh and lock. Ventilation panels of 1U height shall be provided between each item of equipment.
- b) Details of the proposed equipment shall be forwarded to the Consultant with performance specifications, dimensions, construction and finish for approval.
- c) The site shall be fitted with man / machine interface terminal facilities, which shall allow live speech broadcasts to be addressed to selected areas of the site. The unit shall also allow initiation of stored messages and Alarm signals.

Speaker Cables

All cables associated with PA system shall be of following specifications:

- a) The 2 core speaker cable will be connected to the speakers by screw terminals before which it shall be Crimped
- b) Using 1.5 sq. Mm bootlace lugs. Care has to be taken for avoiding any single strand of wire shall not come out of Lug & screw terminals to avoid noise & leakage.
- c) Flexible Copper Conductor of cross section 1.5 Sq. mm / 2.5 Sq.mm PVC insulated, PVCFRLS sheathed
- d) Control Cable as per IS 694. These Cables shall be laid in G.I. Conduits concealed/surface.

APPLICABLE STANDARDS

BS 5839 part 8: Code of Practice for the design, installation and servicing of voice alarm systems

EN60849: International Standards Sound Systems for Emergency

Purposes BS 6259: Reinforcement of Pro-Audio Systems with Voice Evacuation. IEC60268 Part 5: speaker rated power in compliance BS6840 Part 5: Speaker tested in accordance with. 3
UL Listed Speakers EASE, CATT and ULYSSES models for acoustical studies.

INSTALLATION:

- a) Installation shall be as shown on the drawings, and as recommended by the major equipment manufacturer.
- b) All cables, junction boxes, cables supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas

COMMISSIONING:

- a) At final commissioning of each system, the Contractor shall confirm that: All devices, control panels are tested and operate correctly.
- b) The standby batteries are adequately sized. (Measurements of the quiescent and full loads shall be taken and compared to calculated values used at the design stage.) Calculations and measurements shall be submitted to the Fire Engineer.
- c) Commissioning shall be fully documented and the documentation submitted to the Fire Engineer.
- d) The Contractor shall demonstrate each zone and main panel to the satisfaction of the Engineer by conducting a series of witnessed acceptance tests as directed by the Fire Engineer. This shall take place after the above final commissioning and following receipt of the commissioning documentation by the Fire Engineer.
- e) Both the installation and the commissioning activities shall be undertaken as a single continuous operation.
- f) Upon completion of the installation activity, the contractor shall Test, Start-up, Commission and Handover the system to the customer.
- g) The contractor shall make use of the following documents to record test results and details of commissioning tests:
 - Cable Test Sheets
 - Installation Check Report
 - System Layout Drawing(s)
 - System Schematic Diagram(s)
- h) The contractor shall be responsible for inspecting and testing the complete system. The contractor shall present an Acceptance Certificate for signature by the customer.

DOCUMENTATION:

- a) The contractor, upon completion of the commissioning activity, shall hand over the system to the customer.
- b) At the time of hand over, the contractor shall provide the customer with the following documentation:

1. Copy of detailed report
2. Component and equipment list
3. Product description sheets
4. System design drawing(s)
6. System schematic diagram(s)
7. System operating manuals

HANDOVER:

Prior to final acceptance, the installing contractor shall provide complete operation and maintenance Instruction manuals to the owner. All aspects of system operation and maintenance shall be detailed, Including wiring diagrams of all circuits, a written description of the system design, sequence of operation and drawing(s), illustrating control logic and equipment used in the system. Checklists and procedures for emergency situations, maintenance operations and procedures shall be included in the manual.

TRAINING:**General**

The contractor shall provide the customer with details of the training required by personnel to operate and maintain the PA system.

The Contractor and the customer shall jointly agree the number of staff to attend the training courses.

MAINTENANCE:

- a) Routine maintenance should be carried out in accordance with relevant customer's requirements and manufacturer's recommendations. All performance checks undertaken should be recorded in the system log book.
- b) As a minimum, the following performance checks must be undertaken on each maintenance visit. Carry out verification checks as detailed in the commissioning instructions.
 - i) Remove dust and dirt from the Control Panels/speakers using a soft brush or a lint cloth. A solvent which is harmless to the finishes of metal and plastic may be applied to more stubborn stains.
 - ii) Examine the exterior of the enclosure for any signs of damage or loose cable glands and rectify any faults found.
 - iii) Examine the printed circuit boards for signs of overheating, dry joints and/or damaged tracks.
 - iv) Examine the battery terminals for secure connection and for any signs of Corrosion. Replace or repair as required

SCOPE OF WORK

- a) The contractor shall supply, install, test, connect and commission a high quality fast-acting Public Address and Voice Alarm System and Professional Audio
- b) The Public Address and Voice Evacuation System shall comprise of Audio Matrix Units, High Quality speakers, Power Supplies, Side Lobe Free Line Array DSP “Digital Signal Processor” Speakers, Side Lobe Free Bass Array DSP Speakers, Musical Horn Speakers, Wall Mounted Speakers, Pro-Audio Input Plates, Automatic Gain Control Microphones, Audio rack all mounted on a 19” Rack and fully connected and integrated on the fire alarm loop.
- c) The system shall be Decentralized, each Node shall comprise of Distributed Amplifier Unit “DAU” which shall comprise of all the intelligence including but not limited to Master Control “DSP” with in-built messages, Amplifiers, Power Supplies and Music Routers. All these Nodes “DAUs” shall be on LAN.
- d) There shall be no PC to control or to route instructions to these Nodes on the Network.
- e) The system shall report fault back to all network nodes indicating which segment of the network has been damaged. The Fault report shall be pin-pointed out on the Graphical User Interface “GUI” as well.
- f) The system shall be used for Professional Sound Reproduction for all the areas where possible special events take place,. It shall be possible to plug-in or inject Music Sources at certain Plates Locations, and from the GUI “Graphical User Interface” shall be able to route the music to any location in the premise.
- g) The Professional Sound System shall comprise state of the Art Side Lobe Free Line Array Systems for the Mid-High frequencies and a accompanied with state of art Side Lobe Free Bass Array. Both the Speakers shall be DSP “Digital Signal Processing” Active Speakers. These speakers shall provide narrow throw of 5degree vertical and 140-180 degree horizontal.
- h) Prior to placing order for any equipment, the contractor shall submit comprehensive document comprising working drawings, catalogues and descriptive literature of components, acoustic calculation to meet with BS-5839 part8 RASTI requirements of 0.5 on the STI scale and 0,7 on the CIS scale as per EN60849.
- i) The contractor shall be required to train and instruct client's personnel in the correct use, operation and supervision of the system, preferably prior to the handing over of the project.
- j) The contractor shall ensure that all system components offered shall be manufactured by a manufacturer with back ground **of min of 15 years** with a local India support representation and with a service centre in India.
- k) In order to ensure whole site integration capability, the fire and voice alarm system will be awarded to a single specialist local System Integrator who will be responsible for the design, global operation, management and interfacing of the system as defined in BS5839 part 1.
- l) The contractor shall make sure that all power tapping of the speakers must be carried out as specified, even if the acoustic calculations indicates less power tapings.
- m) The back ground noise of the projects shall be considered 75dBA. The contractor must endure

Minimum of 10dB above noise levels are achieved.

- n) The system shall be fully programmed to accommodate fire alarm and voice communication zones as indicated on the drawings and schematics. The system shall be configured to allow on site modifications with the minimum of disruption using the PC based software to facilitate future changes or alterations to the buildings.
- o) The System shall be capable of identifying the Evacuation Zones via Software, and shall be able to Page, Evacuate, Alert zones as required by the Cause and Effect of the Fire Alarm without any limitation to the number of zones.

INSTALLATION:

- a) Installation shall be as shown on the drawings, and as recommended by the major equipment manufacturer.
- b) All cables, junction boxes, cables supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas

COMMISSIONING:

- a) At final commissioning of each system, the Contractor shall confirm that all devices, control panels are tested and operate correctly.
- b) The standby batteries are adequately sized. (Measurements of the quiescent and full loads shall be taken and compared to calculated values used at the design stage.) Calculations and measurements shall be submitted to the Fire Engineer.
- c) Commissioning shall be fully documented and the documentation submitted to the
- d) The Contractor shall demonstrate each zone and main panel to the satisfaction of the Fire Engineer by conducting a series of witnessed acceptance tests as directed by the Fire Engineer. This shall take place after the above final commissioning and following receipt of the commissioning documentation by the Fire Engineer.
- e) Both the installation and the commissioning activities shall be undertaken as a single continuous operation.
- f) Upon completion of the installation activity, the contractor shall Test, Start-up, Commission and
- g) Handover the system to the customer.
- h) The contractor shall make use of the following documents to record test results and details of commissioning tests:
 - i) Cable Test Sheets
 - ii) Installation Check Report
 - iii) System Layout Drawing(s)
 - iv) System Schematic Diagram(s)
- i) The contractor shall be responsible for inspecting and testing the complete system.
- j) The contractor shall present an Acceptance Certificate for signature by the customer.

DOCUMENTATION:

- a) The contractor, upon completion of the commissioning activity, shall hand over the system to the customer.
- b) At the time of hand over, the contractor shall provide the customer with the following documentation:
 - i) Copy of detailed report
 - ii) Component and equipment list
 - iii) Product description sheets
 - iv) System design drawing(s)
 - v) System schematic diagram(s)
 - vi) System operating manuals

HANDOVER:

Prior to final acceptance, the installing contractor shall provide complete operation and maintenance instruction manuals to the owner. All aspects of system operation and maintenance shall be detailed, including wiring diagrams of all circuits, a written description of the system design, sequence of operation and drawing(s), illustrating control logic and equipment used in the system. Checklists and procedures for emergency situations, maintenance operations and procedures shall be included in the manual.

TRAINING:

- a) The contractor shall provide the customer with details of the training required by personnel to operate and maintain the PA system.
- b) The Contractor and the customer shall jointly agree the number of staff to attend the

MAINTENANCE:

- a) Routine maintenance should be carried out in accordance with relevant customer's requirements. All performance checks undertaken should be recorded in the system log book.
- b) As a minimum, the following performance checks must be undertaken on each maintenance visit. Carry out verification checks as detailed in the commissioning instructions.
- c) Remove dust and dirt from the Control Panels/speakers using a soft brush or a lint cloth. A solvent which is harmless to the finishes of metal and plastic may be applied to more stubborn stains.
- d) Examine the exterior of the enclosure for any signs of damage or loose cable glands and rectify any faults found.
- e) Examine the printed circuit boards for signs of overheating, dry joints and/or damaged tracks. Examine the battery terminals for secure connection and for any signs of corrosion. Replace or repair as required.

List of approved makes - FA & PAS Works		
Sr.no	System	Make
1	FAS Panel	Esser/Edwards/Autronica/Notifier or equivalent
2	Multicriteria Detector	E Esser/Edwards/Autronica/Notifier or equivalent sser/Autronica/Notifier or equivalent
3	Heat /Smoke Detector	Esser/Edwards/Autronica/Notifier or equivalent Esser/Autronica/Notifier or equivalent
4	MCP	Esser/Edwards/Autronica/Notifier or equivalent Esser/Autronica/Notifier or equivalent
5	Sounder cum Flasher	Esser/Edwards/Autronica/Notifier or equivalent Esser/Autronica/Notifier or equivalent
6	Monitor Module	Esser/Edwards/Autronica/Notifier or equivalent Esser/Autronica/Notifier or equivalent
7	Control Module	Esser/Edwards/Autronica/Notifier or equivalent Esser/Autronica/Notifier or equivalent
8	Response Indicators	Esser/Edwards/Autronica/Notifier or equivalent Esser/Autronica/Notifier or equivalent
9	PA System	Esser/Edwards/Autronica/Notifier or equivalent Esser/Autronica/Notifier or equivalentp

NOTE: If any of the make for above materials is not available, then Client reserves the right to suggest/ approve the alternate make for the same.

Note:- Besides the above makes, Banks Engineer / Architect has the right to permit use of any equivalent brand / material matching the specified criteria / quality standards.

ANNEXURE – 1

AUTHORIZATION FORM
(To be submitted by OEMS)

ANNEXURE-1: AUTHORIZATION FORM

(Letter to be submitted by OEMs ON FIRM’S LETTER HEAD to System Integrator or Bidders on all Products covered under this contract)

To
Assistant General Manager,
Premises & Estate Department, 2nd Floor,
Local Head Office, Plot No-53a,
SBI Tower, Gift City, Gandhinagar – 382355

Dear Sir,

Ref: Tender for SITC of SBI Corporate office at GIFT CITY & its Operations

We----- who are established and reputed manufacturers of ----- (name & descriptions of goods offered) having factories at (Address of factory) do hereby authorize M/s _____(Name and address of Agent) to submit a bid, and sign the contract with you for the goods manufactured by us against the above Tender.

We hereby extend our full guarantee and warranty for the Solution, Products and services offered by the above firm against this Bid Invitation for a period of 18 Months from the date of contract. We also undertake to provide any or all of the following materials, notifications, and information pertaining to the Products manufactured or distributed by the Supplier:

- a) Such Products as the Bank may opt to purchase from the Supplier, provided, that this option shall not relieve the Supplier of any warranty obligations under the Contract; and
- b) In the event of termination of production of such Products:
 - i) Advance notification to the Bank of the pending termination, in sufficient time to permit the Bank to procure needed requirements; and
 - ii) Following such termination, furnishing at no cost to the Bank, the blueprints, design documents, operations manuals, standards, source codes and specifications of the Products, if requested.
- c) We duly authorize the said firm to act on our behalf in fulfilling all installations, Technical support and maintenance obligations required by the contract.
- d) We hereby extend our full comprehensive guarantee and warranty as per Conditions of Contract for the goods and services offered for supply by the above firm against this tender, and will provide the contracted services if M/s _____ is not able to perform the obligations as per the contract.

Yours faithfully (Name)

(Name of manufacturers)

SIGN & SEAL OF BIDDER

34.0 DETAILED TECHNICAL SPECIFICATIONS OF SECURITY SYSTEM

1 ACCESS CONTROL SYSTEM

1.1 FUNCTIONAL OVERVIEW

Controller Product Family Overview

Provide an open architecture family of interface devices that provides a complete and fully functional hardware/firmware infrastructure for access control software host systems.

The controllers shall communicate with a host system by using industry standard TCP/IP protocol, over 10/100 Mbps Ethernet, Internet, dial-up modem, or wireless modem.

The family of products shall consist of these major components:

- A networked controller that supports up to 32 Reader, Input or Output interface units, and provides a TCP/IP connection to a Host system.
- A reader interface module that supports two Wiegand or Clock and Data card / PIN readers.
- An input monitor interface that supports 16 analog inputs, 2 non-latching output relays.
- An output control interface that supports 12 latching output relays, 2 analog inputs.
- A networked controller / reader interface that supports two Wiegand or Clock and Data card / PIN readers, and provides a TCP/IP connection to a Host system.

The family of products shall not be a proprietary product of the manufacturer of the host access control software application, and must have the ability to migrate to an alternative manufacturer's host access control software application by remote reconfiguration or firmware upgrade and without intervention from the original controller manufacturer.

The family of products shall provide full distributed processing of all access control functions. The unit shall provide fully functional off line operation when not actively communicating with the host access control software application; performing all access decisions and event logging. Upon connection with the host access control software application, the networked door controller or networked controller/reader shall upload all buffered off-line transactions (minimum of 99,999) to the host software.

Transaction buffer storage is expandable to 1M transactions using USB flash drive.

Regulatory Compliance: UL Standards

The family of products shall provide input monitoring and reporting functions shall meet applicable UL 1076 Proprietary Burglar Alarm System standards as a UL Recognized system component, including specific requirements for speed of reporting time, verifying communications with field hardware, detection of substitution of similar field hardware device, four-state alarm monitoring.

3. The family of products shall provide shall meet applicable UL294 Access Control standards as a UL Recognized system component, including criteria for false accepts/rejects, attack resistance and electrical safety.

CE Mark

3. Shall meet European CE Mark standards for electrical safety and RF emissions.

Physical Configuration

Physical Form Factor

Each family product shall be available in a Printed Circuit Board Assembly (PCBA) mounted in a plastic housing.

Housing Configuration

Each family product shall consist of a plastic back plate and cover which is approximately 5.8" (14.7 cm) wide by 4.825" (12.6 cm) high and 1.275" (3.2 cm) deep.

Applicable family products shall have right-angle Phoenix type removable screw terminal connectors for all reader, input and output connections, RJ-45 connectors for TCP/IP connections, and pin headers for other connections.

Each family product shall contain nomenclature that is clearly marked housing cover.

Power Requirements

The family of products shall require a customer-supplied 12VDC regulated Power Supply, with Battery Backup and Input Surge protection, and AC Failure and Battery Low contact outputs.

The reader interfaces shall be capable of supplying 12VDC power to most card readers, but door locking hardware shall require separate power.

Operating Parameters

The family of products shall be capable of operation from 0° to 50° C (32° to 120° F), 0-95% RH, Non- condensing.

The family of products shall be capable of installation in an indoor environment, or otherwise protected in a NEMA-4 Rated Enclosure.

Reader Supervision

The reader interface products shall be capable of monitoring a periodic Reader Supervision message from a reader with this capability, and shall send a reader offline message to the Host, if the message is not received in the event of reader failure or tampering.

The networked controllers shall connect to the Host via TCP/IP (with Modem backup to the Host) and shall connect to downstream interface devices, include door interface, input monitor interface and output control interface.

The networked door controller shall incorporate a 32-bit 200 MHz ARM9 processor running the Linux operating system

The networked door controller shall provide on-board Flash memory to allow program updates to be downloaded directly via the network. The networked door controller or network controller/reader shall provide the following minimum memory:

- 128 MB on-board Flash memory

- 64 MB RAM

The networked controller shall support and communicate any combination of up to 32 slave controllers.

The networked controller shall store a complete access control and configuration database for any combination of up to 32 downstream devices.

The networked controller shall process access control decisions for all connected devices. The networked controller shall process input/output linking for all RS-485 connected devices. The networked controller shall store a transaction history for all RS-485 connected devices.

The networked controller shall connect to the Host and to other devices on the TCP/IP network

The networked controller shall be capable of supporting cardholder databases of 250,000 cardholders (without database changeover) and 125,000 cardholders (with database changeover).

The networked controller shall provide the ability to backup connect to a host via dial-up or wireless modem.

The networked controller shall report all activity to the host.

The networked controller shall receive and drive execution of all real time commands from the host.

The networked controller shall allow local connection of a laptop computer for diagnostics, verification, display or change of card database, configuration database, and transaction history via the TCP/IP or diagnostic port.

The networked controller shall control and communicate with all RS-485 connected devices when offline with the host.

The networked controller shall upload all buffered transactions to the Host when communications are restored.

The networked controller shall have the following IO connections

- RJ-45 connector for Ethernet TCP/IP
- Four RS-485 connections to Reader, Input or Output Interface Units
- Two configurable analog inputs for general purpose applications
- Two non-latching output relays for local alarm annunciation
- AC Fail (if provided by power supply) monitor input
- Battery Fail (if provided by power supply) monitor input
- Enclosure Tamper Monitor input

The networked controller shall have two RS-232 ports, which shall allow fallback communications with the host system in the event of loss of the network (TCP/IP Ethernet) by means of dialup modem or wireless modem

The networked controller shall provide on-board persistent memory to allow program updates to be downloaded directly via the network.

1.2 Reader Interface Device

The reader interface device shall perform all of the basic input / output and access control functions for two doors (or one door with entry and exit readers).

The reader interface device shall connect to a networked controller via an RS-485 network, and shall have a rotary address switch (Range: 0 - 15).

The reader interface device shall have the following IO connections:

Two (2) Readers, in one of the following configurations:

- Two (2) Wiegand interface readers with or without PIN keypads
- Two (2) Clock-and-Data readers
- Two (2) Keypad readers
- Two (2) Door Monitor switch/contact inputs
- Two (2) Request-to-Exit device inputs
- AC Fail (if provided by power supply) Monitor input
- Battery Fail (if provided by power supply) Monitor input
- Enclosure Tamper Monitor input

The reader interface device shall have non-latching relay outputs for the following:

- Two (2) door locking devices (configurable)
- Two (2) auxiliary devices (door held/forced alarm, alarm shunt, communication failure, or general purpose)

The reader interface device shall have local processing capabilities as follows:

- Alarm Shunt and Strike relay timing and latching functions
- Access control decisions based on facility code (degraded mode)
- Simple input/output linking on the same V100
- LED / Beeper control during Card + PIN and other transactions.

Parameter	Specification
Processor	ARM Cortex A8 – 800MHz
RAM	512 MB DDR3L
Operating System	Android® 4.1.2 (Jelly Bean)
Ethernet	100BASE-T
USB	USB 2.0 On-The-Go (OTG)
Door Access Controller	1A (1-Output, 2-Input, 1-Relay)

LCD & Interface	2.0 inch Capacitive Touch screen
LEDs	1 (Power & Status)
User Capacity	500 users (1K biometric records)
Transaction Logs	25,000
Operating Temperature	0°C to +60°C (32°F to +140°F)

1.3 SYSTEM SERVERS AND WORKSTATION HARDWARE

Hardware Requirements:

The following table describes the hardware requirements to install HRView in your computer.

Hardware Component	Recommended
Processor	Intel Xeon E5 Family 4 Cores(8 Threads) 3.0 Ghz - 3.6 Ghz
CPU	3.0 GHz or Above
RAM	8 GB (expandable upto 32GB)
RAID	SATA RAID-5 Controller
Hard Disk	500 GB (Dual)
Secondary Storage	CD Drive for installation
Monitor Display	19" or above, True color (for client component)
Peripheral Device	Mouse, Key Board
Printer/USB Port	2 USB port(optional)

For Client components

Any standard computer with Microsoft Windows XP/2003/2008/windows7 with Min 4GB RAM

Software Requirements

Component	Recommended
Operating System	Server 2008 R2/Windows Server 2012 R2 Standard or Express Edition (32/64 bit)
Database Engine	Microsoft SQL server 2008/2012/2014 Standard or Express Edition
Browser	Latest version of IE (10 or Above) or Mozilla Firefox or Google Chrome
IIS Server	IIS server 7.0 or Above
MS Excel	MS Excel 2003 or above
Acrobat Reader	Acrobat Reader 8 or above

***The SQL Express edition has a database size limitation of 10GB**

1.4 Access Control Software.

Centralized, Flexible, Expandable architecture:

- Many applications can share same Database
- Can be integrated with third party Hardware like fire, intruder, etc
- Customization is possible if required
- Any combination of HID VertX and Edge Controllers can be connected to same Application
- Allows to manage multiple companies, locations, System
- No limitation on adding companies and Locations
- Intelligent tool to get details of newly added network controller automatically.
- Manage employee details & access restrictions.
- Bulk import of Cards

If the Organization is having large no of employee's the application has the facility to import allcard numbers in bulk from excel sheet in a specific format. User can download this specific format from application itself. This facility reduces the time required for data entry.

Supports multiple card formats on same system

- Support up to 253 card formats
- 26 bit card format, 32 bit, 34 bit card formats and 35 bit corporate 1000 format.
- Also support custom card formats

Facility to read unknown card formats

- If card format is not known the application can accept raw hex value
- Select any reader from application, show unknown card format on selected reader
- Application gives information about Facility code and card number of the unknown card.

Manage up to 65535 access groups

No limitation on time zones No limitation on Door Groups

No limitation on Holiday Groups

Manage Extended Access & Pass back exempt

- User can define normal access grant time, for physically challenged employee it's not possible to pass through the door as per normal access grant time.
- Application has facility for such Card holders to assign extended access time so that door force alarm should not generate.
- Application has facility of antipass back but for some key peoples in the organization we can bypass the Anti-passback by exempting them.

Timed/Real Anti-passback for area control : If you set Time Anti-Passback then user can't get access once he swap the card for particular time interval which is defined. If you set Real Anti- Passback then at define area user get normal access.

Facility to reset Antipas back for particular employee in case emergency

Time Attendance System

Web based or client server architecture option available

- No limitation on employee login in case of time attendance system.
- No need of client in case of web based architecture.
- User can view his data/ can request for leave/OD/Tour simply by login in to application from provided URL itself.
- In case of Client Server architecture user can request for leave/OD/Tour from any system in LAN where client application is installed.

Add and manage multiple companies, locations, departments, designations. No limitation on adding companies and Locations

Real time system, on the fly data processing for attendance calculation.

Sections: Group employees into different sections governed by Section Heads for better control.

Multi-user System with various roles and rights to operate system

Maintain Dynamic user hierarchy

- Super admin
- Section admin
- Hierarchy
- Employee

Employee Management: Admin or HR person can add employees. Each Employee master consists of following details.

- Company
- Location
- Department
- Sub Department
- Designation
- Code & Name of Employee
- Email ID
- Address
- DOB & DOL
- Joining Date

- Photograph
- Gender

Multiple categories (attendance rules setting).

Totally user defined settings.

Punch Setting:

- User can define which punch should be consider for time calculation.
- User can define maximum Hrs allowed for employee continuously.
- Provides much flexibility in punch selection for time attendance calculation.

General Setting:

- Work Hrs settings: User can define Min full day hrs and Min half day hrs.

Check IN time Setting: User can set punch time as a check in time

- Application can Ignore punches with difference of less than specified time. (Time is user defined)
- Application should round up work hrs to the nearest, Before and Next level. User can set the time slot.
- User can set Compensation off setting as Min work hrs applicable for comp off and min extra hrs applicable
- for comp off. Also user can set no of comp off in a month.
- User can set Weekly Off in between absent days set as Absent.
- User can set Holiday in between absent days set as Absent.

Over time & Late/Early Setting:

- User can set Overtime Starts After time
- User can define Min OT hrs after Shift and Min OT hrs before Shift
- Based on setting User can Consider OT for work on Wkly Off and Consider OT for work on paid holiday.
- User can set timing for late and early timing based upon company rules.

Shift Management: Multiple shift structures can be created including night shift. Shift rosters i.e. rotational shift patterns can be created & assigned to the employees. Flexi Shifts

Intelligent and auto logic for night shift handling

- User can set IN-OUT mode in category so that the employee who continues shift till next day, the report should generate for shift start date.

- Supports more than 24 work hours using IN/OUT readers
- User can set two different reader for In and Out so that the entries from In reader should consider as IN and the entries from Out reader should consider as Out.
- User can set the maximum hrs the employee can work continuously.

Holidays: Single or multi-day holidays can be added. No limitation on adding holiday

Leave Management: Can maintain various leave rules as per organization policies.

- User can set the leave year
- User can define leave code as per company policy like Cl, SL, PL etc

Leave rule: User can set various rules as

- Max no of days allowed
- Max days allowed at a time
- Max no of times allowed
- Min days allowed at a time/ half day allowed
- Weekly Off in between leave days set as leave
- Holiday in between leave days set as leave
- User can set leave opening balance
- User can send request to section head for leave sanction.
- Leave Carry forward: Leaves will be carried forward from previous year balance.
- Leave Opening balance: User can define leave opening balance.

Manual Punches: Facility to add manual punches has been provided for attendance adjustment.

Compensation Off: Comp-off can be given to an employee if he has worked on holiday/weekly-off day or on the basis of his extra working hours. User can set Compensation off setting as Min work hrs applicable for comp off and min extra hrs applicable for comp off. Also user can set no of comp off in a month.

OD(Outdoor Entry): No of hrs can be defined to mark outdoor entry which means time utilized for official work outside office which gets added into the work hours

Tour Entry: Tour entry can be added if the employee is outside for single/multiple days for official work.

Special Entry: This is a special feature provided where-in the admin can over-write the day status of an employee as present or half-day.

Overtime Request & Approval: Section head can request for bulk overtime approval of all employees under him which can be sanctioned by the authorized user.

User Hierarchy: There are 4 different user profiles in the system i.e. Admin, Section head, Hierarchy admin(Company, location, department or sub-department admin) and Employee.

Employee Login: Employee can log into the system & track his attendance & also apply & track status of various requests like manual punches, leave, tour, outdoor entry etc.

Online Request Management: E-mail can be configured to be sent for various requests like manual punches, leave etc. The authorized admin can also handle these requests online without logging in to the software & the employee is notified back by an e-mail about the request status.

Bulk import & export of employees provided.

Application has facility of bulk import & export of data for following:

- Import master data
- Import shift roaster
- Import export employee data
- Import leave opening balance

Application has standard format to import the data in a specific format. Can be integrated with access control & payroll software.

- Application has the open architecture and centralised data base so that other application like access control and payroll software can be integrated with Time attendance software.
- With Access control software we can define specific reader for IN-OUT for attendance purpose.
- The data received from Access control application should be processed in time attendance software and the processed the data can be use for payroll.

Audit log for all actions against each user: Application has facility for audit log report this gives user details with company, date, time and location of login

Attendance calculation analysis shown for support

- Attendance analysis gives punch details about previous day, current day and next day.
- Report shows shift applied and category applied for the employee
- Based upon settings anlysis report gives summary for day status, total work hrs, extra hrs, break time, late time and early time.

Active directory integration

ERP report: The user can configure the report settings & generate report in any required format.

- User can set report for ERP as report header, date format, date separator, field separator and row terminator.
- User can select the field required for ERP report just by drag-drop option.
- User can add custom text field and can add column header

Wide range of Reports provided with various filtration options which can be exported to a number of formats like PDF, Excel etc.

Following reports are available with Time attendance software: Monthly:

- Employee attendance
- Muster
- Employee shift details
- Graphical report:
- Working hrs histogram
- Attendance summary

Other reports:

- Time card
- IN OUT
- Late Coming
- Early Going
- Continuous absentee
- Continuous late coming
- Continuous early going
- Daily attendance
- Tour
- Special Entry
- OD entry
- Punch

Present in premises /Absent

- Audit log
- Leave register
- Leave Balance
- Leave request
- Daily attendance analysis
- Approved Overtime
- Shift deviation
- Comp off
- Summary
- Department wise summary
- Attendance summary
- Attendance report

- Punch time
- Monthly muster
- ERP report

UTILITIES:

User Access: The Supervisor can define the security level. Each user can have his password & change it. The modules can be accessed depending upon the security level.

Backup: To back up the data for safekeeping.

Change Password: This utility allows the administrator to change password of users.

EML LOCKS

The electromagnetic locks shall be renowned with its excellent holding force and the remarkable features.

- Voltage Input : 12 VDC / 24 VDC
- Current Draw : 12V / 500mA ; 24V / 250mA ($\pm 5\%$)
- Holding Force: Up to 600 lbs (272 kg)
- Hall Effect Contact: SPDT rated 2A at 24 VDC
- Anti-Rust Surface Treatment: Blue Zinc Plating
- Operating Temperature: 0~55° C (32~131° F)
- Operating Humidity: 0~95% (non condensing)
- Weight (Magnet) : 1 kg ($\pm 1\%$)
- Dimensions : Magnet - (L) 220x(W) 42x(T) 25 mm
- Armature - (L) 180x(W) 38x(T) 11 mm

SPECIFICATIONS / FEATURES:

- Compact Size for Space Saving
- Dual Voltage Selectable (12 VDC or 24 VDC)
- Low Current Consumption
- Reliable Holding Force
- Hall Effect Sensor Monitoring Output
- Green/Red LED Indication for EM Lock Status
- Durable and Silence Operation
- Cosmetize Anodized Aluminium Casing
- Surge & Spike Protection PCB
- Anti-Tamper Jam Nuts
- Anti Residual Magnetism Kick Off Button

The magnetic lock shall consist of a magnet mounted onto the door frame and a steel plate attached to the top of the door. The door will be strongly bonded when the magnet is energized holding the steel plate. Instant release is possible when the power supply is cut off, making it most ideal in

emergency escape situation.

2 VISITOR MANAGEMENT SYSTEM

1. The system shall support defining visitor management policy with following options:
 - a. Mandatory fields for visitor pass issue
 - b. Whether appointment is must for every visitor
 - c. Whether Access Card issue to visitor is compulsory
 - d. Whether visitor request to be approved by the group administrator
 - e. Whether Email based approval
 - f. Sending of Email/SMS to the approved visitor
 - g. Sending Email/SMS to the employee on visitor arrival
 - h. Pop up on Employee's system on visitor arrival
 - i. Banned visitor notification
 - j. Lapse Time (Time after which appointment will get expired)
 - k. Default Departure Hours (if some other time is not set)
 - l. Pre Appointment hours (Time before the scheduled appointment during which pass can be generated)
2. System shall support Kiosk Mode option for Visitor management Host application at the reception desk with following fields:
 - a. Name
 - b. To meet
 - c. Company
 - d. Contact No.
 - e. Email Address
3. System shall support **Web-based Visitor Appointment management process** with following features:
 - a. Creating approver groups
 - b. Assigning approver group in bulk to an employee set (Employee can choose to send Visitor request to anyone in the approver set)
 - c. Employee shall be able to check his/her visitor request status.
 - d. Approvers shall be able to check visitor request status
 - e. Approver shall receive Email notification of visitor request by an employee and shall be able to either accept or reject the request by clicking on the embedded web link.
 - f. User Interface for an employee to put up visitor request
 - g. Visitor shall receive email/sms notification on appointment request approval.
4. System shall support following features in the host application at the reception desk:
 - a. Today's appointment and expected visitors
 - b. System user shall check or Inform visitor regarding their appointment status (Pending approval, Rejected, Expected, Inside, Inside Overstay, Visited)

- c. Issue visitor pass with following optional or/and mandatory fields
 - i. Visitor Name
 - ii. Company (Visitor)
 - iii. No. of accompanying person
 - iv. Contact No.
 - v. Email ID
 - vi. Purpose
 - vii. Visitor Type
 - viii. Valid upto (Date and Time)
 - ix. Address
 - x. Remarks
 - xi. To meet Employee
 - d. Option for multiple check In Check out on a single pass for contractors and vendors
 - e. View previous appointments of the visitor
 - f. Real time list of visitors inside
 - g. Real time list of unreturned cards/passes
 - h. Notification on visitor overstay
 - i. Print and record Asset being carried or being deposited by the visitor
 - j. Print and record Vehicle being driven by the visitor
 - k. Option to scan and record visitor identification documents (at least 3)
 - l. Auto complete text boxes for search employee, visitor purpose, visitor type
 - m. Visitor Photo Capture via web camera
 - n. Custom Visitor pass template designing based on following parameters
 - i. Pass dimensions
 - ii. Drag and drop images with custom dimensions such as visitor image, company logo, authorized signatory image, pass id barcode and visitor signature
 - iii. Drag and drop Data fields with custom dimensions such as Visitor name, To meet, Visitor company, Pass expiry date, pass id etc.
 - o. Visitor/contractor - badge/pass printing as per the template designed via Laser printer, smart card printer
 - p. Integration with Barcode scanner for visitor assets scanning
5. The system shall support Access control system integration to control visitor access to specific doors for a predefined time as per following parameters
 - a. Assigning up to four access groups to a visitor
 - b. Elevator access groups
 - c. Escort Employee option
 - d. Pass back exemption
 - e. Extended access
 6. The system shall be extendible to multiple gates for same premises with centralized server
 7. The system shall be extendible to multiple branches with centralized server
 8. The system shall support integration with Signature Pad for capturing of visitor signature
 9. The system shall support integration with SMS modem and Email server for sending SMS and

Email on various events as specified in company policy.

10. The system shall support pop up notification on corresponding Employee computer screen on visitor arrival.
11. The system shall generate following reports for selected time period for selected or all visitors
 - a. Visitor Summary: Report showing visitor’s track history
 - b. Daily Report: Report showing visitor log on day to day basis
 - c. Individual Access report: Report showing visitor details based on card shown on access readers
 - d. Reader Access Report: Report showing card shown by visitor on selected reader

3 TRIPODS

PRINCIPLE OF TRIPOD

Tripod barriers should be ideal solution for a quick singling out of people and for access control. They have to be installed nearby the guard/entrance or building to control the crowd. They should be combined with all type of card readers or ticketing machines.

FUNCTION

Type 0: mechanical, one direction free, opposite direction blocked **Type 1.1:** one direction controlled, opposite direction blocked **Type 1.2:** two directions controlled
Type 2: two direction controlled withservo positioning drive

DRIVE

Type 0 / 1.1 / 1.2:

Manual, end point positioning Type 2, servo positioning drive:
 After a release and a manual push, the tripod barrier should turn automatically by 120°.Door should also open under load.

In the event of power failure

Type 0:one direction free, opposite direction blocked
Type 1:both directions blocked
Type 2:both directions turn freely

Once the Power is Back

If crossbar is folded down, it must be replaced manually. Type 2 resets automatically.

3. Electrical Components

Power supply:

- Operating Volatage: 110 - 250 VAC, 50 - 60 Hz, Control voltage: 24 VDC
- 4 inputs, 24 VDC
- Single release entry /exit, release = crossbar folds down, blocking 8 outputs, 24 VDC
- 3 relays outputs, potential free Contact

Release

A potentialfree normally open contact, e. g. by means of push button or customer’s card reader

4 SWING GATES(P-GATE)

Operation

The servo positioning drive should open and close the door in the desired direction at low power. It should be able to remotely controllable by an access control system or manually controlled. Opening time and opening angle should be adjustable.

3. In the event of power failure both the sections should be free ELECTRICAL EQUIPMENT

Control in external unit
Supply: 230 VAC 50 Hz

It should be compatible with access control systems, standards, serial interfaces

Special interfaces, signal exchange with building services automation and connection of customer’s operating elements should be available on request.

Material Finish

Stainless steel satin finish glossy(Finishes will be finalized after approval from Client/ Architect)
Glazing: 10 mm toughened glass

Protection

Housing should be minimum IP43, components conducting supply voltage protection will be min IP54

Physical Construction of Swing Gate

The Passage width should be 850mm and maximum of 1000mm. Height : Door Leaf having maximum 800mm.

5 BOOM BARRIER

A vehicle access barrier shall mean a rising boom barrier that shall open in case of an impulse with the use of a valid card. The barrier shall close either after the vehicle has passed or after an adjustable hold-open time in case the vehicle chooses not to pass through. Appropriate sensors shall be used for this purpose. It shall meet the following specifications.

S.No.	Item	Description
1	Application	Outdoor
2	IP Rating	54

3	Housing	Barrier Housing Unit: Powder Coated Boom: Powder Coated White RAL 9010 with Red reflective strips.
4	Housing Dimension	Modular
5	Housing Material Of Construction	All Aluminium Housing with Base frame in SS-304 for high protection against corrosion.
6	Protection	All Housing and internal parts will be rust & corrosion free metals or alloys of high strength with suitable Epoxy coating as applicable.
7	Housing Dimension (W X D X H)	Min : 315mm X 360mm X 915mm approximately
8	Boom Specifications	The Booms shall be 4Mtrs
9	Intelligence	The barrier shall use a Blockable DC High Torque Drive in combination with CAN bus communication standard interfaced Controller. It shall offer LCD Display & Graphic User Interface for easy control setting. Possibility for integration via standard user interfaces.
10	Digital Inputs	Minimum 8
11	Digital Outputs	Minimum 4
12	RelayOutputs	At least 6
13	Compliance & Safety	<ul style="list-style-type: none"> • Compliance to CE. Adherence to Safety Requirements of the <ul style="list-style-type: none"> • EMC Directive 2004/108/EC, • Low Voltage Directive 2006/95/EC and • The basic requirements of the Machinery Directive 2006/42/EC
14	Power Supply	230+/- 10% VAC, 50 Hz.
15	Maximum Power Consumption	Not More than 100 watts
16	Opening & Closing Time	1.3 seconds for Boom Length up to 3.5 Meters 4 seconds for Boom Length Between 3.5 to 6 Meters
17	Operating Temperature	-30 Degree Celsius to + 50 Degree Celsius

18	Safety	S/W for Detection of Presence of Vehicle in Loop or in the path of Infrared Safety Sensors available. Loops or Sensors to be used to prevent barriers from closing on the vehicle.
19	Duty Cycle	100%
20	Integration	Shall function in integration with Smart cards, I class reader based access control systems etc
21	Performance Requirement	MCBF- 10 Mil Cycles MTBF- 50,000 Hours MTTR- 30 Minutes
22	Certificates Required	TUV certificate For Opening & Closing time ISO Certificate of the Company Certification for Ingress Protection EMC Test report

6 C.C.T.V CAMERAS AND VIDEO RECORDING

Scope of this section comprises the C.C.T.V cameras, housing, lens, video recording and networking.

GENERAL

All the vendors must attach the point by point compliance for below specification in their technical bid. The product described in this specification is the (IP) based Video Management (VMS) System The proposed solution shall not require proprietary computer, server, and network or storage hardware. The proposed system shall be of a manufacturer with as minimum of five (5) years of experience and offerings in the IP network video software market, the letter stating the same should be submitted by the manufacturer.

- VMS shall be highly stable software, easy on any network and very easy to deploy with the advanced Auto Detection feature for IP cameras.
- VMS shall also provide extreme flexibility as it should manage unlimited servers, sites, and cameras remotely, quickly and efficiently.
- VMS should be an open architecture Video Management Software (VMS) for Windows.
- VMS should accept MJPG, MPEG-4 and H.264 as well as Full HD and megapixel video streams from Network (IP) cameras, encoders and capture boards.
- VMS shall be client-server architecture allowing building hybrid scalable solutions from a single NVR/DVR to multiple servers handling thousands of cameras.
- VMS should accept all video streams from Network (IP) cameras from all major manufacturers such Axis, Arecont Vision, Pixord, SONY, JVC, Panasonic, IQinVision, Toshiba, Zavio, Acti, Vivotek and UDP.
- VMS should also work with several DVR cards, like H.264, SDI "HDCCTV" (up to 960fps and up to 64 channels at D1 resolution) boards from UDP and other manufacturers.

- Moreover VMS should be considered as to be a hybrid system, since a DVR card with analog cameras, IP cameras and IP mega pixel cameras, can be combined together on a single server.

Surveillance from anywhere – Multiple client options shall be supported, including VMScient, Web client and VMS Mobile client app for IOS, and Android.

Web client shall include IE, Chrome, FireFox, Safari, iOS, Android, etc. VMS Web server shall re sample and re-compress original video streams for the best performance, quality and bandwidth utilization.

Fully-featured Client application –All functions, without any exceptions should be controlled both locally and remotely (only one user interface). Anyone who is operating the client application should connect to the server, access live and recorded video, can change settings, etc. in accordance with granted user rights. It should enable quick navigation between cameras from any server.

VMS shall support EDGE/Camera based VCA(Video Content Analytics) with following features:

- DATA MINING for post event analysis and data management.
- Sensitive tracking with a low false alarm rate.
- VCA should adapt automatically to varying lighting and weather conditions.
- Simple detection zone set-up.
- VCA enabled encoder/camera shall be used as a stand-alone intruder sensor or digital output contact can be set to react to specific triggers.
- Analytics stabilization should allow software to work effectively on swaying cameras.
- Rapid 'learning time' should be just a few seconds. It shall be used with PTZ cameras - detection and has to suppress during camera movement
- The System shall support features like- PTZ auto tracking, fog and smoke reduction, image stabilization and camera tamper.
- VCA should not have single point of failure, because the Analytics should be integrated on the Edge HW; Video server or into the Camera.
- VCA should be very easy and simple to configure even for installers with limited experience.
- VCA shall fit many market segments without modifications.

Software based Video Analytics shall include:

- Counting lines
- Camera Tamper Detection
- Camera Shake Cancellation
- Surveillance tracker
- Presence filter
- Appear Disappear Filters
- Abandoned Object Detection
- Removed Object -Detection

- Class and speed filters + calibration
- Direction & dwell filters
- Tail-gating filter
- On-screen counters
- Object Meta data
- VMS data mining

Counting (Software based VCA) - Counting (people, car, and object Counting) shall be highly accurate information on the number of people who enter their premises to use their facilities. It should apply to several applications such as, airports, bus and train stations, bars and clubs, car parks, retail stores and shopping malls, museums and tourist attractions, sports and leisure facilities, and more.

VCA Metadata –VMS shall provision live Viewing of metadata filters such as: Classification for People and Vehicles.

Event and Action Management –VMS should be able to send E-mail and SMS Text notifications. It should Create Events such as: Video Lost, Video Restored, Motion Events, VCA Events and Digital Input. Create Actions such as: PTZ preset, Digital Output, Write to application/event log, Activate Layout, Popup video, Email/SMS Notification and Run program.

The VMS Client should be able to connect to multiple servers simultaneously. A client application user, if granted sufficient privileges, shall connect to unlimited number of servers to view live or recorded video as well as perform other operations.

The VMS application should not impose any limitations on how many cameras can be connected to a server.

VMS should support full featured local and remote playback –With search on motion and areas of motion one should find momentary clips of video without searching for hours. VMS in the playback mode shall allow searching for motion in specific area of the frame, for instance, if an object is missing then just highlighting the area, VMS should take one to all of the video clips that had motion in that area until one is satisfied.

Archive Investigation

The VMS shall support Multi-camera Playback and other features such as:

- Timeline
- Multi Layout Video Export without extra codec needed
- Motion regions settings
- Quick Snapshots over Timeline

Bandwidth Control – There should be built-in module in all VMS editions that shall allow oneto, enable time laps broadcast, Motion control video Transfer, Bandwidth controlled Broadcast, And Video re-compression for optimum video frame rate according to available bandwidth.

All the Client configurations should be a registered file type, so there should be possibility to store different configuration on one computer, email them or export them as database and should open them on any computer with the client

Support for the standard Direct Show devices –The VMS shall support all types of standard direct show devices that include everything from very basic USB cameras to camcorders to advanced multichannel video capture boards.

The VMS screen – shall be configurable for HDTV or wide-screen monitors (WXGA).

IP Camera Configuration –All IP cameras on the LAN shall be configured via Auto Search Wizard. Using the Wizard a user should able to find all Network IP cameras available within the network. A user should be able to configure them and connect them in no time and with little effort.

User shall be able to generate camera status report

Web Server – VMS shall provide a web server as an integrated part of VMS suite. Its sole purpose is to deliver live and/or recorded video streams in a platform independent format without exposing VMS server(s) and camera(s) to the desktop and mobile devices including IE, Chrome FireFox, Safari, iOS, Android, etc. The web-server shall re-sample and re-compress original video streams for the best performance, quality and bandwidth utilization.

VMS Mobile – VMS shall come with Mobile applications for iOS, and Android devices. It should support connections from multiple VMS servers and deliver live and/or recorded video streams.

VMS should Offer free software upgrades. When a new update Version is available VMS client Server should be equipped with an auto detection that will notify the Server or remote pc that a new version is available. During installation a wizard shall guide the user all the way through the installation for both the server or the client installation.

User-friendly wizards –VMS should be easy to use and configure. All commonly used operations, such as adding access to a new Server from the Client application, searching for Network IP cameras within a LAN, User management, etc.

Multi-Language Support –It should support English, German, French, Spanish, Portuguese, Italian, Czech, Polish, Russian, Hebrew, Hungarian, Chinese, Danish, Estonian, Finnish, Greek, Simplified

Chinese, Turkish, Korean and Japanese localizations.

Audio Support – Supports: There should be two ways Audio from IP cameras and encoders. One way Audio is supported from the H.264 frame grabber HC7008, HC7016, HC7032 and from devices it should expose as (compatible) MS DirectShow devices which should include USB audio devices.

Multicast support –(from server to multiple clients)

Authentication for Windows Domain – via Microsoft Active Directory

Server can run as a Windows Service –(no need to login). There should be a feature that allows the Running VMS server to go virtually unnoticed. Also the server should run without logging in, so the security of the server is not compromised. Server shall run as a stand alone server using Windows Exclusivity.

Enterprise Scalability and Monitoring (ESM) –All functions such as: Screen Mapping, LayoutSequencing, Alert Notifications, PTZ Control, Camera Configurations and more without exception shall be accessed and administered both locally and remotely allowing management and administration for an unlimited number of servers around the world. Flexible Event/Action configuration should enable to manage events and notifications such as emails, text messages and more task for multiple servers from one interface.

Object Tracking via PTZ Cameras.

VMS shall share SDK/API for integration of 3rd party applications. Custom programming feature should also be available.

User Management – VMS should control access to cameras and program features. Depending on user status, user shall be either allowed or denied access to software abilities and features such as: Administer server, Camera viewing, remote connection, Playback, Archive, Data Delete and so.

VMS shall allow capturing of video from any source or multiple sources. CCD, CCTV Analog cameras, SDI (HDCCTV), IP camera, USB camera, Web camera etc... Mix and match on the same machine.

USB Joystick Support –Control PTZ Cameras, Presets, Open Archive and much more from remote client with VMS supported USB Joysticks.

Map camera layouts –User shall be able to create map layouts on either Google maps or using a jpeg map. A user shall place camera markers anywhere on a map for easy navigation of cameras.

TCP Port –User shall be able to select TCP port to their preference.

Exclusivity Mode –Exclusivity Mode (windows lock-out) shall be set up, to take special care to ensure that VMS is the only application with which the user is interacting with. Advance properties should be available for start-up and password authentication.

Layouts –Create custom Layouts by grouping cameras from different Servers/Locations into groups for more efficient monitoring, and better management. Drag and drop cameras from a server or

multiple servers to custom layouts.

Layout Sequences –Layouts shall be used for Sequencing. Layout sequences shall be set incustom time intervals with custom layout priorities. Multiple Sequences shall be created and activated at any given time.

Adjustable screens –VMS window shall be able to open multiple instances. It should open asmany as monitor can handle or one can view.

Software watchdog –Advance Watchdog Operations should be Programmable withmaintenance settings. Watchdog should be configured to periodically restart server services to clear any possible problems which could degrade server system performance, (select different time frames (days, hours, Etc), Adjust auto settings for error control and advance detection for problem detection and recovery.

Video adjustment shall be available to adjust every individual camera with its own settings remotely and locally. Adjustments for Brightness, Contrast, Saturation, Sharpness, and Hue.Adjustable image quality camera by camera.Adjustable compression settings camera by camera.

Motion control recording –with option for recording frames when no motion is detected (EX.1 FPS when no motion and 30fps when Motion).

Free distribution of the client software for unlimited computers –Administrator shall **be able to** install client software on unlimited PCs at no additional cost for licensing.

Network Drive Mapping –User shall be able to map network drives at no additional cost forlicensing. Use SAN, DAS and NAS storage.

Multiple resolutions support –(camera by camera) up to D1 (frame cards) and5960 x 3352 Pixels (IP Mega Pixel Cameras)

Display Mode:

1 camera (full screen) layout 4 camera (2 x 2) layout

6 camera [2x2 + 1(large view)] layout

8 camera (7 + 1(large view)) layout

9 camera (3 x 3) layout

12 camera (4 x 3) layout

10 camera (8 + 2(large view)) layout 13 camera (12 + 1(large view)) layout 16 camera (4 x 4) layout

24 camera (6 x 4) layout

25 camera (5 x 5) layout

36 camera (6 x 6) layout

48 camera (6 x 8) layout

54 camera (6 x 9) layout

49 camera (7 x 7) layout

64 camera (8 x 8) layout

96 camera (8 x 12) layout

81 camera (9 x 9) layout
108 camera (9 x 12) layout
100 camera (10 x 10) layout
1 row of streams from 1 to 10 streams in a row.

Generic and Standard Support –VMS shall support PSIA, ONVIF and Generic RTSP compatible devices.

Quota Management –VMS should be able to assign individual per camera recording quotas. Options to constrain footage in gigabytes or duration of days or both.

Supported compressions – H.264, MPEG4, MJPEG, JPEG.

Recording operation should use FIFO Technologies (First in, First Out).

Scheduler-Based Recording:

Motion Detection –Each camera should be set to detect motion. No additional hardware should be required for motion detection; Motion detection should be performed solely on a software based level. Triggered by motion, a camera should perform numerous operations and should not be limited to only recording video. Motion activated recording should supports an unlimited number of Motion Zones that each should have unique sensitivity settings. View results in real time for easy setup. Each Label in Motion Zone should trigger actions. Event log should allows a quick review of video associated with motion or alarm events. High performance Motion Detection mode should be added, featuring software motion detection on key frame and sub stream.

Real-time playback – Without interrupting the recording cycle any camera should play back using the local or remote Client application software. Such playback should not interrupt ongoing video recordings, nor will the quality of the recordings will be compromised.

Control PTZ cameras –Pan, tilt and zoom cameras should be fully controlled from within the Client application.

The user shall be able to export Video on to CD/DVDs. After export, any computer should be able to open the exported videos with audio without the need of codec's or the need to install any playback software.

VMS shall provide an option for to pause live stream whenever archive window is open for faster remote playback

Event Indication – Flashes box around video if event is triggered or motion is detected

Export Snapshots (Save Current Frame) – shall Save as a JPEG or Bitmap file.

Output Video –for NTSC/PAL

Digital Zoom – should be available for all cameras

Screen Footer Options –It should show Average Frame rate, Resolution, Bandwidth Usage and More.

Multi streaming support (designed to reduce CPU and network load on Client PCs) Notifications on server's storage failure/malfunction

Sub stream configuration – it should be available for Generic RTSP video stream configuration.

Following are the types and specifications of cameras proposed to cater all surveillance requirement of the project:

1. Outdoor Unitized Full High Definition (FHD) PTZ Dome Network Camera:

- Outdoor Unitized Full High Definition (FHD) Rapid Dome Network Camera. The camera shall utilize a 1/2.8-type progressive scan Exmor CMOS sensor.
- 1080p FHD picture quality (1920 x 1080 pixels maximum resolution), supporting H.264 at 60 fps (IP). The number of effective pixels shall be approx. 2.38 Megapixels
- Powerful 30X optical zoom capability.
- High frame rate of 60 frames per second (fps) to provide smoother and less blurry moving pictures.
- Wide Dynamic range (Wide-D) equivalent to 130 dB.
- The Exposure mode shall be selected among Full auto, Shutter priority, Iris priority, or Manual when the unique wide dynamic range (View-DR) function is not used.
- When detecting objects which emitting strong light such as car headlights or flashlights in a very dark area, the camera shall mask the strong lights automatically.
- Minimum scene illumination of 0.4 lx in Color mode and 0.03 lx in Black and White (B/W) mode (50 IRE [IP], F 1.6, View-DR Off, VE Off, Auto Gain Control maximum rate MAX, 1/30s, 30fps).
- Bit rate (Kbps) shall be selected among 64, 128, 256, 384, 512, 768, 1000, 1500, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 16000, 24000, or 32000.
- The camera shall have an integrated 30X auto-focus powered zoom lens.
- The camera shall have 12X digital zoom capability.
- The camera shall have the total zoom ratio of 360X with 30X optical zoom and 12X digital zoom capabilities.
- The focal length shall be 4.3 to 129.0 mm
- Focus mode shall be selected among Auto or Manual (Near, Far, or One Push Focus). Also, focus near limit shall be set for the range at which to automatically focus.
- The supported resolutions shall be 1920 x 1080, 1280 x 720, 1024 x 576, 720 x 576 (PAL), 720 x 480

(NTSC), 704 x 576, 640 x 480, 640 x 360, 352 x 288, and 320 x 184 resolution.

- **IP66-rated waterproof and dust-tight feature:**

The camera shall be IP66 rated in accordance with the IEC 605292 standard for outdoor surveillance, or indoor where water ingress may pose an issue.

- **IK10-rated vandal-resistant feature:**

The camera shall be IK10 rated in accordance with the IEC 62262 standard to vandal-resistant feature for protecting the camera from destructive behaviors.

- **Intelligent Motion Detection :**

This feature shall be able to minimize the number of false alarms by eliminating environmental noise such as trees moving, ripples in water, reflection from wet roads and gain noise to name but a few. The camera should be able to compares 15 frames together, which ensures that only ambiguous objects moving can trigger a real alarm.

- **The camera shall have the following scene analytics, all of which can be set from the camera setup menu:**

- **Intrusion:** When a moving object enters the designated area, an alarm sounds.

- **Passing:** A passage line is determined, and when a moving object passes the set line, an alarm sounds.

- **Left Object Detection:** When an object has been left unattended for too long in the designated area, an alarm sounds

- **Removed Object Detection:** When an object has been removed from the designated area, an alarm sounds.

- The camera shall be compliant with the Open Network Video Interface Forum Profile S (ONVIF Profile S) conformance.

2. Fixed-type Full High Definition CS-mount Network BOX Camera

- Fixed-type Full High Definition (FHD) CS-mount Network Camera

- 1080p FHD picture quality (1920 x 1080 pixels maximum resolution), supporting H.264 at 60 fps (IP)

- The camera shall utilize a 1/2.9-type progressive scan Exmor CMOS sensor.

- The number of effective pixels shall be approx. 2.14 Megapixels.

- The focal length shall be 2.8 to 8.0 mm.

- The aperture range for the lens (F number) shall be F 1.2 (Wide) to F 1.95

- The supported resolutions shall be 1920 x 1080, 1280 x 720, 1024 x 576, 720 x 576 (PAL), 720 x 480

(NTSC), 704 x 576, 640 x 480, 640 x 360, 352 x 288, and 320 x 184 resolution.

- Wide Dynamic range (Wide-D) equivalent to 130 dB
- Simultaneously encoding up to 3 of the following streams in any combination, including multiple instances of the same compression format: JPEG and/or H.264 (High/Main/Baseline Profile)
- Minimum scene illumination of 0.1 lx in Color mode and 0.07 lx in Black and White (B/W) mode (50 IRE [IP], F 1.2, View-DR Off, VE Off, Auto Gain Control maximum rate MAX, 1/30s, 30fps).
- The camera shall adjust the target brightness for the automatic exposure setting by selecting the exposure correction value from the list box on the menu
- The camera shall have a True Day/Night (D/N) function to switch to Day mode (color mode) or Night mode (black and white mode) depending on the light level.
- The camera shall also have 4X digital zoom capability.
- The camera shall have the total zoom ratio of 11.6X with 2.9X optical zoom and 4X digital zoom capabilities.
- The camera shall have an Easy Focus function, which adjusts the camera focus via the Easy Focus button on the rear of the camera or remotely via the GUI. When the camera is switched between day and night modes, the Easy Focus function is activated to keep the camera focused.
- The camera shall be compliant with the Open Network Video Interface Forum Profile S (ONVIF Profile S) conformance.

3. Vandal-resistant Mini Dome Full High Definition (FHD) Compact Network Camera

- Vandal-resistant Mini Dome Full High Definition (FHD) Compact Network Camera
- 1080p FHD picture quality (1920 x 1080 pixels maximum resolution), supporting H.264 at 30 fps (IP)
- The camera shall utilize a 1/2.9-type progressive scan Exmor CMOS sensor.
- The number of effective pixels shall be approx. 2.14 Megapixels
- The focal length shall be 2.8 mm.
- The aperture range for the lens (F number) shall be F 2.0
- Wide Dynamic range (Wide-D) equivalent to 90 dB.
- Simultaneously encoding up to 3 of the following streams in any combination, including multiple instances of the same compression format: JPEG and/or H.264 (High/Main/Baseline Profile)

- Bit rate (Kbps) shall be selected among 64, 128, 256, 384, 512, 768, 1000, 1500, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 16000, 24000, or 32000
- Minimum scene illumination of 0.3 lx in Color mode and 0.3 lx in Black and White (B/W) mode (50 IRE [IP], F 2.0, View-DR Off, VE Off, Auto Gain Control maximum rate MAX, 1/30s, 30fps).
- The camera shall have polygonal privacy zone masking which blocks out unwanted or prohibited area within the video image to protect privacy.
- The camera shall have the following scene analytics, all of which can be set from the camera setup menu:
 - **Intrusion:** When a moving object enters the designated area, an alarm sounds.
 - **Passing:** A passage line is determined, and when a moving object passes the set line, an alarm sounds.
 - **Left Object Detection:** When an object has been left unattended for too long in the designated area, an alarm sounds
 - **Removed Object Detection:** When an object has been removed from the designated area, an alarm sounds.
- **IK10-rated vandal-resistant feature:**

The camera shall be IK10 rated in accordance with the IEC 62262 standard to vandal-resistant feature for protecting the camera from destructive behaviors.
- The camera shall be compliant with the Open Network Video Interface Forum Profile S (ONVIF Profile S) conformance.

4. Outdoor IR Bullet Full High Definition (FHD) Network Camera

- Outdoor IR Bullet Full High Definition (FHD) Network Camera
- 1080p FHD picture quality (1920 x 1080 pixels maximum resolution), supporting H.264 at 30 fps (IP)
- Wide Dynamic range (Wide-D) equivalent to 90 dB
- Minimum scene illumination of 0.1 lx in Color mode and 0 lx in Black and White (B/W) mode (50 IRE [IP], F 1.2, View-DR Off, VE Off, Auto Gain Control maximum rate MAX, 1/30s, 30fps, IR illuminators On*) with built-in IR (Infrared) illuminators.(* B/W mode)
- The camera shall have 20 pieces of built-in IR LED illuminator to provide high-quality IR images. This shall allow for capturing images in the complete darkness (0 lx) while avoiding wash-out of the object, and users can recognize the object even it is very near to the camera in Night mode.
- **Intelligent Motion Detection (IMD):**

This feature shall be able to minimize the number of false alarms by eliminating environmental noise such as trees moving, ripples in water, reflection from wet roads and gain

noise to name but a few. This is very different to other manufacturers that typically compare just two frames together. This camera compares 15 frames together, which ensures that only ambiguous objects moving can trigger a real alarm.

As a result, this enables end users to focus on real events, not suffer from loss of attention and quickly locate video that has been recorded upon alarm activations.

- The camera shall adjust the target brightness for the automatic exposure setting.
- Focal Length $f = 3.0$ mm to 9.0 mm
- The camera shall have the total zoom ratio of 12X with 3X optical zoom and 4X digital zoom capabilities.
- The camera shall have a True Day/Night (D/N) function to switch to Day mode (color mode) or Night mode (black and white mode) depending on the light level
- Bit rate (Kbps) shall be selected among 64, 128, 256, 384, 512, 768, 1000, 1500, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 16000, 24000, or 32000
- The camera input power shall be Power over Ethernet (PoE) (IEEE 802.3af compliant, Class 2).
- Power consumption for the camera shall be Max. 11.4 W (IEEE802.3af-compliant PoE system).
- The camera operating temperature shall be within the following range:
-22 °F to +122 °F (-30 °C to +50 °C)
Cold start temperature must be greater than -4 °F (-20 °C).
- The camera storage temperature shall be within the following range:
-4 °F to +140 °F (-20 °C to +60 °C)
- **IP66-rated waterproof and dust-tight feature:**
The camera shall be IP66 rated in accordance with the IEC 605292 standard for outdoor surveillance, or indoor where water ingress may pose an issue
- The camera shall be compliant with the Open Network Video Interface Forum Profile S (ONVIF Profile S) conformance.

5. 360-degree Panorama view Mini Dome Network Camera with 5-megapixel CMOS Sensor

- The camera shall provide 5-megapixel, high-resolution video and a 360-degree view of an area with the use of just one camera. The camera shall be ideal for both indoor and outdoor environments.
- The camera shall utilize a 1/2.5-type progressive scan CMOS sensor.
- The number of effective pixels shall be approx. 5 Megapixels
- The lens shall capture 360 degrees of real-time video.

- 5-megapixel (2560 x 1920) high resolution live video, supporting H.264 at 10 fps (IP) and JPEG at 13 fps.
- The camera shall require a minimum scene illumination of:

Color:

0.7 lx (50 IRE [IP], F 2.0, Auto gain control maximum rate MAX, 1/30s, 10 fps) (fisheye mode)

0.4 lx (50 IRE [IP], F 2.0, Auto gain control maximum rate MAX, 1/30s, 10 fps) (fisheye mode)

B/W:

0.3 lx (50 IRE [IP], F 2.0, Auto gain control maximum rate MAX, 1/30s, 10 fps) (fisheye mode)

0.1 lx (50 IRE [IP], F 2.0, Auto gain control maximum rate MAX, 1/30s, 10 fps) (fisheye mode)

- The dynamic range shall be more than 60 db.
- The focal length shall be 0.98 to 1.12 mm.
- The aperture range for the lens (F number) shall be F 2.0.
- The camera shall be capable of 1 guard tour (position tour), for which up to 20 presets can be programmed, and moves to each preset sequentially when guard tour is activated.
- 11 kinds of view modes:
A variety of 11 multiple view modes supported by Active X shall be capable of having 360-degree immersive navigation, including the camera's original 360-degree hemispheric view, a 180-degree panoramic view and multiple simultaneous views all produced from the same hemispheric image.
- The camera shall have up to 5 privacy zones masking (quadrangle formed by any 4 corner points) which blocks out unwanted or prohibited area within the video image to protect privacy. Mask colors shall be Black.
- The supported resolutions shall be:
for Fisheye mode (H.264, JPEG): 2560 x 1920, 2048 x 1536, 1600 x 1200, 800 x 600, 640 x 480
for 1080p mode (H.264, JPEG): 1920 x 1080, 1600 x 904, 1360 x 768, 1280 x 720, 640 x 360
- Bit rate (Kbps) shall be selected among the range of 20 Kbps to 16 Mbps.
- Frame rate (fps) shall be selected among the following ranges:
 - 1 to 10 for H.264 (fisheye mode)
 - 1 to 13 for JPEG (fisheye mode)
 - 1 to 30 for H.264 and JPEG (1080p mode)
- Simultaneously encoding up to 3 of the following streams in any combination, including multiple instances of the same compression format: JPEG and/or H.264 (High/Main/Baseline Profile)
- **IP66-rated waterproof and dust-tight feature:**
The camera shall be IP66 rated in accordance with the IEC 605292 standard for outdoor

surveillance or indoor where water ingress may pose an issue.

- **IK10-rated vandal-resistant feature:**

The camera shall be IK10 rated in accordance with the IEC 62262 standard to vandal-resistant feature for protecting the camera from destructive behaviors.

- The camera shall be compliant with the Open Network Video Interface Forum Profile S (ONVIF Profile S) conformance.

6. Outdoor Ruggedized Mini Dome Full High Definition (FHD) Network Camera with Built-in IR illuminators

- Outdoor Ruggedized Mini Dome Full High Definition (FHD) Network Camera
- 1080p FHD picture quality (1920 x 1080 pixels maximum resolution), supporting H.264 at 30 fps (IP)
- The camera shall utilize a 1/2.9-type progressive scan Exmor CMOS sensor.
- The number of effective pixels shall be approx. 2.14 Megapixels.
- Wide Dynamic range (Wide-D) equivalent to 90 dB
- Simultaneously encoding up to 3 of the following streams in any combination, including multiple instances of the same compression format: JPEG and/or H.264 (High/Main/Baseline Profile)
- Minimum scene illumination of 0.1 lx in Color mode and 0 lx in Black and White (B/W) mode (50 IRE [IP], F 1.2, View-DR Off, VE Off, Auto Gain Control maximum rate MAX, 1/30s, 30fps, IR illuminators On*) with built-in IR (Infrared) illuminators.
(* B/W mode)
- The camera shall have 20 pieces of built-in IR LED illuminator to provide high-quality IR images without overexposure.
- The IR illuminators shall be effective (50 IRE [IP]) at 30 m (98.4 ft.).
- The camera shall also have 4X digital zoom capability.
- The camera shall have the total zoom ratio of 12X with 3X optical zoom and 4X digital zoom capabilities.
- The camera shall have an Easy Focus function, which adjusts the camera focus.
- The focal length shall be 3.0 to 9.0 mm.
- The aperture range for the lens (F number) shall be F 1.2 (Wide) to F 2.1 (Tele).
- **Intelligent Motion Detection:**

This feature shall be able to minimize the number of false alarms by eliminating environmental noise such as trees moving, ripples in water, reflection from wet roads and gain noise to name but a few. The camera shall compare 15 frames together, which ensures that only ambiguous objects moving can trigger a real alarm.

As a result, this enables end users to focus on real events, not suffer from loss of attention and quickly locate video that has been recorded upon alarm activations.

- **IP66-rated waterproof and dust-tight feature:**

The camera shall be IP66 rated in accordance with the IEC 60529 standard for outdoor surveillance, or indoor where water ingress may pose an issue.

- **IK10-rated vandal-resistant feature:**

The camera shall be IK10 rated in accordance with the IEC 62262 standard to vandal-resistant feature for protecting the camera from destructive behaviors.

- The camera shall be compliant with the Open Network Video Interface Forum Profile S (ONVIF Profile S) conformance.

7. IP based Network video management software

- Software Version capable of supporting minimum 230 cameras & above
- Should Include Licenses for 205 cameras
- One Server should not cater to more than 70 cameras.
- Unlimited clients Licenses
- The Client shall support minimum 5 X 5 Live & Playback View.
- Supported camera Brands & Models as per makes in Tender Specs
- Auto Detect Camera devices during setup.
- System Login must support Windows Active directory Secure Connection through HTTPS
- Compression Technology supported must be MJPEG, MPEG4, MXPEG & H.264.
- Software features should include Virtual Matrix Alarms, Map Support, logs / alarms, memory management.
- Software should have capability to support its own video analytics or seamless integration with 3rd part vendors if required later on stage

8. Intel Xeon E5 2620 V2 (Octa Core)

- 3.10 GHz, 15 Mb 1600 MHz, 16 GB RAM, 1TB HDD, MULTI BURNER; RAID 01 in built (M5110e card) ,1TB GB 10K 6Gbps SAS 2.5" SFF G2HS HDD, QLogic 8Gb FC Dual-port HBA for IBM System x, Microsoft Windows Server Standard 2012 R2 ROK,5License Windows Server CAL 2012

9. Recording Storage Server/NAS Box

10. Should be capable of recording all the cameras @4CIF resolution @ 25 FPS @ 300 Bitrate for 90 days recording in H.264 Format with Minimum 60 TB HDD usable at RAID 5. Cost to be included with 36 Months Warranty and Replacing the same in 10 hours incase of any System Failure

11. Client Workstation with following configurations:

- Processor – Intel i7 4770K/ 3.10 GHz,
- Memory – Minimum 4 GB,
- Hard disks – 120 GB SATA at 7200 rpms,
- OS- Windows 7, Ultimate edition 64bit,
- Network Card – 2Gbit/s network card,
- NVIDIA Graphic card of minimum 2 GB,
- Dual Port card for connecting minimum of 4 below LCD Screen
- Should complete with all accessories required to complete the installation as per project requirements

12. 55" Thin Bezel LED monitor

1920 x 1080 P (16:9) Resolution LED monitor

2 HDMI & 1 VGA ports,

2 USB connectivity complete with all accessories required to complete the installation. With

Minimum viewing of 16 CCTV Snap

13. Racks For server & storage

- 42 U Equipment rack / Console with glass door
- 19 inch cable manager used for routing cables horizontally at the frontend of the cabinet.
- Earthing kit to provide grounding to the equipments on the rack.
- Overall height is 2033.5 mm
- Usable height is 1866.9 mm
- Overall depth is 124 mm
- Overall width is 600 mm

14. 28 port PoE layer 2 Fully Managed switches

- Number of ports are 24 Ports 10/100/1000 Mbps PoE 4 SFP
- Network cables : UTP Cat.5, Cat.5e (100m max) & EIA/TIA-568 100-ohm STP (100m max)
- Full/half duplex for 10/100Mbps speeds
- Switching Capacity is 56 Gbps
- Minimum of 30 Watt available at each Port and maximum of 370 Watt.
- with IP multicast snooping and data-driven IGMP support
- Operating temperature is 23° to 122° F (-5° to 50°C)
- Storage temperature is -4° to 158° F (-20° to 70°C)

15. 24 port PoE layer 2 Fully Managed switches

- Number of ports are 20 Ports 10/100/1000 Mbps PoE 4 SFP
- Network cables : UTP Cat.5, Cat.5e (100m max) & EIA/TIA-568 100-ohm STP (100m max)
- Full/half duplex for 10/100Mbps speeds
- Switching Capacity is 56 Gbps
- Minimum of 30 Watt available at each Port and maximum of 370 Watt.
- with IP multicast snooping and data-driven IGMP support
- Operating temperature is 0° to 40°C
- Storage temperature is -40° to 70°C

16. 28 port PoE layer 3 Fully Managed switches

- Number of ports are 24 10/100 BASE-T + 4 Combo 1000BASE-T/SFP
- Network cables : UTP Cat.5, Cat.5e (100m max) & EIA/TIA-568 100-ohm STP (100m max)
- Switching Capacity is 12.8 Gbps
- Ethernet Ring Protection Switching
- Loopback Detection
- Maximum power consumption 23.4 Watt.

- Mean time between failure is 9.5 Mpps
- Operating temperature is 0° to 50°C

17. CAT 6 armoured cable

- 23 AWG Annealed Bare Solid Copper
- Sheath of cable is Fire Retardent PVC Compound (FR PVC)
- Flame rating of cable is 70° C As per Vertical Tray Flame Test As per UL 1685 CM rating
- Operating temperature is -20° to 75°C
- Storage temperature is -20° to 75°C

18. 6U wallmount panel

Construction features:

1)Top and Bottom covers : Multi-bend one piece construction for accentuating cantilever stress. Design incorporates a 45mm cavity which is used to accommodate exhaust at the top and cable length at the bottom . Top and bottom covers are ventilated on all sides for assisting natural air flow. Also provided are 15mm pitch incremental square slots along the depths of the cover for recess mounting of panel mounts.

2)Cable entry provision : Is provided by 35mm round knock outs in the top and bottom covers which are edge protected by rubber gromets to prevent cable damage.

3)Side panels : Side panels are provided with hinges and slam latches for easy access of the equipments from the sides. Side access ensures proper reach to the accessories mounted on the rear 19" panel mounts.

4)Vertical member : A set of 4 vertical pillars (multibend design) with a gusset welded to close the ends at the top and bottom to ensure high lateral stability under cantilever load condition.

5)Front toughened glass door : Ventilated metal trims with a toughened tinted glass pasted permanently. Ventilation provided on the trims to avoid creation of heat pockets between the equipment face and the glass door.

6)19" panel mounts : L- Angle construction with 9.5mmx9.5mm square shots provided in 1U pitch pattern to hold standard cage-nuts. Mounting Dimensions to IEC-297-3 for all electronic equipment.

• Dimensions of Panel:

- Overall height is 371.3 mm

- Usable height is 266.7 mm
- Overall depth is 500 mm
- Usable depth is 356.75 mm
- Width is 600 mm

2 SYSTEM REQUIREMENTS & NETWORK

1. The supported operating systems shall be Microsoft Windows 8.1 Pro 32 bit and 64 bit, Microsoft Windows 8 Pro 32 bit and 64 bit, Microsoft Windows 7 32 bit and 64 bit (Ultimate/Professional), Microsoft Windows Vista 32 bit (Ultimate/Business), and Microsoft Windows XP 32 bit (Professional).
2. Minimum PC requirements shall be the Intel Core i7, 2.8 GHz or higher, with 2 GB RAM or more supporting 1600 x 1200 or higher resolution, 24-bit True Color display capability with Ethernet 100Base-TX.
3. The camera shall incorporate a built-in web server, such that the standard web browser Microsoft Windows Internet Explorer (version 7.0, 8.0, 9.0, 10.0, or 11.0 recommended) can be used to access the camera without need for special viewer software.
4. The following web browsers can also be used to access the camera with the plug-in free viewer: Firefox version 19.02, Safari version 5.1 and Google Chrome version 25.0.
The plug-in free viewer enables the above browsers automatically when they are started. The plug-in free viewer display method will be selected automatically.
ActiveX viewer can allow for H.264 (High/Main/Baseline Profile) video streams and JPEG format images on the Google Chrome version 25.0.
5. The camera shall support ActiveX viewer which allows the camera image to be viewed in Internet Explorer.
The ActiveX viewer allows for recording of video and audio directly to the PC's hard drive, and supports direct audio from the PC Mic to the camera.
6. The camera shall be capable of generating HTML code for the video image, allowing for easy web page integration.
7. The camera shall support the following network protocols:
IPv4, IPv6, TCP, UDP, ARP, ICMP, IGMP*, HTTP, HTTPS, FTP (client only), SSL, SMTP, DHCP, DNS, NTP, RTP/RTCP, RTSP over TCP, RTSP over HTTP, and SNMP (v1, v2c, v3).
Network security shall be via password (basic authentication) and IP filtering.

7 BAGGAGE INSPECTION SYSTEM

The machine should be capable of scanning Laptop Bags, Tiffin carrier, Visitor bags, International passenger bags and very flat objects such as envelopes.

7.1 Tunnel Dimensions - Tunnel should be capable of scanning the baggage size of not less than 780 mm x 580 mm.

7.2 Penetration – The Penetration shall not be less than 39 mm steel plate typical & 37 mm steel plate guaranteed.

7.3 Sensitivity –

The machine should be able to display a single insulated copper wire of 38 Gauge Wire (Guaranteed) & 40 Gauge wire (Typical).

7.4 Health & Safety -

Machine should be International standards including the U.S.F.D.A., Center for Devices and Radiation Health performance standards for cabinet X-Ray systems (Federal Standard 21-CFR 1020.40). Also permitted by the Federal Standard. Film safety guaranteed for high speed films up to ISO 1600.

7.5 X-ray dose –

The radiation level should not exceed accepted health standard i.e., within 0.1 Mr. / hr. at a distance of 5 cm from external housing.

7.6 X-ray beam divergence –

The X-ray beam divergence should be such that the complete image of maximum size of bag is displayed without corner cuts.

7.7 X-ray Inspection –

Facility for variable contrast should be incorporated to allow enhancement of lighter and darken portion of the image. System should have facility of variable Gamma, organic & inorganic stripping, baggage counter

7.8 Lead impregnated safety screens –

Lead impregnated safety screens should be available at either ends of the tunnel.

7.9 Color Imaging –

The system supplied shall be of 6 Colors& 1 Grayscale Color Image options.

7.10 Conveyor Height –

The Conveyor height shall be in the range of 720-730 mm.

7.11 Conveyor belt Speed –

Conveyor speed shall be atleast 0.23 m/s in forward direction.

7.12 Input / output rollers system –

The input and output frame shall be provided with rollers of length in multiples of 500 mm on each side with barrier frame to prevent bags falling off.

7.13 Conveyor Load –

165 Kg distributed load (364 lbs)

7.14 Operating Temperature & Humidity –

The operating temperature should be 0°C to 50 °C Humidity - Up to 95% non-condensing

7.15 Power Requirements & Power Conditioning –

Power Requirements shall be 230VAC 50 Hz. 10 Amp Max Power Conditioning – UPS Power shall be provided.

7.16 Bi-directional Scanning –

Bi-directional scanning facility should be provided without holding any switch.

7.17 Certification –

The quoted system shall have the following approvals –

- 1) AERB
- 2) CE
- 3) CB
- 4) ISO 9001
- 5) 3. 3rd Party Electrical Safety Certifications

7.18 Operational Safety –

Emergency stop switch at both the ends of tunnel should be provided

7.19 User Manual –

Three sets of operator manual should be provided with the system.

7.20 X-Ray Generator -

The X-Ray generator should be of the minimum rating as mentioned below –

- 1) Anode Voltage - 180kV – operating at 165 kV.
- 2) The system should operate at a voltage lesser than the maximum or rated voltage to increase the life & output of the X-Ray Generator.

- 3) Tube Current – Shall not exceed 1.2 mA
- 4) Cooling - Hermetically sealed oil bath
- 5) Beam Direction - Vertically upwards
- 6) Duty Cycle – 100%

7.21 Monitors / Display Units –

The system should be able to produce clear color& Monochrome images on Dual 19 in. (48.26 cm) high-resolution, low radiation, ergonomic, LCD color monitor

7.22 Keyboard Controls –Image features should be keyboard controllable.

7.23 Zoom facility –

Zoom facility should be available to magnify the chosen area of an image up to x32 or more.

7.24 Contrast Sensitivity–

24 Visible Levels & Approximately 4096 Grey levels should be stored.

7.25 Computer Specifications -

The Computer should from a standard manufacturer (Dell, HP, Compaq) with the minimum specifications as mentioned below –

At a minimum: Core II Duo 3.0 GHz, 2 GB RAM, 160 GB HDD, 256 MB Video Card with Digital Display, UPS to support PC and electronics.

7.26 Operating Software –

The system should work on one customized, OEM Designed software only. The software shall be Windows based.

7.27 Keyboard Control –

- i) All operating software features should be controlled from keyboard of machine only.
- ii) Keyboard function should be “user friendly”

7.28 Standard Features

The standard features shall include the following –

- Automated image archiving - up to 50,000 images
- User-friendly Image review - for up to last 100 images
- System Health, Advanced continuous diagnostics
- High penetration function

- Density alert
- Edge-enhancement imaging
- Baggage counter
- Color and black/white imaging
- Bi-directional conveyor movement
- Geometric image distortion correction
- Horizontal and vertical imaging
- Image annotation
- Manual archiving of images in bitmap format
- Organic and inorganic imaging
- Clarify feature for improved resolution and penetration
- Print image function
- Programmable penetration and contrast levels
- Pseudo-color and reverse monochrome
- Real-time image manipulation
- High resolution 19 in. (48.26 cm)LCD Monitors
- User-defined access to image archive
- 2X to 32X User-selectable zoom
- Z-number measurement

7.29 Optional Features –

The system shall have the following optional features that may be incorporated for future –

- Advanced Image Archive, up to 100,000 images
- Threat Image Projection software
- Screener Assist Threat Detection System
- Localized language capability
- Entry/exit rollers (0.5m, 1.0m or 1.5m)
- Barrier for roller table
- 24 in. (60.96 cm) LCD monitor ,(replaces 19 in. [43.18 cm] monitor)
- Tropical Kit
- Remote configuration
- Remote Workstations
- Suspect Search Station
- Supervisor Workstation
- Foot mat
- Heavy-duty rubber casters
- Polar Heating Kit

7.30 Threat Image Projection (TIP) Software –

Password Protection – All software features of machines should be ‘online” and “password” protected.

1. Report Facility - The system should have software controlled diagnosis report facility and the system should give printout, if printer is connected.
2. Rebooting – The system should not require reboot to enable / disable a software feature.
3. Operators training – TIP software facility should be incorporated in the offered X-ray machine to assist supervisors in testing the operator’s alertness and training X-ray screener /operators to improve their ability in identifying specific threat object.
4. TIP Image Library – The TIP facility should have an image library containing at least 100 explosive devices, 100 knives and 100 firearms as well as CDs, floppies, thumb devices, etc .,in various sizes, shapes, locations and orientations.
5. Expansion of TIP Library - The system should have facility to expand the library to incorporate additional images by user without assistance of the manufacturer.
6. Image Analysis - Once the screener / operator has responded to identify the computer generated threat image, it should remain on the screen for a predefined user programmable time for analysis. The image should be highlighted, upon identification, and feedback message shall be visible to the screener / operator.
7. System Administrator - The threat image projection facility should have details of user database such as screener / operator name, user ID number, level of access such as screener / operator and Administrator with password.
8. Restricted Access - Access to startup menu should be restricted only to authorized individuals. A login procedure by means of ‘Password’ or ‘Security Key’ should be provided to achieve restricted access.
9. Log-in - The login procedure should not take more than 20 seconds.
10. TIP Bypass - The system should have facility to bypass the TIP facility, if programmed so, by the system Administrator. It is to be ensured that the TIP software should not be a hindrance to normal functioning of X-ray machines.
11. TIP Database - All TIP data should be stored in the system database for a minimum period of two months, after it has been downloaded. No individual, regardless of access rights to the TIP components should be able to delete or amend any of the TIP data i.e. TIP data on the actual x-ray machine should be stored as read-only files.

12. Feedback - The feedback should clearly indicate on screen that a TIP object has been correctly identified / TIP object has been missed/No TIP object was present. No message needs to be presented if the screener / operator correctly passes a clear bag.
13. TIP Logs - TIP log should indicate particulars of name of the screener/operator, time and date of threat image projection, whether threat image was successfully identified or missed, etc.
14. Reports - The report on TIP system should have date and time (from-to) as per requirement, screener/ operator particulars and decision/outcome such as 'HIT', 'MISS' or 'FALSE ALARM' in percentage as well in absolute numbers, number of bags screened, categories of threat objects such as explosives devices, knife, weapon, etc.

7.31 Physical Dimensions –

The Physical dimensions shall not exceed 1880 mm x 1023 mm x 1394 mm (74 in x 40 in x 55 in)

7.32 Continuous Diagnostic Software Feature –

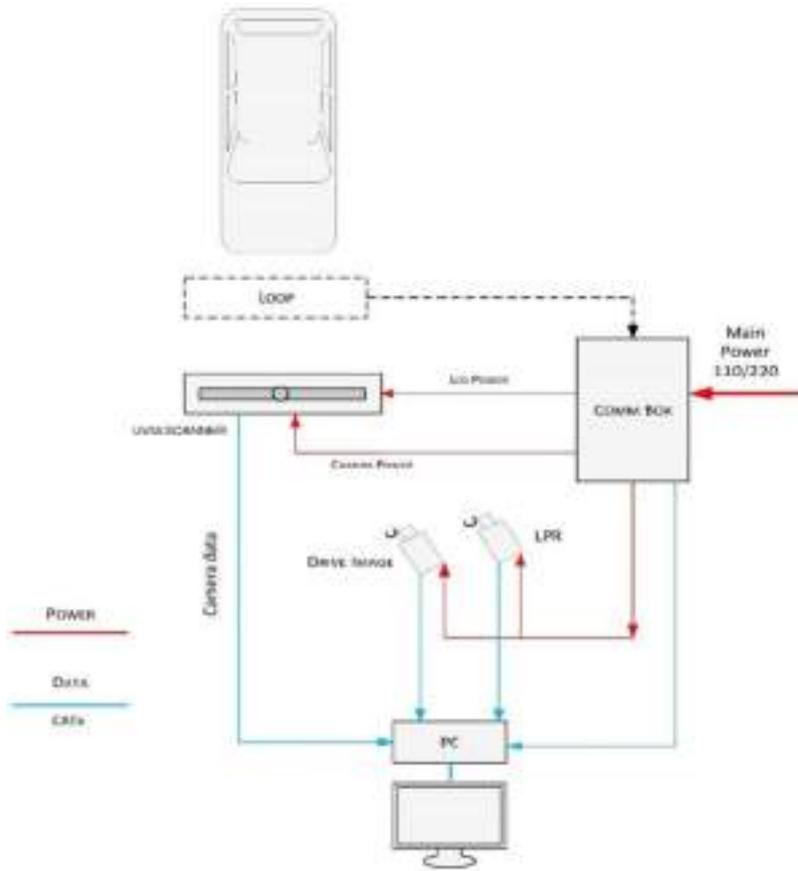
The supplied system shall be equipped with Continuous Diagnostic software which shall monitor all the critical components of the system like the Power Supplies, X-Ray Generator, Voltages, Current, Diodes, Tunnels, Temperature, etc. and generate the log of errors files.

8 UVSS (Under Vehicular Surveillance System) Specifications

1. The Under vehicular Surveillance system (UVSS) shall be provided with complete system that will consists of the latest technology in Area Scan cameras, Monitors, Industrial Strength PCwith no fans and a sealed body with a minimum configuration of a Pentium i7, 8 GB Ram, 1 TB HDD, 6 USB Ports, 1 HDMI Port, 1 Display Port, 1 – DVI port, 2 – RS-232 Ports, 2 RS-485 Ports, 1 E-SATA HDD Port and 1 Digital Audioconnection, related cabling, LPR Camera, Driver Image camera, LED Lighting arrangement , Relays, Data Acquisition module, Loop Detector Module , Loop Detector Cable, metal framing for in ground , Outdoor NEMA rated Field installation box and the associated Power supplies.
2. The UVSS camera shall be suitable for day /night operation along with a minimum of 23” LCD monitor for viewing.
3. The UVSS shall have a capability of storing a minimum of 100,000 images or more if required.
4. The UVSS should be able to capture very high resolution & complete composite underbody image of any vehicle passing over it, without the vehicle being required to be fully stopped, by using an Ultrahigh quality color AREA Scan camera.

5. The UVSS should be able to handle vehicles moving at different speeds ranging from 1 KMPH up to 75 KMPH, while the composite image so captured by the system should be automatically and dynamically adjusted according to the speed of the vehicle using multiple loop based sensors.
6. The UVSS system should have a feature of dynamically and automatically adjusting the brightness and contrast of the system to ensure good quality images, irrespective of the different external lighting conditions.
7. The UVSS system should have a facility to view the composite image and video images, offline for all vehicles.
8. The UVSS system applications & operating software shall be based on open architecture. It shall have a user friendly Graphical User Interface (GUI) with provision for multiple users logging of events and search facility.
9. The UVSS must have a feature to magnify the composite images (current and past), so as to facilitate a closer and zoom-up view of it.
10. The UVSS system must have a facility to take back-up of all the transactions to any usual backup / storage media and also should be able to print out reports.
11. The UVSS components should be enclosed in a suitable all-weather-proof housing.
12. The UVSS complete civil installation structure should be suitably designed so as to withstand total vehicle load up to 75-Tons, so as not to cause any accidental or physical damage to the unit.
13. The UVSS should have open protocol for integration with other security systems and also networking for any remote monitoring requirements.
14. The UVSS Unit shall be having 900 FPS. This shall help the user determine upon site conditions for the allowable speed of the vehicles. 900 FPS will support up to 75 KMPH.
15. The UVSS shall have an option for Monochrome or Color resolution.
16. The UVSS shall have a minimum warranty of 2 years on the system.
17. The UVSS shall have no limitation on Vehicle length.
18. The UVSS system shall be field replaceable.
19. The UVSS shall have capability of importing database from client's approved list to activate approved drivers entries on campus along with LPR / vehicle details and images of drivers.

20. The UVSS shall have provision for different hierarchy for authorization for operating the system.
21. The UVSS shall have capability to dynamically adjust the image up to speed of 75 KMPH.
22. The UVSS shall use a Progressive Area Scan GigE IP Camera.
23. The UVSS shall have a frame rate of minimum 500 FPS up to a maximum of 900 FPS to support speeds of up to 75 KMPH.
24. The UVSS shall have a minimum resolution of 1400 with a field of view of a least 145 Deg. at the Widest angle with ultra-low distortion using patented Linear Optical Technology® at a minimum of 5 megapixel resolution.
25. The UVSS camera shall be UL / CE and FCC certified.
26. The UVSS shall not use older Line Scan technology.
27. The UVSS shall not require any additional auxiliary view cameras to view hard to see area of the undercarriage.
28. The UVSS system shall have provision to record and save Driver image of all Right hand side or left hand side driven vehicles.
29. The UVSS system should have LPR capabilities to record, identify and read plates from all countries, irrespective of fonts, language, and or formats. The displayed information should support the GUI on the screen as well as capability to print and save in different formats as per the users' needs.
30. The UVSS should be able to be supported on line if required by user.
31. The UVSS should be able to connect to other Devices (i.e Boom Barrier,AccessControl,IP CCTV etc). It should have the connectivity for integration with other devices.
32. The UVSS System should be able to keep a record of all the vehicles for at least 1 Month and be able to compare the images of same Vehicle if appeared earlier to detect any foreign materials attached to CAR and this should give an Alarm on the screen for better security.



9 SPECIFICATION SHEET FOR MULTI ZONE DFMD

GENERAL SPECIFICATIONS:		REQUIREMENT
	Detectable Metals	Detection capability for both ferrous and non ferrous metals
	Passage dimensions	Height- 185cm or more Breadth – 70cm or more Width – 50cm or more
	Weight	90kg maximum
	Alarm	Audio Visual alarm with alphanumeric LCD display, height on person bar display (Metal locator), low battery indication.
	Sensitivity	Wide range of sensitivity setting and fine tuning, Adjustable in step to 250 levels. Including a 4 level Base setting.
	Zones	9-Zones. Minimum
	Calibration	Manual and automatic by built- in key pad. All functions should be programmable and controlled by a microprocessor.
	Counter	Intelligent traffic counter for calculating the number of people in and out also the alarm number with percentage display.
	Protection	a.) Conform to relevant electric safety standard (Supported by Test Certificates from NABL accredited laboratory). b.) Magnetic field should be harmless to Pacemakers, magnetic media, and photographic films (Supported by Test Certificates from NABL accredited laboratory)
	Temperature	The DFMD should work satisfactory in temperature range of -10 DegC to +55DegC and humidity of 95% non-condensing. (Supported by Test Certificates from NABL accredited laboratory)
HARDWARE SPECIFICATIONS:		

	<p>Control Panel:</p>	<p>a.) A suitable control panel shall be provided to turn unit on, access and adjust setup and programming. The control panel shall be used to turn the DFMD on. The unit should be ready to operate within ten seconds. The manual self-test shall be activated at any time by pressing suitable control menu. The control panel shall be used to turn the DFMD off, ensuring that all of the information and settings are stored in memory before shut down.</p> <p>b.) The DFMD Control panel should be tamper proof. All settings should be secured with a key lock. Further security should be accomplished with a cabinet lock to prevent unauthorized access to physical cables, connectors & electronics.</p>
	<p>Display:</p>	<p>A visual display should be located in the overhead panel. The display should provide calibration and operational information, including program and sensitivity settings, operator functions. The display should display all self-prompting regulation and control functions as well as traffic count information.</p>
	<p>Counter:</p>	<p>The DFMD shall have a traffic counter that should track the number of people that have passed through the detector, the number of alarms and should calculate the alarm percentage. The counter should be used to obtain an automatic update on the traffic count.</p>
	<p>Zones:</p>	<p>The detector shall have a minimum of 9 zones of metal detection. These zones shall operate as individual detectors and detect the presence of metal in their confined region. Zone display shall be on front panel with human symbol. The zones shall be arranged in the following methodology: Top Left, Top Center and Top Right. Middle Left, Middle Center and Middle Right. Bottom Left, Bottom Center and Bottom Right</p>

<p>Alarms and Indication:</p>	<ul style="list-style-type: none"> a.) There should be both visual and audible alarms. It should be possible to adjust volume of the audible alarm. At its loudest setting, the volume should be adequate to overcome ambient noise present nearby. b.) Green to Red indication as visual indication of an alarm should appear when the unit detects a targeted amount of metal within the walk-through according to the program and base sensitivity settings. When a target is detected, the alarm light should appear even if the audio volume is off. c.) A Bargraph Display should be provided which can indicate the approximate quantity of metal passing through the detector. d.) A mimic display should be present on the control panel which can indicate the locations of zones that have detected the metal. e.) There shall be a visual Indication for operation on Battery and on Mains.
<p>People Counter:</p>	<p>The DFMD shall have a traffic & alarm counter inbuilt. The system should also be functional bi-directional. The counter should track the number of people that have passed through the detector, the number of alarms and should calculate the alarm percentage. The counter should be used to obtain an automatic update on the traffic count.</p>
<p>Power Supply and Battery Backup:</p>	<p>The DFMD shall have a 90-270v operation SMPS Power Supply, Should be provided with internal battery back-up for 12 hours minimum operation in case of power cut. The Battery shall be of lead acid maintenance free type.</p>
<p>Remote Control:</p>	<p>The DFMD shall have a remote control to operate the control panel without using the buttons on the panel. The Remote shall have similar buttons as on the control panel to allow similar operation.</p>
<p>PC Connectivity:</p>	<p>The DFMD shall have a provision to interface to a Computer Network using the Ethernet connection. There shall be a</p>

		provision to interface multiple DFMD's on the same network to monitor or control the detectors through Software.
OPERATIONAL FEATURES		
	Ready Time:	The DFMD shall be ready to operate in less than 10 seconds after the detector is switched on. The Detector shall calibrate itself automatically after being switched on. All the settings in memory saved previously shall be applied automatically.
	Password Protection:	<ul style="list-style-type: none"> a.) There shall be two levels of password protection for User and Supervisor level device control. Both User and Supervisor shall have their own passwords. b.) The Supervisor shall have the authority to change or reset the password for both User and Supervisor. c.) The Passwords shall be saved in memory and shall be retained in case of power loss to the DFMD.
	Control Level Restriction:	The level of access to the settings of the DFMD shall be restricted in two Levels, User and Supervisor. The User shall have access to only the Basic settings, whereas the Supervisor shall have access to all the Settings of the DFMD.
	Volume Levels:	There shall be at least 10 levels of volume control settings. At the lowest level of setting the volume shall be completely off for silent operation in areas where noise is not permitted. When the volume is set to zero the visual indications shall not be affected.
	Alarm Time:	It shall be possible to adjust the time duration of the alarm, This should allow the Supervisor to set the Alarm indication to the desired time period depending on the flow of people.
	Sensitivity:	The sensitivity for all the 9 zones shall be programmable individually, or as Top, Middle and Bottom zones in groups of 3. It shall also be possible to set the sensitivity for all zones at once to Low, Medium or High.
	Base Level:	There shall be a provision to select the Base level settings

		between 3 levels. This shall affect the sensitivity of all the zones of the detector. A High Base level shall make the zones more sensitive to the metal.
	Frequency Control:	It shall be possible to adjust the frequency of operation of the detector. This shall enable multiple detectors to work close to each other without interfering with each other. There shall be at least 15 level of frequency control capability. Once the frequency is selected it shall be saved in memory.
	Traffic Counter:	<ul style="list-style-type: none"> a.) The traffic counter shall count the number of people passing through the detector. It shall display the balance of people in one direction. b.) The counter shall count the number of alarms and shall also Display the Alarm percentage. c.) It shall be possible to set the increment and decrement direction of the Counter.
	Infrared Sensors:	It shall be possible to disable the Infrared sensors from the menu system by the Supervisor if required. The Counter shall continue to operate in this situation.
	Auto Set and Self test:	There shall be a provision for the DFMD to set itself automatically if required. This feature can be used to setup the DFMD in any environment at optimal levels. There shall be a self test capability, in case the User or Supervisor wants to check the proper functioning of the detector.
ACCESSORIES		
	Software CD:	There shall be compatible PC Software to control and Monitor the DFMD. The Software shall have the following features: <ul style="list-style-type: none"> a.) Capability to set the sensitivity of each zone, Base Level, Volume, Alarm Duration etc through a PC terminal. b.) The Software shall have a display of the Counter from

		<p>the DFMD</p> <p>c.) There shall be a provision to reset the counter or the DFMD from the PC terminal.</p> <p>d.) The Software shall also display the serial number from the DFMD.</p> <p>e.) There shall be a provision to set the DFMD to the default settings from the PC interface.</p>
	User Manual:	There shall be a user manual with information on installation, operation and Software operation and installation.
	Floor Mounts:	ABS Plastic Floor mounts shall be provided for safety and mounting the DFMD to the floor. This shall prevent it from falling if pushed over by someone.
	TEST Samples	Test samples for testing during commissioning and during maintenance.

List of approved makes- ELV System		
Sr.no	System	Make
1	Dome, Bullet CamerasCCTV Camera (UL Listed)	Honeywell/Bosch/Pelco/Sony/Mobotix/Avigilon
2	Network Video Recorder	Honeywell Enterprise/Bosch/ Pelco/ Sony
3	Display Monitor	Samsung/ Sony/ LG
4	Network Switches	Cisco/ Juniper/D Link
5	Cat 6 LAN cable (Structured Cabling) / Patch cable	D Link/Legrand/ Systimax
6	Network/Server Racks	Netrack/ WQ/ Paduit/ Rittal/ Emerson/Valrack/ Schneider(APC)/Der wiser
7	OFC	D Link/Legrand/ Systimax
8	Patch panels	Cisco/ Juniper/D Link
9	IP Based EPABX System	Matrix/ Panasonic/ NEC/ CISCO /Ericsson
10	Anolog/ Digital IP Based Phones	Matrix/ Panasonic/ NEC/ CISCO /Ericsson
11	Telephone Jack	Matrix/ Panasonic/ NEC/ CISCO /Ericsson
12	Managed Network Switches	Cisco/ Juniper/D Link
13	Differential Pressure Switches	Honeywell/Siemens/Dwyer/Fipro/GreyStone
14	Water Flow Switches	Honeywell/Siemens/Dwyer/Fipro/GreyStone
15	CO2 Sensor	Honeywell/Siemens/Dwyer/Fipro/GreyStone
16	Level Switches	Honeywell/Siemens/Dwyer/Fipro/GreyStone
17	Level Transmitters	Honeywell/Siemens/Dwyer/Fipro/GreyStone
18	Flame Proof Level Switch	Honeywell/Siemens/Dwyer/Fipro/GreyStone
19	Hydrogen Sensor	Honeywell/Siemens/Dwyer/Fipro/GreyStone
20	Static Pressure Sensor	Honeywell/Siemens/Dwyer/Fipro/GreyStone
21	Current Relay	Honeywell/Siemens/Dwyer/Fipro/GreyStone
22	DDC Panel	Atlas CATV/Arrow Engineers/Valrack/Rittal
23	Indoor CCTV	Sony/Pelco/Mobotix/Avigilon
24	PTZ CCTV	Sony/Pelco/Mobotix/Avigilon
25	POE Switches	Dlink/Cisco/Panduit
26	Management Server	HP/Dell/IBM/Dell/EMC
27	Recording Server	HP/Dell/IBM/Dell/EMC

28	LCD	Samsung/LG/Sony
29	VESDA	FAAST/System Sensor/Minimax
30	Seamless Pipe	Jindal/Astral/Zenith
31	NOVEC1230	Minimax/UTC/Chemtrol/Fenwal
32	ACS Controller	HID V2000/DDS/LENEL/Cardax
33	Access Card Reader	HID/DDS/LENEL/Cardax
34	Biometric Reader & Controller	-Kronos/Lenel/Invixium
35	EM Locks	Algatec/Adit/Bell
36	Push Button	Algatec/Adit/Bell
37	PAS	Bosch/Ateis/Schrack
38	UVSS	Comport/Elgoteam/Gate Keeper
39	Signages Board	Autoglo/Prolite/Glowmax/Technoware
40	Tripods & P Gates	Kabba/Elka/Automatic
41	Boom Barrier	Magnetic/Automatic/Kabba/Elka
42	Baggage Scanner	Rapiscan/Autoclear/Smith/Hyundai
43	2cx1.5sq.mm Cable armoured shielded multistrand	Polycab/RR Kabel/Caliplast/Lapp
44	4cx1.5sq.mm Cable armoured shielded multistrand	Polycab/RR Kabel/Caliplast/Lapp
45	8cx1.5sq.mm Cable armoured shielded multistrand	Polycab/RR Kabel/Caliplast/Lapp
46	8cx1.5sq.mm Cable armoured shielded multistrand Twisted	Polycab/RR Kabel/Caliplast/Lapp
47	CAT-6 Cable armoured	BEC/KEC/Precision
48	PVC Conduit	BEC/KEC/Precision
49	GI Conduit	BEC/KEC/Precision
50	Cable Tray	Profab/Indiana

Notes : If any of the make for above materials is not available, then Architect/ Client reserves the right to suggest/ approve the alternate make for the same.

Note:- Besides the above makes, Banks Engineer / Architect has the right to permit use of any equivalent brand / material matching the specified criteria / quality standards.

35.0 TECHNICAL SPECIFICATION FOR SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF LIFTS**SCOPE OF WORK**

a) The work covered by the contract is for Supply, Installation, Testing & Commissioning of following lifts in Proposed Construction of Residential Twin Towers at Block No 41, Gift City, Gandhinagar, ujarat, with one year free comprehensive maintenance of all lifts. The installation work shall meet the requirements as detailed in tender documents and specifications

A. Lifts-

- i) 4 x 14 Passengers, 2.50 MPS, LMR/MRLS Lift. Stops as per Drawing
- ii) 2 x 12 Passengers, 2.50 MPS, LMR/MRLS Lift. Stops as per Drawing

b) The Bidder shall assume full responsibility for the details of equipment selection. Erection and commissioning of the lifts. The installation shall comply with all the safety codes and GIFT Lift Rules & Regulations (If Any) .

c) Excluded from the Scope of Lift Installation Work

The following items of work are excluded from the scope of Lift Installation Work

- i) Clear finished hoist way
- ii) Overhead including floor slab and the lift pit
- iii) Ventilation of lift shaft
- iv) Electrical Power Supply with isolating switch and 2 Nos earth continuity connections to the Controller of Machine IL Emergency and Test Panel(s) when the controller is mounted in the lift well.

V) Architraves for Lift Entrance

IV. Hoisting hooks/ISMB/ISMC in overhead ceiling, as per Lift Supplier's Specification.

d) Included within the Scope of Lift Installation Work

All works pertaining to the lift installation including supplying, fixing and painting of machine supporting beams, bearing plates, buffer support, channels, hoistway steel door frames at each landing, fascia plates, landing sills, metal counter weight guards, guides and brackets, pit ladder and other steel items and all foundations, pedestals required shall be within the scope of lift installation work. Scaffolding for lift erection and wooden posts for supporting the door and cutting of walls, floors ceilings, steel reinforcements or partitions together with any repairs made including those required for pit floor, grouting of all bolts, sills, steel members indicator and button boxes etc in position, and making good the damages including wiring and providing light points and socket outlet points in the hoistway and pit shall be within the scope of lift installation work.

2. CODES AND STANDARDS

Design of elevator components, their installation and operation shall meet with

1. IS-14665 (Part-2/Section-1) 2000 specifications for electric passengers and goods elevators.
2. IS-14665 (Part-2/Section-1): 2000 code of practice for installation, operation maintenance of electric passenger and goods elevators.
3. IS-i 4665 (Part-i): 2000 outline dimensions of electric elevators.
4. IS-i4665 (Part-3): 2000 for Safety Rules.
5. IS-14665 (Part-4): 2000 for components of elevators
6. I.E. Rules, 1956, as amended upto 2005.

All codes and standards referred herein mean the latest and any work to alternative cc or practice shall be specifically stipulated by the Bidder citing the variations for acceptance by the Owner.

3. POWER SUPPLY

a) Necessary electric power supply connection required till the completion of erection of the equipment will have to be arranged for by the contractor at his own. However, the Owner may assist the contractor in obtaining such connection temporary wiring carried out for this temporary supply will be in conform it; the requirements of the local power supply agency. The necessary connection charges for temporary supply as well as consumption charges if provided/arranged by Owner will have to be borne by the Contractor.

b) Permanent Electric Supply for the machines, lift car lights and fans and lights well shall be available from the main switches of lift control panel. Any wiring onward from these switches shall have to be carried out by the contractor at his cost. Earthing required for the equipment shall also have to be provided by contractor at his cost from the earthing terminals provided by the Owner near controller/machine.

Adequate nos of light points and power outlet points with necessary local switches shall be provided for the lift well(s) and pit(s) by the contractor including making necessary wirings and earthings from the switch provided by the owner.

4. Abbreviation

Wherever the following abbreviations occur they shall be interpreted to read as follows B.S.S.: British Standard Specification.

ISS: Indian Standard Specification.

3. I.E.E. Regulations: Regulation for the Electrical Equipments of Building issued by the Regulations Institution of Electrical Engineers, London.

I.E. Rules: Indian Electricity Rules in force at the time of installation A.C: Alternating Current

K.W: Kilowatts

B.H.P: Brake Horse Power M.P.S.: Meter Per Second KG: Kilogram

MRL: Machine Room Less

5. AMBIENT TEMPERATURE AND HUMIDITY CONDITION

All lifts with associated equipments shall be suitable for continuous use in an ambient temperature of 450 centigrade and relative humidity of 100%, both not occurring simultaneously.

6. CONTRACT DRAWINGS

The successful Bidder shall be required to submit the following drawings at appropriate stages for approval of the Architects/Owner.

- i) General arrangement drawing in plan and elevation.
- ii) Plan, Cross sectional elevation and end view of the machinery wherever applicable including their weight, and various force, reactions acting on the floors, walls foundations.
- iii) Drawing showing details of locations of fixtures for guides in the lift shaft. iv) Foundation drawing of all plants including weight wherever applicable.
- v) Schematic Control Circuit Drawings.

On completion of the work, a complete set of 'As Built' drawings in triplicate shall be handed over to the Owner for their record. Schematic wiring diagrams are also to be handed over to the Owner in triplicate at the time of handing over. Further, a copy of the detailed wiring diagram shall be framed and installed by the contractor in a location suggested by the Owner/Architect.

7. TECHNICAL PARTICULARS

Bidder shall furnish Technical particulars of the equipments offered in the proforma as attached so as to enable a critical technical analysis of their offer.

8. COMPLETION TESTS

A. Load Test

A contract load test under the supervision of Statutory Authorities and in presence of the Owner's representative shall be carried out before the lift is put into commission. During the test the brakes, limit switches, buffers and car safety devices shall be caused to function with the contract load in the lift. The lift shall be tested for accuracy of levels at all loads in either direction and for smooth vibration less travel. The lift shall be accepted upon satisfactory completion of the contract load test and after the same is certified by Statutory Authority/Lift Inspector and Owners representative.

B. Other Completion Tests

i) Insulation resistance tests to earth of the entire electrical equipment and wiring installation are to be carried out by means of a constant pressure of 500 volts testing megger set and the test result shall not be less than 1 megohm.

ii) Result of continuity test of the conduit installation and any other metal work earth shall not be more than one ohm.

iii) The temperature of motors and associated control equipments shall be checked after a continuous run of at least one hour duration to ensure U temperature rises are within the limit.

iv) Test for speed shall be carried out and the speed shall not vary more than 10% of the specified speed under any conditions of load during ascending r descending.

9. FEES & LICENSES

The Contractor shall submit requisite application forms with necessary fees to the State Lift Inspector/Authority for permission to erect and for operation after getting the requisite forms (to be provided by him) duly filled in and signed by the Owner. He will liaison with the lift inspector including payment of all incidental charges, and arrange the provisional approval, inspection and issue of the license by the Lift Inspector regular use of the lifts.

The contractor will bring all his tools and tackles, testing apparatus at the time inspection of Government Inspector! Authority and he will be solely responsible getting the lift installation approved/passed by the lift inspector/Authority.

Statutory fees paid by the contractor will be reimbursed by the Owner on submission of authentic documents/receipts in the name of the Owner. Other Statutory fees will be paid by the Owner on production of documents/receipts of such payment.

10. MAINTENANCE

The contractor shall undertake comprehensive maintenance of the equipment installed under this contract for a minimum period of 18 months from the date of virtual completion of the work and acceptance of the complete installation. The maintenance during the above period shall be free of cost to the Owner and shall cover weekly inspection of the equipment, carrying on necessary adjustment, oiling, and greasing and replacement of parts, if necessary and attending to the breakdown calls immediately.

11. GUARANTEE

The lift installation shall carry warranty for a period of 12 months, within the purview of Defect Liability Period, from the date of virtual completion of work and handing over, against defective materials and workmanship. During the warranty period the contractor shall rectify, repair or replace defective parts and components free of cost to the Owner.

12. TRAINING OF OWNER'S PERSONNEL

The contractor shall associate with him during the erection and maintenance period, the maintenance staff of the Owner to familiarize them with the operation and routine maintenance of the machinery and equipments.

13. Technical Data

Technical Data Sheet is attached as Annexure A

14. SPECIFICATIONS FOR THE LIFT-

i) Machinery-

Shall be Gear less (MRL design) type located directly above the lift well. This shall be complete with motor, electromagnetic brakes, shaft, sheaves, all mounted on a single bed plate. Motor shall be specially designed for lift service with high starting torque, low starting current and low noise level. The machine will be provided with dust resistant. Machine should be latest gearless design as per relevant IS.

ii) Suspension Ropes/Belt and Sheaves

a) Round steel wire rope or synthetic rope or coated steel belts can be allowed for suspension of the car and counterweight.

Steel wire ropes shall conform to IS 14665 (Part 4/Sec 8).

Synthetic ropes used shall comply with IS 15785:2007, Annex A. Ratio of sheave diameter to diameter of rope shall be minimum 25:1 and minimum factor of safety on rope breaking strength will be 16.

Coated steel belts (CSB) used shall comply with IS 15785:2007, Annex. B. Ratio of sheave diameter to steel chord will remain 40:1 and minimum factor of safety on CSB breaking strength will be 12.

b) Deflector and overhead sheaves shall be of 30 ton ferromolybdenum casting or steel, with grease lubricated bearing supported on structural steel beams. Sheaves shall be provided with grooves to maintain constant traction and positioned as to obtain proper loading of car and counter weight ropes.

c) If two to one roping is employed, to ensure safety a guard shall be provided on the top of the car as per IS: 1860-1968.

iii) Brakes

a) General Provisions

The lift shall be provided with a braking system which operates automatically: In the event of loss of the mains power supply; and In the event of the loss of the supply to control circuits.

The braking system shall have an electro-mechanical brake but may, in addition, have other braking means (for example, electric).

b) Electro-mechanical brake

This brake on its own shall be capable of stopping the machine when the car is travelling downward at rated speed and with the rated load plus 25 percent. In these conditions the retardation of the car shall not exceed that resulting from 'the operation of the safety gear or stopping on the buffer. The electro- mechanical device will also prevent the elevator from moving when the car is at rest and no power is applied to the hoist machine.

All the mechanical components of the brake which take part in the application of the braking action on the drum or disc shall be installed in two sets. If one of the components fail to apply a sufficient braking effort to slow down the car, travelling downwards at rated speed and with rated load, the other component shall continue to work.

Any solenoid plunger is considered to be a mechanical part, whereas solenoid coil is not a mechanical part.

The component on which the brake operates shall be coupled to the traction sheave or drum by direct and positive mechanical means.

A continuous flow of current is required to hold off the brake when the lift is in normal use.

The interruption of this current shall be effected by atleast two independent electrical devices, whether or not integral with those, which cause interruption of the current feeding the lift machine. If, whilst the lift is stationary, one of the contactors has not opened the main contacts, further movement of the car shall be prevented at least at the next change in the direction of motion.

Braking shall become effective without supplementary delay after opening of the brake release circuit.

Any machine fitted with a manual emergency operating device shall be capable chaving the brake released by hand and require a constant effort to keep the brake open.

Band brakes shall not be used. Brake linings shall be incombustible.

iv) Overload Protection of Lift

In case of overloading the lift, an alarm bell fitted in the car will sound to alert the passengers that the lift has been overloaded & the door will stay open and overload sensor will prevent the lift from moving until the excess load is removed.

v) Automatic Rescue Device

This will enable to move the lift car to the nearest lower landing in case of lift stoppage in between landings due to power failure. The electronic controller along with necessary dry maintenance free batteries with battery charger shall be installed at a suitable location on the top landing floor which will continuously monitor the normal power supply into the main lift controller and activate the rescue operation within a few seconds of a power failure. It will bring the lift car to the nearest lower floor and open the doors automatically. Thereafter, the lift car shall remain parked there until normal power supply resumes.

vi) Guides & Fastening

Heavy duty steel tee guides as per IS 4666-1968 shall be provided for car and counter weight, the guide surface being machined and polished. These shall be continuous through the entire length of lift well and shall withstand without any deformation with a fully loaded car. The ends of the guides shall be tongued and grooved to provide smooth joints and connected with steel joint plates. The guide rails shall be securely fastened to Brackets or supported by approved heavy rail clamps. Guide brackets or supports shall be bolted or welded to the steel inserts provided in the hoistway.

Guide rail lubricators shall be provided in the car. The lubricators shall be able to evenly distribute the oil over the guide rails at adjustable feed rates.

vii) Lift Car

a) Size

To be quoted by the Bidder, according to the specified capacity and to be accommodated in the available lift well (approximate size has been mentioned in lift detail).

b) Car Frames

The car frame shall be made of structural steel of rigid construction to withstand without permanent deformation. Car shall be so mounted on the frame that minimum vibration and noise are transmitted to the passengers inside.

c) Car Platform

The car platform shall be of framed construction and shall be mounted on rubber isolating pads supported on the car frame. The flooring of the car shall be provided with 5 mm thick PVC tiles of approved design, unless stated otherwise.

d) Car Body

The lift car enclosure shall have side, rear, front and ceiling of stainless steel. The enclosure including the door shall withstand deformation against a thrust of 35 kg applied normally at any point as per IS 4666- 1968. Ventilation opening shall also be as per above IS.

e) Car Roof

The roof shall be constructed to withstand the weight of 2 men. Access trap of ample dimension shall be provided in the roof of the car to provide for emergency exit.

f) Car Fixtures

Besides car operation pane' and signals as specified elsewhere the following shall be provided:

i) Suitable sweep ceiling fan, recess mounted in ceiling, with grills.

ii) Indirect LED lighting.

iii) Battery operated automatic emergency light with rechargeable Dry maintenance free battery (2 hours back-up) and battery charger.

iv) One handset unit for intercom.

v) Stainless steel handrail on three sides.

g) Car Operation Panel Control Panel

i) The control panel should be installed near the hoisting equipment;

ii) The control panel should be accessible from the landing for maintenance purposes;

iii) Adequate safety measures should be provided to control unauthorized access;

iv) Adequate illumination should be provided for the control panel for eas1 maintenance. Illumination should be available even when there is no power supply. Minimum of 50 Lux illuminations should be provided for the control panel;

Flush type car operation panel having the following fixtures, shall be provided the car as specified elsewhere as per IS 14665 (part 4)Sec 9).

i) Car Call Button corresponding to Landing Call.

ii) Auto/Attendant Key Switch.

iii) Fan Switch

iv) Alarm Bell Switch for battery operated alarm bell situated in Grctr Floor.

i) Door open and close button.

vi) Non-Stop Button.

vu) Up and down button

viii) Emergency stop button.

ix) Independent switch for independent control of car

h) Working areas in the Car or on the Car Roof

i) If maintenance/inspection work on the machinery is to be carried out from inside the car or from the car roof, the following applies:

Any kind of uncontrolled and unexpected car movement resulting from maintenance/inspection that can be dangerous to persons carrying out maintenance/inspection work shall be prevented by a mechanical device and electrical device.

When the car is blocked against all movement it shall be possible to leave the working area easily

and safely.

Any necessary devices for emergency operation and for dynamic tests (such as brake tests, traction tests, safety gear tests, buffer tests or tests of ascending car over speed protection means) shall be arranged so that those can be operated from outside of the well.

vii) Car and Hoistway Entrance, Door Operation and Interlocks The car and hoistway entrances should be centre opening & provided with centre opening automatic power operated stainless steel doors with vision panels. Lift door entrance as specified in the technical specification to be provided with electronic door detectors, high speed door operator, sheave type two points hangers and tracks. Suitable posts for supporting the doors for entrance are to be provided by contractor. Clear opening as offered by the contractor is to be quoted. Door operation shall be positive acting and powered by AC motor rigidly connected to door. Operation shall simultaneously open the car and hoistway door and maintain the door fully opened or closed at each floor stop. Door operator shall be suitable for attendant/automatic operation and shall be provided with hydraulic cushion for smooth stop.

Full height infra red door safety is to be provided on each side. When the car door is V in its open position, the door safety ray will retreat thus assuring a substantially clear opening. Should these rays sense a person or object while the door is closing, the car and hoistway doors will return to the open position. Reversal of the doors may also be accomplished by pressing the door 'open" button in the car operating panel.

The following interlocks for the door shall be provided -

- a) Car shall not move until the hoist way door is mechanically locked in the closed position.
- b) Hoistway door cannot be opened from the landing side unless the car is on that particular floor.
- C) Car shall not move while the car door is open.

viii) Signal etc

- a) Digital car position indicator in car enclosure having stainless steel face and having easy to read digital position indicator and illuminated up and down arrows.
- b) Hall Button with tell-tale lights at each landing with stainless steel face.
- c) Digital Car Position Indicator in all floors having stainless steel face and easy to read digital position indicator.

ix) Fireman's Switch

2. Fireman's switch with glass to break for access shall be provided in lift lobby at ground floor as per requirement for fire fighting.

x) Levelling

The lift shall be incorporated with suitable floor levelling devices. Levelling accuracy ± 8.0 mm shall be achieved.

xi) Counter Weight

Counter weight shall consist of cast iron weights housed in a rigid structural Steel frame work. Counter weight shall be equal to the weight of the car and 40% of the contract load or any other percent to promote smooth and economical operation.

xii) Lift Pit

A metal counter weight guard to the required height shall be provided at the bottom of the hoistway in the lift pit.

In lift pit a ladder, and a light point with switch and a 5A switch socket outlet shall be provided for each lift.

xiii) Spring Buffers

These shall have a long stroke and be so designed that they will stop the car and counter weight from governor tripping speed at an average rate of retardation not exceeding gravity.

Blocking and supports if found necessary for the buffers shall be supplied within the scope of lift installation work.

xiv) Governor & Safety Devices

A mechanical safety device for stopping the lift in the event of slackening or fracture of any rope or failure of electricity and protecting the car from falling or exceeding admissible speed as per relevant Clause of B.S. 2655 and I.S. 4666- 1968 actuated by a speed governor shall be mounted under the car platform and securely bolted to the frame. The governor shall be installed with the hoist machine and driven by governor rope suitably connected to the car and mounted on its own pulleys. The governor rope shall not be less than 8 mm in dia and shall be of steel in accordance with IS 4666-1968 and IS 2365-1963. The operation of Governor at over speed shall open a switch disconnecting the power from the lift and shall trip the safety mechanism which shall instantaneously engage the guide with sufficient force to stop the car from governor tripping speed, with full load in the car and bring the car to a smooth stop with an average rate of retardation within the limits in the code of practice for various loads. The governor shall be accurately adjusted to operate at tripping speed specified in the code of practice and sealed. The Governor jaws shall grip the rope in minimum time after the governor reaches tripping speed. The governor rope gripping devices shall be so designed that no appreciable damage or deformation to the rope results from the stopping action of the device. The pressure of the two jaws on the guide shall be equalized.

Governor tripping speed shall be within 100% to 125% of rated speed. Safety gears of the following types shall be used (a) Gradual Wedge Clamp type (b) Flexible guide Clamp type. The maximum stopping distances of lift cars with the contract load in the lift car and the minimum stopping distance with the attendant only in the lift car shall be as follows

Maximum Minimum

Gradual Wedge Clamp type 2.13 mtrs 0.46 mtrs Flexible Guide Clamp type 0.53 mtrs 0.15 mtrs

xv) Ventilation

The machinery spaces shall be suitably ventilated. The electric equipment of the machinery shall be protected as far as it is reasonably practicable from dirt, harmful fumes and humidity.

xvi) Reverse Phase Relay

Shall be provided on the controller to protect the lift equipment against phase reversal, low voltage and phase failure.

xvii) Terminal Limit Switches and Ultimate Terminal Switches

Terminal switches shall stop the car automatically at terminal floors within the top and bottom permissible over travel. They shall act independently of the operating devices, the ultimate limit switches and the buffers. They shall be in accordance with clause 23 of ISI 4666-1968.

Ultimate terminal switches shall be provided in accordance with the statutory requirements and standing practices. When provided, these shall arrange to stop the car automatically within top and bottom clearances independently of the normal terminal switches but with the buffers operative, by disconnecting the motor from the supply and bring the brakes into operation in case of over run.

In the event of these switches operating due to over-travel it shall be possible to operate lift only after manually resetting the back-up limit switches, for the purpose, which shall be installed in an accessible location for easy manual resetting.

xviii) Controller

Controller for the machine shall be designed to give the required operation as specified and shall be securely mounted on substantial self supporting steel frame designed for floor mounting.

To prevent access of Lizards, vermin's etc. the controller shall be enclosed and hinged vermin proof door shall be provided.

The switches handling power circuit shall be equipped with suitable contacts. The acceleration and speed control of lift shall be controlled by adjustable time relays.

All wiring shall be neatly, numbered, grouped and cleated. All leads except for control indicator circuits shall be provided with soldered lugs or suitable clamps and washers. Control & Indicator wires shall be brought to accessible clamps and washers or soldered terminals or studs. The wiring on the back of the panel shall be of the flame resisting type.

The controller shall automatically limit the current to that required for the specified requirements and shall prevent the electrical equipment from overload or excess current.

The controller shall be arranged to cut off the power, apply the brake and bring the car to rest upon failure of power or operation of any electrical safety device. Tropical insulation shall be provided throughout.

xix) Auxiliary Switches

For use of maintenance personnel, the following switches shall be provided on top of lift car

a) Emergency stop switch.

b) Maintenance switch - The controlling circuitry shall be so arranged that in the event of the operation of this switch the car speed shall be less than the rated speed and car movement shall be possible only on application of continuous pressure on a button. It shall be positioned to prevent inadvertent operation.

xx) Travelling Cables

All multi core travelling cables employed for the car shall satisfy the requirements of IS 4287-1967. Trailing cables for lighting, fan and signal circuits shall be separate. Length shall be adequate to prevent any strain due to movement of the car.

xxi) Lighting for Hoist way/Lift Well

Suitable light points shall be provided in the lift well. One socket outlet shall be provided in the liftwell for use of maintenance personnel at a level slightly above the ground floor landing. All the points shall be group controlled. Wiring shall be carried out in surface conduit, by the contractor.

xxii) Wiring

Except for the travelling cables, all wiring shall be carried out with PVC wires, drawn into steel conduit. PVC wires shall be 650/1100 volts grade. Conduit shall be heavy gauge welded and shall comply with IS specification. 16 SWG conduits shall be run on the surface and all accessories used shall be of the inspection type with screwed ends. Travelling cables shall be Tough Rubber sheathed and shall comply with IS specification. They shall originate in the half way boxes in the lift well and shall terminate at the car distribution box. They shall be so hung that the correct size of loop is obtained.

All the above wiring shall be carried out by the contractor.

xxiii) Earthing

The Owner shall provide one earth bus bar consisting of G I flat 25 mm x 6 miii. The

Owner will also provide two earth leads from the extremities of the earth bar to the Earthing system on Earth stations in the ground floor. The contractor shall 'Earth' each item of apparatus and plant supplied by him by means of two separate and distinct earth wires, each not less than half of the largest current carrying conductor subject to a minimum no. 8 SWG hard drawn bare copper wire. The earth wire shall be bolted to the earth bus, through sockets. All contact faces and sockets shall be tinned.

xxiv) Operation

Automatic Simplex or Duplex full collective operation with/without attendant control with self

leveling device.

xxv) Variable Voltage Variable Frequency Speed Control Equipment with two way self levelling devices

A. Variable Voltage Motor with variable voltage variable frequency drive, Microprocessor based closed loop control with micro levelling.

i) Each lift will include one static convertor (Silicon Controlled Rectifier) controlling set of compact design. The unit will be of self supported and self ventilated type and the rotating element will have a single continuous steel shaft. The Static Convertor (Silicon controlled rectifier) unit will be of high efficiency and low power consumption and will have sufficient capacity to handle the drive mechanism without overheating the peak load elevator service.

The Static convertor unit (Silicon Controlled Rectifier) will be designed to suit for nominal power supply of 415V, 3 Ph, 50 Hz supply with variations as per IE Rules with microprocessor control to give smooth and trouble free operation of the lifts with closed loop control system.

ii) Protective device with HRC fuses and over load relays are to be supplied to protect the driving motor and the static converter against overloads, short circuit, Proper Phase Sequence (RYB), phase failure etc. Necessary HRC control fuses shall be provided for control circuit protection. The elevator motor and the static converter (Silicon Controlled Rectifier) unit shall be protected against overload and short circuit.

iii) The static converter and the controller shall be provided with suitable voltage regulator to take care of the voltage fluctuations occurring in the system from 360 to 450V, AC.

15. ERECTION AND COMMISSIONING

Erection of equipment shall be carried out in a workmanlike manner without causing any hindrance to the work of the other contractors.

All rotating equipment shall be mounted on suitable rubber/spring isolation mounts to minimize transmission of noise and vibrations.

Entire installation shall conform to the requirements of the Lift Inspector/Statutory Authority and it is the sole responsibility of contractor to obtain approval for the layout and equipment, General Arrangement drawing and necessary license for erection and operation of lifts.

16. List of Approved Makes/ Brands

Kone, Schindler, Thyssenkrupp, Mitsubishi, Otis or approved equivalent.

36.0 DETAILED TECHNICAL SPECIFICATIONS FOR HVAC WORKS

1.0 PUMPS

1.1 SCOPE:

The scope of work under this Section comprises the supply, erection, testing and commissioning of pumps conforming to the specifications of the type and capacities specified in the Schedule of Equipment. Pumps shall be suitable for the purpose they are intended.

1.2 CONSTRUCTION:

Pumps shall be as per I.S. 1520/1960 and shall be of the following construction:

Pump	Horizontal Monoblock
Casing	Cast Iron/Cast Steel
Impeller	Bronze
Shaft	High Tensile Steel
Bearings	Heavy Duty Ball/Roller Bearings
Base Plat	Cast Iron/Fabricated M.S.
Flanges	To I.S.S. 1536/1960
Packing	Graphite Asbestos
Maximum Speed	1450 R.P.M. Horizontal Split Casing Pump / 2900 R.P.M Monoblock Pumps
Driver	TEFC Motor
Starter	As per Schedule of Equipment

Driver ratings shown are only tentative and Bidder shall select their drivers at least 5% in excess of the maximum B.H.P. of the pump plus transmission losses, if any.

1.3 ACCESSORIES AND FITTINGS:

The following accessories shall be provided with each pump among other standard accessories required.

- Coupling guard.
- Lubrication fittings and seal piping.
- Test and/or air vent.
- Mechanical seal

1.4 INSTALLATION:

Pumps shall be installed as per manufacturer’s recommendations. Pump set shall be mounted on concrete block which in turn is mounted on machinery isolation cork or any other equivalent vibration isolation fittings. The concrete foundation shall be made by the Owner to the drawings and specifications of the Contractor and the isolation pads shall be supplied by the Contractor. The Contractor shall, however, ensure that the foundation bolts are correctly embedded.

Pumps sets shall preferably be factory aligned. However, necessary site alignment shall be done by competent persons. Before the foundation bolts are grouted and the couplings bolted, the bed plate levels and alignment results shall be submitted to the Engineer.

1.5 TESTING:

Bidder shall submit the performance curves of the pumps supplied by them. They shall also check the capacity and total head requirements of each pump to match his own piping and equipment layout.

On completion of the entire installation, pumps shall be tested, wherever possible, for their discharge head, rate of flow and B.H.P. and test results shall be furnished as per section - 'TEST READINGS'. Where it is not possible, at least the discharge head and B.H.P. (as measured on the input side) shall be field tested. Test results shall correspond to the performance curves.

Bidder shall furnish the required testing instruments and arrange for their connection as required.

1.6 PAINTING:

After complete installation and testing of pumps, accessories and fittings shall be given two coats, three mils each of approved finishing paint.

The Pumps shall be factory painted with touch-up after installation, if required.

1.7 VARIABLE SPEED PUMPING SYSTEM

This section includes:

- Variable Speed Pumping Package
- Individual Components
- Pump Control Panel
- Adjustable Frequency Drive
- Sensor Transmitters
- Sequence of Operation

1.8 REFERENCES

- Hydraulic Institute
- ANSI - American National Standards Institute
- 3. NEMA - National Electrical Manufacturers Association
- UL - Underwriters Laboratories. Inc.
- 3. ETL - Electrical Testing Laboratories
- CSA - Canadian Standards Association
- 3. NEC - National Electrical Code
- ISO - International Standards Organization

- IEC - International Electro technical Commission

1.9 SUBMITTALS

Submittals shall include the following:

- System summary sheet
- Sequence of operation
- Shop drawing indicating dimensions, required clearances and location and size of each field connection
- Power and control wiring diagrams
- System profile analysis including variable speed pump curves and system curve. The analysis shall also include pump, motor and AFD efficiencies, job specific load profile, staging points, horsepower and kilowatt / hour consumption.
- Pump data sheets
- Submittals must be specific to this project. Generic submittals shall not be accepted.

1.10 QUALITY ASSURANCE

- The pumping package shall be assembled by the pump manufacturer. An assembler of pumping systems not actively engaged in the design and construction of centrifugal pumps shall not be considered a pump manufacturer. The manufacturer shall assume "Unit Responsibility" for the complete pumping package. Unit responsibility shall be defined as responsibility for interface and successful operation of all system components supplied by the pumping system manufacturer.
- The manufacturer shall have a minimum of 20 years' experience in the design and construction of variable speed pumping systems.
- The local supplier of Chilled Water Variable Speed Pumping System (VSPS) must have relevant expertise in all aspects of design, application engineering, installation, programming, interfacing, commissioning and after sales service. Supplier must have, as a minimum, commissioned 25 sets of chilled water VSPS in India.
- All functions of the variable speed pump control system shall be tested at the factory prior to shipment. This test shall be conducted with motors connected to AFD output and it shall test all inputs, outputs and program execution specific to this application.
- The manufacturer shall be fully certified by the International Standards Organization per ISO 9001.
Proof of this certification shall be furnished at time of submittal.
- Manufacturer shall be listed by Underwriter's Laboratories as a manufacturer of packaged pumping systems.
- Bidders shall comply with all sections of this specification relating to packaged pumping systems. Any deviations from this specification shall be bid as a voluntary alternate clearly defined in writing. If no exceptions are noted, the supplier or contractor shall be bound by these specifications.

1.11 ACCEPTABLE MANUFACTURERS

Subject to compliance with these specifications, ITT Bell & Gossett shall be acceptable:

1.12 MANUFACTURED UNITS

- Furnish and install as shown on the plans a Power save Variable Speed Pumping System as manufactured by ITT Bell & Gossett.
- The control system shall include as, a minimum, the programmable logic pump controller, adjustable frequency drive(s) and remote sensor/transmitters as indicated on the plans. Provide additional items as specified or as required to properly execute the sequence of operation.
- The variable speed pump logic controller, adjustable frequency drive(s) and remote sensor / transmitter(s) shall ship as individual components to the jobsite.
- Pump logic controller, adjustable frequency drives, sensor / transmitters and related equipment shall be installed by the mechanical contractor as shown on the plans.
- 3. Line voltage power wiring shall be installed by the electrical contractor as shown on the field connection drawings and wiring diagrams supplied with the pumping package.
- Low voltage (24 VDC and 115 VAC) wiring shall be installed by the controls contractor as shown on the field connection drawings and wiring diagrams supplied with the pumping package

1.13 COMPONENTS**1.13.1 Pump Logic Controller**

- The Technologic pump logic controller assembly shall be listed by and bear the label of Underwriter's Laboratory, Inc. (UL). (Canadian Standards Association (CSA) listing available upon request.) The controller shall meet Part 15 of FCC regulations pertaining to class a computing devices. The controller shall be specifically designed for variable speed pumping applications.
- The controller shall function to a proven program that safeguards against damaging hydraulic conditions including:
 - A. Motor overload
 - B. Pump flow surges
 - C. Hunting
 - D. End of curve protection
- The pump logic controller shall be capable of staging and de-staging pumps based on an Efficiency Optimization Program to provide the lowest KW draw. This optimization program requires an optional flow meter, KW meter, and system differential pressure sensor for activation.
- The pump logic controller shall capable of accepting 16 analogue inputs from zone sensor/transmitters indicated on the plans. The controller shall scan each analogue

input a minimum of once every 500 milliseconds. It shall then select the analog signal that has deviated the greatest amount from its set point. This selected signal shall be used as the command feedback input for a hydraulic stabilization function to minimize hunting. Each input signal shall be capable of maintaining a different set point value.

- The pump controller shall be capable of controlling 5 pumps in parallel.
- The controller shall be field expandable to control up to 6 pumps in parallel and accept up to 16 analogue inputs. This modification shall consist of nothing more than the addition of analogue input modules and shall not require the use of special tools or factory reprogramming. Controllers not capable of being expanded to this level shall not be acceptable.
- The hydraulic stabilization program shall utilize a proportional – integral – derivative control function. The proportional, integral and derivative values shall be user adjustable over an infinite range.
- The pump logic controller shall be self-prompting. All messages shall be displayed in plain English. The operator interface shall have following features:
 - A. Multi-fault memory and recall
 - B. On-screen help functions
 - C. LED pilot lights and switches
 - D. Soft-touch membrane keypad switches.
- The readout shall be four lines of forty 0.50” brightly-lit fluorescent characters capable of displaying the following values:
 - A. Flow in GPM
 - B. Pressure in PSIG
 - C. Differential pressure in PSIG
 - D. Temperature in degrees F or C
 - E. Differential temperature in degrees F or C F. BTU calculation
 - G. Kilowatt consumption
 - H. Tons per hour calculation
 - I. Wire to water efficiency calculation
- The following communication features shall be provided to the BAS:
 - A. Remote system start/stop
 - B. Failure of any system component
 - C. Process variable
 - D. AFD speed
- The pump logic controller shall be a Bell & Gossett Technologic 5000. Enclosure shall be NEMA 1.

1.13.2 Adjustable Frequency Drive

- The adjustable frequency drive(s) shall be pulse width modulation (PWM) type, microprocessor-controlled design.

- The AFD, including all factory installed options, shall have UL & CSA approval.
- Enclosure shall be wall mounted or free standing depending on amp rating. A Hand – off - auto switch and speed potentiometer shall be functional via AFD key pad.
- AFD shall utilize a diode bridge rectifier to convert three phase AC to a fixed DC voltage. Power factor shall remain above 0.98 regardless of speed or load. AFDs employing power factor correction capacitors shall not be acceptable.
- Insulated Gate Bi-Polar Transistors shall be used in the inverter section to convert the fixed DC voltage to a three phase, adjustable frequency, and AC output. An internal line reactor shall be provided to lower harmonic distortion of the power line to increase the fundamental power factor.
- The following customer modifiable adjustments shall be provided:
 - A. Accel time: 0.1 to 1800 seconds
 - B. Decel time: 0.1 to 1800 seconds
 - C. Minimum frequency: 0 Hz
 - D. Maximum frequency: 120 Hz
 - E. Analogue input filter : 0.1 to 10 seconds
 - F. Analogue outputs : 10 to 1 gain
- Speed reference signal shall be customer selectable for:
4-20 mA or 0-10 DC
- The AFD shall be suitable for elevations to 3300 feet above sea level without derating. Maximum operating ambient temperature shall not be less than 104 degrees F. AFD shall be suitable for operation in environments up to 95% non-condensing humidity.
- The AFD shall be capable of displaying the following information in plain English via a 40-character alphanumeric display:
 - A. Frequency
 - B. Voltage
 - C. Current
 - D. Kilowatts per hour
 - E. Fault identification
 - F. Percent power
 - G. Percent power
 - H. RPM

1.13.3 Sensor / Transmitters

3. Provide field mounted differential pressure sensor transmitter(s) as indicated in BOQ on the plans. Unit shall transmit an isolated 4-20mA dc signal indicative of process variable to the pump logic controller via standard two wire 24 DC system. Unit shall a corrosion resistant steel body with 1/8" NPT process connections. It shall have a NEMA 1 electrical

enclosure capable of withstanding 450PSI static pressure. Accuracy shall be within 0.5% of full span.

1.13.4 Sequence of Operation

- The system shall consist of a Technologic pump logic controller, multiple pump/AFD sets with manual and automatic alternation and pump staging.
- The pumping system shall start upon the closure of customer's contact when the pump logic controller Mode of Operation selector switch is in the REMOTE position.
- When the pump logic controller selector switch is in the LOCAL position, the pumping system shall operate automatically.
- Sensor/transmitters shall be provided as indicated on the plans.
- Each sensor/transmitter shall send a 4-20mA signal to the pump logic controller, indicative of process variable condition.
- The pump logic controller shall compare each signal to the independent, engineer/user determined set points.
- When all set points are satisfied by the process variable, the pump speed shall remain constant at the optimum energy consumption level.
- The pump logic controller shall continuously scan and compare each process variable to its individual set point and control to the least satisfied zone.

- If the set point cannot be satisfied by the designated lead pump, the pump logic controller shall initiate a timed sequence of operation to stage a lag pump.
- The lag pump shall accelerate resulting in the lead pump(s) decelerating until they equalize in speed.
- Further change in process variable shall cause the pumps to change speed together.
- When the set point criteria can be safely satisfied with fewer pumps, the Technologic pump logic controller shall initiate a timed destage sequence and continue variable speed operation.
- As the worst case zone deviates from set point, the pump logic controller shall send the appropriate analog signal to the AFD to speed up or slow down the pump/motor.
- In the event of a system differential pressure failure due to a pump or AFD fault, the Technologic pump logic controller shall automatically start the next variable speed pump/AFD set in sequence and continue variable speed operation.
- In the event of the failure of a zone sensor/transmitter, its process variable signal shall be removed from the scan/compare program. Alternative zone sensor/transmitters, if available, shall remain in the scan/compare program for control.
- The zone number corresponding to the failed sensor/transmitter shall be displayed on the operator interface of the pump logic controller.
- In the event of failure to receive all zone process variable signals, all AFDs shall maintain 100% speed, reset shall be automatic upon correction of the zone failure.
- PUMP or AFD fault shall be continuously scrolled through the display on the operator interface of pump logic controller until the fault has been corrected and the controller

has been manually reset.

2 PLATE HEAT EXCHANGERS

2.1 Design Requirements:

2.1.1 Application:

- Chilled Water Cooling (Water – Water Heat exchanger OR Water – Brine Heat exchanger)
- Steam heater (water Vs Dry Sat. steam.)

2.1.2 Type:

- Counter current and parallel flow only.

2.1.3 Performance Requirements:

- Units shall be sized to meet design conditions as specified in the schedule with a maximum allowable pressure drop as per schedule in each circuit.
- In addition, units shall be sized with allowance for 15% extension for future addition of plates.
- Design Pressure / Temperature: 16 bar/ 35 deg C or as per schedule
- Test Pressure: 1.5 times the design pressure
- The design shall prevent intermixing and leakage of fluid to outside of unit.
- The units shall withstand the maximum test pressure on either hot or cold side with the opposite side at 0 bar or as per schedule.
- Units to be factory tested in accordance with applicable code.
- Provide metal nameplate with the following details
 - a. Manufacturer's name
 - b. Type of Unit
 - c. Serial No.
 - d. Year of manufacture
 - e. Fluid group
 - f. Inlet / Outlet connections
 - g. Volume
 - h. Design Pressure
 - i. Design temperature
 - j. Test Pressure

2.2 Materials

2.2.1 Plates

- One piece pressed type AISI 316 stainless steel plate, and tapered gasket groove.
- Each plate to have herringbone corrugations to optimize heat transfer with nominal pressure losses.
- The channel depth between two plates should be in between 1.9mm to 2.5mm both values inclusive.

- End plates shall be of AISI 316 material and 0.6mm thickness.
- Design of plates to strictly follow counter current and parallel flow principle.
- Design to allow for removal and replacement of single plate without removal of the plate on either side.
- Design shall prevent fluid intermixing and provide leakage to the outside of the unit
- Plates should not lock to adjacent plates
- Each plate should strictly have a built in five point alignment system to accurately locate the plates in the frame assembly to prevent lateral plate movement under pressure.
- Plates shall be reinforced at the upper and lower mounting slots to prevent bending hangers on the plate.
- The plates shall have no welded stiffeners etc. and should be designed to allow pressurization of each circuit to a full differential of 1.5 times the design pressure without buckling or deformation of heat transfer plates
- Plates to be specifically manufactured in order to obtain design delta T.

2.2.2 Gasket

- One-piece, moulded Nitrile Butyl Rubber (NBR) gasket.
- Gaskets shall have relieving grooves to prevent intermixing of fluids and cause leak to outside of unit.
- The gaskets shall be locked into the groove by Clip On / Clip AD / Tape On method. Glued gaskets are not preferable.
- Gasket should be suitable for fluid & given process temperature
- Specific Gasket Groove should be there on plate, to for Gasket Fitting.

2.2.3 Frame

- The frame assembly should be bolted construction and not welded frame assembly
- The frame shall be carbon steel construction sand blasted and two coats of blue paint.
Manufacturer painting specifications to be provided.
- The moveable cover shall have only stainless steel material roller for ease of movement without additional rigging or handling equipment.
- Provide lifting lugs to allow lifting of entire unit's flooded weight.
- Bolts shall be provided with rolled threads to reduce galling and minimum high width hexagonal nuts to adequately distribute the load.
- Critical bolts to strictly have ball bearing boxes, for certain range of PHE's
- Provide plastic covers over threaded rod extension for protection of threads
- Connections to be studed port design with connection lining to be of constructed of same plate material and electrometric liner.
- The plates shall only contact with stainless steel surfaces.
- The portion of the carrying bar in contact with plates shall be an integrated into the

carrying bar.

- Tilted Bolt openings in Pressure Carrying Plates, for safety & easy maintainability
- The following connection sizes and max heights can be offered

Connection sizes	PHE heights (mm)
DN100	2200
DN150	2300
DN200	2400
DN250	3200
DN300	3250

2.3 Manufacturers

- Subject to full compliance of the project specification provide heat exchangers:
- Manufacturer to confirm location in India of fully established service centre with reconditioning and re-gasketing facility. The manufacturer shall confirm 24 hours service availability to attend faults at project site by factory-trained engineer. Service setup to be verified by consultant / client.
- References of service jobs carried out in India to be provided by the supplier.
- Manufacturer to confirm that they have the pressing facility at least for certain range of plates.
- The manufacturer to confirm availability locally in India of all essential spare parts for the plate heat exchanger proposed.
- The supplier to confirm presence of manufacturer’s factory trained and qualified service engineer to assist in installation and carry out commissioning at site.
- Note: Consultant / Client evaluation will not be limited to compliance and could include;
 - a. Visits to running installations 5 years old
 - b. Capability study at manufacturers works
 - c. Assessment of local Sales and Service setup
 - d. Note: Minimum 1 upto a maximum of 3 submittals can be called for by the client for evaluation
 - e. Spare parts
 - f. The vendor / supplier shall be responsible for supporting the spare parts requirement for all the equipment covered by contract

3 VIBRATION ISOLATORS

3.1 SCOPE

- All mechanical equipment shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure.
- Vibration isolators shall be selected in accordance with the weigh distribution so as to produce reasonably uniform deflection.

3.2 TYPE-AMOUNTINGS

Double deflection neoprene mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Bolt holes shall be provided for those areas where bolting is required. On equipment such as small vent sets and close coupled pumps, steel rails shall be used above the mountings to compensate for the over-hang.

3.3 TYPE-B MOUNTINGS

Spring type isolators shall be free standing and laterally stable without any housing and complete with ¼" neoprene acoustical friction pads between the baseplate and the support. All mountings shall have levelling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Spring shall have a minimum additional travel to solid equal to 50% of the rated deflection, Submittals shall include spring diameters, deflections, compressed spring height and solid spring height.

3.4 TYPE-C MOUNTINGS

Equipment with operating weight different from the installed weight such as chillers, boilers, etc. and equipment exposed to the wind such as cooling towers shall be mounted on spring mountings as described in engineering Specification Type B, but a housing shall be used that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection, cooling tower mounts shall be located between the supporting steel and roof or the grillage and dunnage. The installed and operating heights shall be the same. A minimum clearance of ½" shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operations. Mountings used out of doors shall be hot dipped galvanized.

3.5 TYPE-D HANGERS

Vibration hangers shall contain a steel spring and 0.3" deflection neoprene element

in series. The neoprene element shall be molded with a rod box isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing thru a 30 deg. arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing of the hanger showing the 30-deg. capability.

3.6 TYPE-E HANGERS

Vibration hangers shall be as described in engineering Specification Type D, but they shall be pre-compressed to the rated deflection so as to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale.

3.7 TYPE-F HANGERS

Vibration hangers shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short-circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing thru a 30 -deg. arc before contracting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Hangers shall be provided with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps. Submittals shall include a scale drawing of the hanger showing the 30 deg. capability.

3.8 TYPE-G BASES

Vibration isolator manufacturer shall be furnish integral structural steel bases. Bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases, which may be 'T' or 'L', shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth need not exceed 14" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of one inch.

3.9 TYPE-H BASES

Vibration isolator manufacturer shall provide steel members welded to height saving brackets to cradle machines having legs or bases that do not require a complete supplementary base. Members shall be sufficiently rigid to prevent strains in the equipment.

3.10 TYPE-I BASES

Vibration isolator manufacturer shall furnish rectangular structural beam of channel concrete forms for floating foundations. Bases for split case pumps shall be large enough

to provide support for suction and discharge base ells. The base depth need not exceed 12” unless specifically recommended by the base manufacturer for mass or rigidity. In general, bases shall be a minimum of 1/12th of the longest dimension of the base, but not less than 6”.Forms shall include minimum concrete reinforcement consisting of half inch bars or angles welded in place on 6” centres running both ways in a layer 1.1/2” above the bottom, or additional steel as is required by the structural conditions. Forms shall be furnished with drilled steel members with sleeves welded below the holes to receive equipment anchor bolts where the anchor bolts fall in concrete locations. Height saving brackets shall be employed in all mounting locations to maintain a 2” clearance below the base.

3.11 TYPE-J FLEXIBLE NEOPRENE CONNECTORS

- Flexible neoprene connectors shall be used on all equipment as indicated on the drawings or on the equipment schedule. They shall be manufactured of multiple ply of nylon tire cord fabric and neoprene both molded and cured in hydraulic rubber presses. No steel wire or rings shall be used as pressure reinforcement. Straight connectors shall have two spheres. Connector’s upto and including 1 1/2” diameter may have threaded ends. Connectors 2” and larger shall be manufactured with floating galvanized flanges recessed to lock the connector’s raised face neoprene flanges. Hoses shall be installed on the equipment side of the shut-off valves
- Connectors shall be rated a minimum of 150 psi at 220 deg. F. Flanged equipment shall be directly connected to neoprene elbows in the size range 2 1/2” through 12” if the piping makes a 90 deg. turn at the equipment. All straight through connections shall be made with twin-spheres properly pre- extended as recommended by the manufacturer to prevent additional elongation under pressure.12” and larger sizes operating above 100 psi shall employ control cables with end fittings isolated by means of 1/2” thick bridge bearing neoprene washer bushings designed for a maximum of 1000 psi.

3.12 TYPE-K FLEXIBLE HOSES

Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3” and larger shall be flanged. Smaller sizes shall have male nipples. Lengths shall be as tabulated

FLANGED MALE	NIPPLES
3x1410x26	1.2x91.1/2x13
4x1512x28	3.4x102x14
5x1914x30	1.0x112.1/2x18
6x2016x32	1.1/4x128x22

Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Hosses shall be type BSS as manufactured by Mason Industries Inc.

3.13 TYPE-L ACOUSTICAL FLOOR, CEILING&WALL SEAL

Where piping passes through equipment walls, floors or ceilings, the vibration isolator manufacturer shall provide a split seal consisting of two bolted pipe halves with $\frac{3}{4}$ " or thicker neoprene sponge bonded to the inner faces. The eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project minimum of 1" past either face of the wall. Where temperatures exceed 240 deg. F, 10lb density fibre glass may be used in lieu of the sponge.

3.14 TYPE-M PIPE ACCESSORIES

Vibration isolator manufacturer shall provide an all directional acoustical pipe anchor, consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum half inch thickness of heavy duty neoprene and duck or neoprene isolation material. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction

4 DOUBLE SKIN AIR HANDLING UNITS

4.1 SCOPE

The scope of this section comprises the supply, erection, testing and commissioning double skin construction air handling units, conforming of these specifications and in accordance with Drawings and of the Schedule of Quantities.

4.2 DOUBLE SKIN AHUs

The Air Handling Unit shall be double skin construction, backward curve Centrifugal blow – thru type comprising of various section such as mixing plenum, filter section. Coil section, fan section, filters plenum as per details given in Drawings and Schedule of Quantity.

4.3 HOUSING / CASING

- The housing/casing of the Air Handling Unit shall be of double skin construction. The frame work shall be of Extruded aluminum hollow sections. All the frame shall be assembled using pressure die cast nylon plastic joints to make a sturdy, strong and self-supporting frame work for various section.
- 23±2 mm thick Double Skin Panels shall be made of 0.6 mm Pre-coated GSS on outside and 0.6 mm Plain GSS sheet inside with CFC free Polyurethane Foam of density 40 ±2 kg/cum. in-house injected in between. These panels shall be screwed from inside on to the frame with soft rubber gasket in between to make the joints air tight & thermal brake profile.
- Frame work for each section shall be joined together with soft rubber gasket in between to make the joints air tight. Suitable air tight access doors/panels with Aluminum hinges and Nylon locks shall be provided for access to various

sections for maintenance. The entire housing shall be mounted on heavy duty GSS channel.

- Wherever return air is ducted & not surrounding the AHUs or AHUs are exposed to atmosphere, the AHU shall have thermal break profile and panels with thermal barrier. AHUs exposed atmosphere shall have 43±2 mm PUF with thermal break profile. The Thermal break & profiles shall be Arosio make or approved equivalent

4.4 FAN

The fan shall be backward curved, double inlet, double width type. The fan shall be of imported origin, AMCA Certified for air and sound, factory tested and assembled by the original manufacturer. The Wheel

& housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on EN8 or C-40 carbon steel solid shaft supported to housing and heavy duty ball bearings. The impeller & fan shaft shall be statically and dynamically trim balanced to ISO 1940 quality grade after assembly. A computer printout with vibration spectrum analysis shall be submitted. The fan outlet velocity shall not be more than 500 meters/min (1600 FPM). Fan housing with Motor shall be mounted on a common extruded aluminum base mounted inside the air handling housing on anti-vibration mounts. The fan outlet shall be connected to casing with the help of fire retardant neoprene impregnated fabric of imported origin, mounted on aluminum extruded channels, acting as a flexible connection for anti-vibration. The same type of connection shall be provided at the AHU outlet for the connection of AHUs to the duct.

4.5 COOLING/HEATING COILS

- The multi rows deep cooling or heating coil shall be seamless imported copper tubes shall have 12.5 mm to 15 mm dia and 0.41 mm thickness. The coil shall have continuous anti- corrosive hydrophilic blue coated 0.16 mm thick Aluminium plate fins. The fins shall be spaced by collars forming integral part of the fins and the fins should be firmly bonded to copper tubes assembled in 1.2 mm thick stainless steel frame. The tubes shall be staggered in the direction of airflow. Face and surface areas shall be such as to ensure rated capacity from each unit and such that air velocity across coil shall not exceed 150 meters per minute (500 FPM). Fins spacing shall be 4 to 5 fins per cm (10 to 12 fins / in). Tubes shall be mechanically expanded for minimum thermal contact resistance with fins. The coil circuit should be sized for adequate water velocity but not exceeding 1.8 m/s (6 FPS). The water headers shall be of 1.6 mm thick MS pipes. The header shall be complete with water in/out connection vent plug at the highest point and drain at the bottom.
- Each coil shall be factory tested at 21 kg. Per sq.cm. Air pressure under water. The coil shall be pitched in the unit casing for proper drainage. The computerized selection and test certificates for the cooling coil shall be submitted by the manufacturer.
- All coils above 6 rows shall be in 2 sets. I.e. one of 4 rows & the rest as specified with a cleaning gap of 750 mm.

- The condensate drain tray constructed out of 20 G. Stainless steel sheet (SS304) and shall have multiple-slope towards drain connection. The tray shall be insulated with 25 mm close cell nitrile insulation (Arm flex Class 'O').The insulation shall be sandwiched between 2 sheets of SS304.

4.6 FILTERS

4.6.1 Pre filter

Each unit shall have filter section with pre filters of the following technical specifications:

- a) Frame - Aluminum anodized
- b) Type - Box type
- c) Media - Non woven synthetic supported by HDPE mesh on one side and aluminum mesh on the other side. Non-flammable.
- d) Sealing of Media - By means of epoxy
- e) Efficiency - 90% down to 10 micron particle size
- f) Clean Filter - 4 mm pressure drop
- g) Dirty Filter - 12 mm pressure drop

4.7 MIXING BOX

Wherever return air is ducted, double skin mixing plenum shall be provided having construction similar to air handling unit with provisions of flanged connections for return air and fresh air and factory fitted, manually operated extruded aluminium volume control dampers. Filter plenum wherever required shall be of the same construction as of casing and shall be factory fabricated by the AHU manufacturer only.

4.8 MOTOR AND DRIVE

Fan motors shall be $415 \pm 10\%$ volts, 50 cycles, 3 phase, squirrel – cage, totally enclosed fan cooled with class F Insulation and IP – 55 protection. Motor shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through v- belt – drive arrangement. Belts shall be of the oil-resistant type.

4.9 SAFETY FEATURES

Each unit must have safety features as under:

- The fan access door shall be equipped with port hole window and micro-switch inter locked with fan motor to enable switching off the fan motor automatically in the event of door opening.
- The AHUs shall be equipped with 2 nos. weatherproof lights for proper illumination inside fan section.

One light shall be inter connected with the limit switch and other light shall be provide with externally mounted IP 55 on / off type switch covered with soft

membrane. The limit switch should be interlocked with motor. In case of opening of the door during running of fan the motor would automatically trip off and light would automatically switch on.

- The Access Door shall further have perforated screen as on added safety feature bolted on to the unit frame.
- Fan and motor base shall be properly earthed from the factory.
- All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.

4.10 ACCESSORIES

- Each air handling unit shall be provided with manual air vent at high point in the cooling/heating coil and drain plug in the bottom of the coil.
- Each outlet shall have manually operated Aluminum aero foil volume control damper with Nylon gear operation.
- The unit shall be complete with all accessories including but not restricted to the following :
 - A. Globe and gate valves
 - B. Manual air vents
 - C. Thermometers and 4" dia. pressure gauges with cock on the supply and return lines.

4.11 CONTROLS

All controls shall be electric and complete with auxiliary relays, contactors, wiring, etc. All control wiring from the central control panel and in the AHU room shall be carried out by the HVAC Contractor. All power wiring from the starter / isolator within the AHU room shall be carried out by the HVAC Contractor.

4.12 PERFORMANCE DATA

The Air Handling Unit shall be selected for the lowest operating noise level of the equipment. Fan performance rating and power consumption data, with operation points clearly indicating shall be submitted and verified at the time of testing commissioning of the installation.

4.13 TESTING

Cooling/heating capacity of various air handling unit models shall be computed from the measurements of air flow and dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements shall be by an anemometer and temperature measurements by accurately calibrated mercury in glass thermometers. Computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

4.14 SUBMITTALS

After assembly of air handlers at site the manufacturers shall submit three complete sets of AHU drawings, test certificates of coil, test certificate of fan, test certificate of AHU and operation & maintenance manual.

4.15 LIMITATIONS

- The air velocity at face of filter shall be not more than 500 FPM (150 MPM)
- The air velocity at fan outlet shall be not more than 1600 FPM (500 MPM).

5 FAN COIL UNITS

5.1 SCOPE

The scope of work under this section comprises the supply, installation, testing and commissioning of Fan Coil Units conforming to the specification and of the sizes and capacities set forth in the schedule of Equipment.

5.2 FAN COIL UNITS

- Fan Coil Units shall consist of water coil section, fan deck, motor and blower assembly, side, top and bottom sheets of corrosion resistant galvanised steel formed to provide air- discharge flanges, insulated drain pan, attached to the unit without metal-to-metal contact. Four slots shall be provided in the top flange to accommodate mounting hangers and overall height from the bottom of the drain pan to the top of the mounting flanges shall not exceed 11" for horizontal type units.
- Casings shall be galvanised sheet steel not thinner than 1.2 mm/18 SWG suitable stiffened to minimise drumming and vibration and shall be protected against corrosion and finished inside and outside with stove primer. All corners shall be without sharp edges. Casings shall include space for pipe work connections and valves and there shall be access to the fan and motor, filter, damper, drain pan, pipe work connections and valves for maintenance purposes.
- Coils shall be plate-fin design. Bends and joints shall be silver alloy brazed. The coils shall be suitable for 10.2 Kg per sq.cm working pressure. A manual air vent shall be located on the return header and a drain plug shall be located in the supply header. Supply and return connections shall be 16 mm OD copper. Tubes shall be 16 mm OD with 5 fins per cm. Copper tubes shall be 0.7 mm thickness and aluminium fins shall be 0.27 mm thickness.
- Slow speed double inlet centrifugal forward curved aluminium fans and direct drive resiliently mounted two bearing motors shall be on a single vertical mounting plate. The entire assembly shall have built-in thermal overload protection. The fans shall be statistically and dynamically balanced.
- Drain pan shall be fabricated from 18 swg GSS powder coated from outside and epoxy coated inside.

- The drain pan shall be sandwiched insulation of 19 mm Armaflex Class 'O' nitrile rubber.
- Unit shall have a secondary extended drain pan of similar construction as the main drain pan. This pan shall collect drip water from valves/ pipes, etc.
- Filters shall be non-flammable synthetic, non-woven media washable type and shall be easily removable.
- The motors shall be 3-speed double ended shaft with minimum capacity of 1/10th HP for 1 Ton, 1/8th HP for 1.5 Ton and ¼ HP for 2 Ton. The motor shall be suitable for 220/230 volts single phase AC supply and shall be of AUE make or approved equivalent.
- Units shall be complete with all inter-connecting copper tubing between MS piping and 2- way / 3-way motorised valve. Each FCU will be approved with a ball valve with strainer on the chilled water inlet connection and ball valve without strainer on the chilled water outlet connection control.

5.3 CONTROLS

FCUs shall be provided with the following controls:

- Wall mounted Digital room thermostat controlling a 2-way / 3-way motorised valve in the chilled water line.
- Speed fan switch with ON-OFF control to be integral part of thermostat.
- 5.3. All electrical connections, control wiring and conducting from the thermostat to the Fan Coil Unit shall be provided by the HVAC Contractor. The Electrical Contractor shall provide an electrical outlet next to the Fan Coil Unit.

5.4 INSTALLATION

The FCUs shall be suspended from the ceiling with hangers. Only approved make of Anchor fasteners will be used for suspension.

5.5 TESTING

CUs shall be tested for their design, performance and test results shall be furnished as per Section - "TEST READINGS".

6 SELF CONTAINED AIR/WATER COOLED PACKAGE UNITS

6.1 SCOPE

The scope of this Section comprises supply, erection, testing and commissioning of Self- contained Air/Water Cooled Package Units conforming to these Specifications and in accordance with the requirements of the Schedule of Equipment.

6.2 UNIT BASE & CASING

Base panel shall be constructed of fabricated steel structures of adequate size. Casing panels shall be of heavy gauge GSS welded construction, removable type to

provide easy access to equipment and shall be bonderised and painted. Casing shall be complete with plenums, discharge outlets, grilles, space for refrigeration equipment's, fans, cooling coils, etc.

6.3 COMPRESSOR

Compressor shall be of multi-cylinder hermetic/semi hermetic type complete with drive and motor, dynamically balanced, removable cylinder sleeves, oil return check valves, suction and oil strainers, discharge and suction shut off valves, site glass, etc. Compressor and motor assembly shall be installed on a spring mounted floating platform to provide quiet and vibration less operation.

6.4 CONDENSERS

- Condensers shall be water-cooled or air-cooled as required.
- Water-cooled condensers shall be with removable heads to enable cleaning of the tubes. Condensers shall be complete with water inlet and outlet connections, gate valves, relief, purge and gauge valves, drain valves, air vents, test cocks, thermometers, pressure gauges and other standard accessories necessary with the equipment supplied.
- Air-cooled condensers shall be fin and tube type and remotely placed. Base panels shall be constructed of fabricated steel structure of adequate size. Casing shall be of heavy gauge, GSS corrosion resistant, welded and shall be finished with enamel paint. Condenser coils shall have aluminium fins mechanically bonded firmly to copper tubes. Face and surface areas of the coils shall be adequate for rated capacity. Air velocity across the coils shall not exceed 150 M.P.M. Condensers shall be complete with fans, T.E.F.C. squirrel cage induction motors, D.O.L. starters, etc. Condenser fans shall low velocity/low noise type.

6.5 COOLING COILS

Cooling coils shall be of the fin and tube type, having aluminium fins, firmly bonded to copper tubes. Face and surface areas shall be such as to assure rated capacity and the air velocity across the coil shall not exceed 150 M.P.M. Coil shall be provided with shut off and control valves.

6.6 FAN SECTION

- Fan should be off or ward curved type, preferably with variable pitch pulleys. Fan motor shall be of 3- phase, 400 volts, 50 cycles squirrel cage, totally enclosed fan cooled type.
- The fan and motor shall be so selected so as to have adequate capacity plus 15% over the capacity required to handle the air quantity in the ducting system.

6.7 FILTERS

Filters shall be cleanable (Purolator) type. Air velocity across the filter shall not

exceed 100 M.P.M.

6.8 VIBRATION ELIMINATORS

- Units shall be provided with vibration eliminators to eliminate vibration and for noiseless operation.
- Vibration isolators shall be Dunlop cushy foot mounts. Serrated rubber pads shall only be allowed after obtaining necessary permission from the Engineer.

6.9 THERMOSTAT

All thermostats shall be imported Honeywell/Johnson type.

6.10 INSTALLATION

- The self-contained air-conditioning unit shall be mounted on vibration eliminators.
- The Contractor shall supply the required charge of refrigerant, lubricants and other consumables for testing and commissioning the equipment.
- All the equipment shall be thoroughly tested and checked for leaks. The refrigeration system shall be vacuumed to within 7.5 mm Hg. absolute and maintained for four hours. At the end of this period, the pumps shall be stopped and vacuum maintained for twenty four hours without exceeding a vacuum drop of 2.5 mm Hg. absolute. The Contractor shall certify that the vacuum was maintained as specified above.
- All safety controls, low and high refrigerant pressure controls, starter overload trips shall be suitably set and a record of all the settings shall be furnished to the Consultant.
- The Contractor shall provide for M.S. air-cooled condenser stands, copper refrigerant piping, power and control cabling and all necessary materials to make the system complete.

6.11 TESTING

- Unit capacity in Tons refrigeration, shall be computed from the temperature readings and on water- flow measurements. Flow measurements shall be preferably through flow meters. Computed results shall conform to the specified capacities and the power consumption shall conform to the figures furnished with the tender.
- All instruments, services needed for the tests required for the computation of capacities and power consumption shall be furnished by the Contractors themselves.

6.12 PAINTING

All the equipment in general including mounting frames, etc. shall be painted with two coats of a suitable paint of approved colour.

7 VENTILATION & EXHAUST FANS

7.1 SCOPE

Scope of work under this section comprises the supply, erection, testing and commissioning of the ventilation / exhaust system of the capacities set forth in the Schedule of Equipment.

All fans shall be static and dynamically balanced.

Fans shall be of the type, size, arrangement and capacity as indicated in the schedule and/or as shown on the drawings.

- Unless specified, fan performance rating data shall be tested accordance with AMCA Standard 210- 85(Air Moving and Conditioning Association), ANSI/ASHRAE Standard 51-1985 "Laboratory Methods of Testing Fans for Rating". Sound ratings shall conform to AMCA Standard 300-85, "Reverberant Room Method for Sound Testing of Fans".
- A computer printout of fan performance rating corresponding to the AMCA licensed data, with corrected ratings for altitude and temperature, fan operating speed, bearing life, etc. shall be submitted for approval.
- All fans shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade after assembly. A computer printout with the vibration spectrum analysis shall be attached to the fans.
- Fan motors shall comply in all respects with continuous rating in accordance with IEC34 or equivalent. Motor bearings shall be of ball or roller type, grease or lubricant sealed for life. Fan and drive shall be earthed to prevent accumulation of static charge.
- Kitchen exhaust fan shall be of Bifurcated Axial or SISW Centrifugal direct or belt driven type. DIDW Centrifugal and Direct Drive Axial Flow Fan where belts or motor are in the air stream are not acceptable.
- Fans shall be installed at staircase or lobby where fresh air intake is free from any obstruction and shall be energized only by fire alarm system. Fan shall be of Axial Flow Fan or DIDW Centrifugal Fan. Protective grille at the suction of the fan is required.
 - Fans for elevated temperature (Smoke Extraction Fans) with components rated for high temperature (250C, 2Hrs) service, with belt drive assemblies exposed to the air stream are not acceptable.
- 3. For Smoke Extraction Fans where motor is in the air stream with electrical/electronic temperature limit switch for motor protecting shall not be used.
- Anti-condensation heater is recommended to be installed for all Pressurization and Smoke Spill Fans, and the control circuit shall be arranged such the way that the heater is off when the starter is on and vice versa. Heaters shall be wired from the respective local motor control panel or motor control console.
 - Fan should be of G.S.S. , the Steel sheet should be JFE Galva zinc (Base

metal cold rolled), JIS G3302, SGCC with Z22 (minimum coating weight on both sides @ 220 g/m²) zinc coating & Zero Spangle, skin passed, chromate and dry.

- If fan is open to atmosphere, Fans shall be with pure polyester powder coating for minimum thickness of 60 microns.

7.2 AXIAL FLOW FANS (DIRECT DRIVE)

- Fans shall be licensed to bear the AMCA Air and Sound Certified Ratings Seal. The test standard used shall be ANSI/AMCA 210-85, ANSI/ASHRAE Standard 51-1985 "Laboratory Method of Testing Fans for Rating" and AMCA 300 "Reverberant Room Method for Sound Testing of fans".
- To achieve the minimum and equal clearance between the blade tips and casing, tube casing shall maintain its roundness by means of using one piece of sheet metal with 90 edge flanging up.
- Fan motor base support shall be properly secured (locked and sealed) to the fan housing and be of adjustable type to have precise control of motor shaft central position as well as running clearance between blade tips and casing. Motor (KW/HP) shall be able to be changed or upgraded at site without changing fan housing or ducting construction.
- Fans supplied shall be complete with factory fabricated mounting bracket (ceiling or foot mounted) and suction/discharge matching flanges as accessories.
- All hubs shall be cast Aluminium alloy (Grade LM2) unless for Smoke Extractor Fans where high temperature (250C/2Hrs) air is expected then Aluminium alloy or steel fan impeller blades are required. Otherwise impeller blade material with Polypropylene (PP), Glass-reinforced Polypropylene (PPG) and Glass-reinforced Polyamide (PAG), to provide self-balancing, anti-static, anti-sparking characteristic is preferable.
- Running clearance between blade tips and casing shall not exceed 1% of the impeller diameter, and 2% for smoke spill high temperature fan where mechanical expansion coefficient is different from normal ambient temperature. Fan manufacturer shall provide the fan assembled with the same clearance between blade tips and casing of the tested prototype. Note that the air performance and pressure loss are greatly affected by this clearance.
- Impellers shall be secured to the drive shaft by a key and keyway. Axial location shall be provided by a collar or shoulder on the drive shaft together with a retaining washer and screw fitted into a tapped hole at the end of the shaft and locked in position. Blades shall be secured in place to the angle setting by setscrews, locking nuts or setting pins.
- Fan motor shall be totally enclosed and external terminal box of at least IP55 shall be provided.
- Fans shall not exceed 1500 RPM.
- All fans after assembly shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade. A computer printout with vibration spectrum analysis shall be attached to the fans.

- Fan should be of G.S.S. The Steel sheet should be JFE Galvazinc (Base metal cold rolled), JIS G3302, and SGCC with Z22 (minimum coating weight on both sides @ 220 g/m²) zinc coating & Zero Spangle, skin passed, chromated and dry.

7.3 VANE AXIAL FLOW FANS (DIRECT DRIVE)

- To achieve the minimum and equal clearance between the blade tips and casing, tube casing shall maintain its roundness by means of using one piece of sheet metal with 90 edge flanging up with Fixed Guide Vanes.
- Fan Casing should be provided with Special Designed Integral Straightening Vanes to reduced turbulence provide high performance & low noise level.
- Fan motor base support shall be properly secured (locked and sealed) to the fan housing and be of adjustable type to have precise control of motor shaft central position as well as running clearance between blade tips and casing. Motor (KW/HP) shall be able to be changed or upgraded at site without changing fan housing or ducting construction.
- Fans supplied shall be complete with factory fabricated mounting bracket (ceiling or foot mounted) and suction/discharge matching flanges as accessories.
- All hubs shall be cast Aluminium alloy (Grade LM2) unless for Smoke Extractor Fans where high temperature (250C/2Hrs) air is expected then Aluminium alloy or steel fan impeller blades are required. Otherwise impeller blade material with Polypropylene (PP), Glass-reinforced Polypropylene (PPG) and Glass-reinforced Polyamide (PAG), to provide self- balancing, anti-static, anti-sparking characteristic is preferable.
- Impellers shall be secured to the drive shaft by a key and keyway. Axial location shall be provided by a collar or shoulder on the drive shaft together with a retaining washer and screw fitted into a tapped hole at the end of the shaft and locked in position. Blades shall be secured in place to the angle setting by setscrews, locking nuts or setting pins.
- Fans shall not exceed 1500 RPM.
- All fans after assembly shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade. A computer printout with vibration spectrum analysis shall be attached to the fans.
- The Fan should be AMCA Certified for Air Performance.
- 3.9 Fan should be of G.S.S., the Steel sheet should be JFE Galvazinc (Base metal cold rolled), JIS G3302, and SGCC with Z22 (minimum coating weight on both sides @ 220 g/m²) zinc coating & Zero Spangle, skin passed, chromated and dry.

7.4 CENTRIFUGAL FANS

- Fans shall be 'Buffalo' or equivalent, non-overloading type. The fan C.F.M. static pressure, class arrangement, width, direction of rotation, mode of discharge, etc. shall be as indicated in the Schedule of Equipment and in

the applicable drawings or as required.

- The scroll shall be manufactured from hot dip galvanised sheet steel with side plates of Aero- dynamic profile.
- Fans shall be provided with stationary inlet vanes as a standard accessory. Movable inlet vanes shall be provided only where specified for automatic control. Movable inlet vanes shall be complete with necessary linkages for actuation by automatic controls.
- Fans shall also be provided with heavy duty outlet dampers mounted in a separate frame, wherever required.
- All Class I fans shall be provided with sleeves bearing with generous oil reservoir, drain plug, oil level indicator, etc. Class II and III fans shall be provided with heavy duty ball bearings pre-greased & self – aligning.
- Fans shall be driven by electric motor as specified in the Schedule of Equipment. Motor ratings are only tentative and where a fan requires a higher capacity motor, the Contractor shall clearly point out the requirements and make his offer accordingly. Motor ratings shall be at least 5% over limit load plus transmission losses.
- Exhaust fans handling corrosive fumes shall be made of non-corrosive materials or coated with corrosion resistant paints with epoxy or chlorinated rubber base.

7.5 CABINET SUPPLY/EXHAUST UNITS

- Units shall be complete factory assembled, tested and of approved manufacturers.
- Casing shall be of heavy gauge galvanised sheets, ribbed and reinforced with access provided by hand holes and casing panels.
- Fans shall be driven by an electric motor as specified in the Schedule of Equipment. Motor ratings are only tentative and where a fan requires a higher capacity motor, the Contractor shall clearly point out the requirements and make his offer accordingly. Motor ratings shall beat least 5% over transmission losses.
- Fan shall have limit switch with Aluminium wire guard to shut off the fan.

7.6 INDUCED JET FAN

Application: Car Park/Basement ventilation

7.6.1 Fan:

- Jet fan shall be tested in AMCA lab for Air & Sound performance. Test results shall be submitted for review.
- Double Flanged casing shall be produced in Galvanised steel. To achieve the minimum and equal clearance between the blade tips and casing, tube casing shall maintain its roundness by means of using one piece of sheet metal with 90 edge flanging up.

- All hubs shall be cast Aluminum alloy (Grade LM2) for Smoke Extractor Fans where high temperature (250C/2Hrs) air is expected then Aluminum alloy fan impeller blades are required.
- Running clearance between blade tips and casing shall not exceed 1% of the impeller diameter and 2% for smoke spill high temperature fan where mechanical expansion coefficient is different from normal ambient temperature. Fan manufacturer shall provide the fan assembled with the same clearance between blade tips and casing of the tested prototype. Note that the air performance and pressure loss are greatly affected by this clearance.
- Impellers shall be secured to the drive shaft by a key and keyway. Axial location shall be provided by a collar or shoulder on the drive shaft together with a retaining washer and screw fitted into a tapped hole at the end of the shaft and locked in position. Blades shall be secured in place to the angle setting by setscrews, locking nuts or setting pins.
- All axial fans shall be dynamically balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade.

7.6.2 Motor:

- Fan motor shall be class H insulation Smoke Venting special rated Motor for 250 Deg.C @ 2 hrs. Motor Manufacturer should certify for its Temp. Rating. Motor shall be of Single/Dual Speed (for smoke exhaust application)
- Fan motor base support shall be properly secured (locked and sealed) to the fan housing and be of adjustable type to have precise control of motor shaft central position as well as running clearance between blade tips and casing.

7.6.3 SILENCER:

- Outer Casing Shall be made of Galvanized steel sheet and Inner casing shall be made of Galvanized steel perforated sheet with Z22 (220 GSM) grade. Silencer should have Rounded nose to smooth airflow and a tapered tail to reduce the air turbulence and pressure drop. Silencer should be with Glass fibre as absorption filler material to achieve excellent acoustic performance.
- Each Jet fan model should be available with 2D type silencer as standard length. The complete assembly shall provided with inlet & outlet painted protection net for protection against foreign particle.

7.6.4 Testing:

- Smoke and heat exhaust fans are required to be in compliance with the requirements of Class B performance, as defined in BS 7346 Part 2:1990 Class B OR EN12101-3:2002. This requires the fan to be subjected to a rated temperature of 250 Deg C for a rated duration of 120 minutes.

7.7 PROPELLER TYPE EXHAUST FANS

- Propeller type fans shall be G.E.C. make or equivalent. Fans shall be of the broad type, ring or diaphragm mounted and the capacity shown in the Schedule of Equipment. Fans shall be provided with gravity type louvers unless otherwise stated.
- Fan drive shall be single phase or three phase motors as indicated in the Schedule of Equipment and shall be complete with starter.

7.8 PROPELLER TYPE ROOF EXHAUST FANS

Roof exhaust fans shall be of S.F. Products type, G.E.C., P.M.A. propeller fan or equivalent. Fan capacity shall be as shown in the Schedule of Equipment and fan shall be complete with fan motor, starter, dampers and dome

7.9 SMOKE EXHAUST CENTRIFUGAL FANS

- Standard with UL listing for "Power ventilators for Smoke control Systems" for 500 degrees F for 4 hours and 1000 Degrees F for 15 min. Units have centrifugal backward inclined steel wheels with embossments on the blades and cooling fins for added strength and cooling. Flange Safety Vibration Isolators are oversized to accommodate the added heat and weight. Unit has heat baffle to reduce motor compartment temperature. Unit shall have dual Belt and Pulley system.
- Fans shall bear the AMCA Certified Ratings Seal for sound and air performance.
- Each fan shall bear a permanently affixed manufacturer's name plate containing the model number and individual serial number for future identification.

7.10 FILTERS

Filters shall be non-flammable 90% efficiency down to 10 microns. Filters shall be cleaned by dusting or reverse air-blown.

7.11 INSTALLATION

- The concrete foundations required for the fans shall be prepared by the Owner to the drawings supplied by the Contractor. However, the Contractor shall supply all foundation bolts, base plate, wherever required, vibration eliminators, etc. and shall also ensure that all the above accessories are placed securely in proper position while the foundation is cast.
- Vibration eliminators shall be provided with an efficiency of not less than 80%.
- Fan inlet and outlet connections shall be by means of flexible canvas connections.
- Fan belt drive shall be complete with belts, belt, sheaves and suitable belt guard.
- For all kitchen exhaust or any other high temperature exhaust, flexible

connection at the fan inlet and outlet shall be of double lobe grease and fire resistant Neoprene sheets.

- Grease tight access panels of sufficient size and shall have to be provided with 50 mm drain plug at the bottom of the fan for grease removal.

7.12 TESTING

Fan shall be tested for the performance and test results shall be furnished as given in Section TEST READINGS'.

7.13 PAINTING

On completion of the erection and testing, fans shall be painted with the two coats of an appropriate paint of approved colour.

8 PIPING

8.1 SCOPE

Scope of this Section comprises the supply and laying of all pipes required for this project. The Engineer's drawings show the general layout of the piping and they are not meant as working drawings. On the award of the contract, the Bidder shall prepare his own detailed working drawings.

8.2 CONDENSER, CHILLED & COIL CONDENSATE DRAIN WATER PIPING

- All piping laid indoors shall be as follows :

Pipe Size	Material Fitting Sealing	Joints	&	Material
15 mm to 300 mm	Welded Welded B S 534/1934	Pipe Slip-on	-	3 mm 3 ply rubber insert
350 mm & Over	Welded Pipe B S 534/1934	Welded Slip-on rubber	3 mm 3 ply	-

- Flanges shall be to I.S. 1536/1960.
- All piping shall be black mild steel 'C' Class unless otherwise stated. Pipes shall be new and from standard manufacturers. Pipes shall be given one primary coat of red oxide paint before being installed. Pipes shall be sloping towards drain points.
- Fittings shall be new and from standard manufacturers. Fittings shall be malleable casting of pressure ratings suitable for the piping system. Fittings

used on welded piping shall be of the weldable type. Flanges shall be new and from standard manufacturers. Supply of flanges shall include bolts, washers, etc. as required.

- Tee-off connections shall include the following :-
 1. For larger pipes (where the main pipe is 150mm dia or larger), fabrication on site is accepted (gas cut opening, profiled branch, fillet-welded). However, swept 'shoes' should be used for both supply and return
 2. Where the main pipe is 125mm dia or less:-
 - A. Where branch size equals main size, use factory-made equal tee (seamless)
 - B. Where branch size is one size smaller than main, use factory-made equal tee (seamless) and reducer on the branch
 - C. Where branch size is more than one size smaller than main:-
 - a) 50mm and smaller diameter branch site fabricated (machine drilling, profiled branch, fillet-welded)
 - b) 65mm and larger diameter branch site fabricated (gas cut opening, profiled branch, fillet-welded)
 - c) Both supply and return should use swept 'shoes'

Through reducing tees wherever possible. Otherwise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be resorted to.

- All equipment and valve connections or connections to any other mating pipes, shall be through unions/screwed flanges up to 50 mm dia. and flanges (welded or screwed for G.S.) for larger Diameter as required for the mating connection.
- All welded piping is subject to the approval of the Architect and sufficient number of flanges and unions shall be provided as required under above section.
- Valves shall be provided as shown in the applicable drawings conforming to the following specifications :

Size	Construction	Ends
12mm to 50 mm	Ball Valves	Screwed Female
50mm & over	Butterfly Valve	Flanged

- Check valves shall be provided as shown on the drawings and conform to the following

Size	Construction	Ends
12 mm to 65 mm	Gun Metal	Screwed Female
65 mm & over	Gun Metal/C.I	Flanged

Swing check valves shall normally be used in all water services. Lift type valves may be used in horizontal runs. Air release and clean out plugs shall be provided and valves shall be suitable for 21 kg/sq. cm test pressure.

- Strainers shall be preferably of the approved 'Y' type with C.I. or fabricated steel bodies designed to the test pressures specified for the gate valves. Strainers shall have removable bronze screen with 3 mm perforations and a permanent magnet. Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of all screens without disconnection of the main pipe. All strainers shall be provided with equal size isolating gate valves with rising spindles so that the strainer may be cleaned without draining the system. Strainers shall be provided on the suction side of each pump; and on inlet side of the heat exchange equipment.

Piping Systems in Polyethylene (HDPE)

1. Scope

This specification covers the requirements for the HDPE Piping Systems intended for a wide range of industrial applications including water, wastewater and effluent treatment as well as a wide range of chemical applications. The components of the HDPE piping system are in accordance with the following standards.

2. Basic System Data

2.1 Material Specification for HDPE

All HDPE pipes are manufactured either from PE100 with a value of MRS 10 MPa, which pipes and fittings are designed for 25 years operational life with water at 20°C. The material is designed for use with pressure bearing piping systems with long-term hydrostatic properties in accordance with EN ISO 15494.

2.2 Characteristics of PE

Characteristics- PE100 -Units- Standard

- Density 0.95 g/cm³ EN ISO 1183-1
- Yield stress at 23 °C 25 N/mm² EN ISO 527-1
- Tensile e-modulus at 23 °C 900 N/mm² EN ISO 527-1
- Charpy notched impact strength at 23 °C 83 kJ/m² EN ISO 179-1/1eA
- Charpy notched impact strength at 40°C 13 kJ/m² EN ISO 179-1/1eA
- Ball indentation hardness (132N) 37 MPa EN ISO 2039-1
- Crystallite melting point 130 °C DIN51007
- Heat conductivity at 23 °C 0.38 W/mK EN 12664
- Water absorption at 23 °C 0.01 - 0.04 % EN ISO 62
- Colour Black RAL RAL 9005

- Limiting oxygen index (LOI) 17.4 % ISO4589-1

Product Marking

All pipes must be marked permanently and consecutively at intervals of at least 1 meter.

- Material identification: OEM manufacturing plant identification
- Material code: PE100
- Pipe diameter, wall thickness, SDR and PN: see Tables 1 – 3
- RAL symbol and Z-40.23-406 (DIBt)
- Manufacture date, shift and machine number
- Product standard: EN ISO 15494, DIN 8074/75

Fittings

All HDPE fittings are either as butt fusion type made out of PE100, metric sizes d20– 800, or socket fusion type made out of PE80, metric sizes d20–110, labelled of OEM. The dimensions of both fitting types fulfil the tolerance requirements of the standard EN ISO 15494. They need to be tested according to EN 10204. All threaded connections have pipe threads in accordance with the requirements of ISO 7-1.

All butt fusion spigot fittings of the dimension d20–225mm are manufactured with laying lengths designed for use with the infrared fusion machine IR Plus and IR A from OEM.

Accessories

- Flanges

Backing flanges in metric sizes DN15–400 shall be designed according to EN ISO 15494, in a thermo plastic-oriented design, consisting of 100% glass fibre reinforced polypropylene, PP-GF30, graphite black and UV stabilized. These flanges are manufactured in a seamless technology injection moulding process. The backing flange shall be optimised with a V-groove in the inner diameter to ensure an evenly distributed force on the thermo plastic flange adapter. The backing flanges shall be marked with dimension, PN-value, standards, brand and lot number. Connecting dimensions metric according to ISO 7005, EN 1092; Bolt circle diameter PN10; Inch: ANSI B 16.5, BS 1560; class 150 (1/2"–12"). As an alternative backing flanges in metric sizes DN15–800 shall be designed according to EN ISO 15494, in a thermo plastic-oriented design, consisting of glass fibre reinforced polypropylene, PP-GF30, graphite black and UV stabilized with steel or cast inserts. The backing flanges shall be marked with dimension, PN-value, standards, brand and lot number. Connecting dimensions metric according to ISO 7005, EN 1092; Bolt circle diameter PN10 (DN15–800) + PN16 (DN15–400); Inch: ANSI B 16.5, BS 1560; class 150 (1/2" – 8").

- Gaskets

Gaskets in metric sizes DN10–800 shall consist of elastomeric material according to EN681, designed with or without metal reinforcement for use with flange adaptors according to EN ISO 15493. Gaskets with reinforcement shall be designed to be centred by the outer diameter.

Gaskets with reinforcement shall provide fixation aids to fit on the flange bolts.

- Pipe Support System

Pipe Support System shall as per Codes or OEM standard with respective different sizes.

Quality

- Production Conditions Pipes, fittings, valves and accessories shall be manufactured in an environment operating a Quality Assurance System to ISO 9001 and an Environmental Management System conform to ISO 14001.
- Marking All components are embossed with a permanent identification during the production process to ensure full traceability. The following information will be mentioned: Manufacturer’s name or trade mark, Production lot number , material, Dimension, Pressure rating
- Uniformity Pipes, fittings, valves and welding machines shall be supplied from one manufacturer, Piping Systems to ensure correct and proper jointing between components and uniform chemical and physical properties of the piping system.
- Training, Certification and Installation Site personnel, involved with piping installation, shall undergo training and certification from an authorized local institution prior to performing any jointing operations on site.

8.3 PIPING INSTALLATION

- The drawings indicate schematically the size and location of pipes. Pipe runs and sizes may, however, be changed to meet the site conditions. The Contractor, upon award of the work, shall prepare detailed working drawings, showing the cross section, longitudinal sections, details of fittings, locations of isolating, drain and air valves, etc. They must keep in view the specific openings in buildings and other structures through which the pipes are designed to pass.
- Piping shall be properly supported on or suspended from stands, clamps, hangers, etc. as specified and as required. The Bidder shall adequately design all the brackets, saddles, clamps, hangers, etc. and be responsible for their structural integrity.
- Pipe supports shall be of steel, adjustable for height and prime-coated with rust preventive paint and finish-coated black. Where pipe and clamp are of dissimilar material, a gasket shall be provided in between.
- Spacing of pipe supports shall not exceed the following:

Pipe Size (mm)	Spacing (Mtr.)
3 to 12	1.22

19 to 25	1.83
32 to 150	2.44
150 and above	3.05

Pipe hangers shall be fixed on walls and ceilings by means of metallic raw plugs or approved shear fasteners.

- Vertical risers shall be parallel to walls and column lines and be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 12 mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall also have a suitable elbow or concrete pipe support at the lowest point.
- Pipe sleeves of 50 mm larger diameter shall be provided wherever pipes pass through walls and the annular space filled with felt and finished with retaining rings.
- Cut-outs required in the floor slab for taking the various pipes are indicated in the drawings. Tenderers shall carefully examine the cut-outs provided and clearly point out wherever the cut-outs shown on the drawings do not meet with the requirements and indicate if any additional cut-outs are required.
- Piping work shall be carried out with minimum disturbance to the other work on the site. A programme of work shall be chalked out in consultation with the Engineer.
- Details of clamps, anchors, etc. shown in the various drawings are only tentative and the Contractor shall make sure that the clamps are adequate for the pipe support. Piping layout shall take due care of expansion and contraction in pipes.
- All pipes using screwed fittings shall be accurately cut to the required sizes and threaded in accordance with I.S. 554/1955 and burrs removed before laying. Open ends of the piping shall be blocked as the pipe is installed to avoid entrance of foreign matter. Wherever reducers are to be made in horizontal runs, eccentric reducers shall be used if the piping is to drain freely; in other locations, concentric reducers may be used.
- Air valves shall be provided at all high points in the piping system for venting. Valves shall be of the double float type with G.M. /C.I. body, vulcanite balls, rubber seating, etc. Air valves shall be of the sizes specified and shall be associated with an equal size gate valve with rising spindle.

Mains	Air Valves
Upto 100 mm	25 mm
100 mm to 300 mm	38 mm
Over 300 mm	50 mm

- Discharge from the air valves shall be piped through an equal sized G.S. pipe to the nearest drain or floor waste.

- Drains shall be provided at all low points in the piping system and shall be of the following sizes:

Mains	Drain
Upto 300 mm	25 mm
Over 300 mm	38 mm

Drains shall be provided with gate valves of equal size with rising spindle. Drains shall be piped through equal size G.I. pipe to the nearest drain or floor waste. Piping shall be pitched towards drain points.

8.4 PRESSURE GAUGES

Pressure gauges shall be not less than 150 mm dia. dial and of appropriate range and be complete with shut off gauge cocks, etc. duly calibrated before installation.

- Pressure gauges shall be provided at the following locations
 - A. Supply and return of chillers and condensers.
 - B. Suction and discharge of pumps.
 - C. Inlets and outlets of heat exchangers.
 - D. Supply and return of all water.

- Care shall be taken to protect pressure gauges during pressure testing.

8.5 THERMOMETERS

- Thermometers shall be either 150 mm dia. dial or direct reading industrial type of appropriate range duly calibrated before installation.
- Thermometers shall be installed in separable wells.
- Thermometers shall be provided at the following locations:
 - A. Dial type thermometers on supply and return of chillers and condensers.
 - B. Dial type thermometers on suction and discharge of pumps.
 - C. Dial type thermometers on inlet and outlet of heat exchangers.

8.6 EXPANSION TANK

The Expansion Tank of adequate size shall be provided. The bottom of the tank shall be not less than 0.6 metre above the highest point of the chilled water system. MS tanks may be provided unless otherwise stated. Tanks shall be insulated and finished with aluminum cladding and complete with float valve, gauge glass, drain, overflow, make-up water connections, ball valves and vent piping.

8.7 TESTING

- All piping shall be tested to hydrostatic test pressure of at least one and half times the maximum operating pressure, but not less than 7 kg/sq.cm. For a

period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer.

- Piping repaired subsequent to the above pressure test shall be re-tested in the same manner.
- Systems may be tested in sections and such sections shall be securely capped.
- The Engineer shall be notified well in advance by the Contractor of his intention to test a section or sections of piping and all testing shall be witnessed by the Engineer or his authorised representative.
- The Contractor shall make sure that proper noiseless circulation of fluid is achieved through all coils and other heat exchange equipment in the system concerned. If proper circulation is not achieved due to air bound connections, the Contractor shall rectify the defective connections. He shall bear all the expenses for carrying out the above rectifications, including the tearing up and re-finishing of floors, walls, etc. as required.
- No insulation shall be applied to piping until after the completion of the pressure testing to the satisfaction of the Engineer.
- The Contractor shall provide all materials, tools, equipment, instruments, services and labour required to perform the test and to remove water resulting from cleaning and/after testing.

8.8 PAINTING

- After all uninsulated piping has been installed, tested and run for at least ten days or eight hours each, the piping shall be given two finish coats, 3 mils each, as per the colour indicated by the Engineer.
- The direction of flow of fluid in the pipe shall be visible marked in white arrows.

8.9 CHILLED WATER TREATMENT (Closed Chilled Water Circuit)

- **General**

For newly installed system it is essential that the system is thoroughly flushed with water to dislodge any sand, silt, mud or welding butts left in the system. It is also necessary to pre-clean the system with specific chemicals and dispersants to remove the factory contaminants such as cutting oils, mill scale, welding scales and other contaminants likely to exist in the piping network and other equipment's and heat exchangers.

Once the system is thoroughly cleaned, it should be chemically treated to afford protection to the system against corrosion, deposit formation and fouling etc. The chemical treatment affords excellent protection to the system when it is applied to clean and passivated system. The chemical treatment introduced in uncleaned and dirty system does not afford adequate protection and therefore thorough pre-cleaning and flushing of the system is very essential.

- **Initial Cleaning Procedure**

A. Flushing With Water During the initial cleaning, it is preferred that system is not taken on the load, but water is circulated through all the heat exchangers.

Fill the system with fresh water and circulate for at least 6-8 hours and heavily drain from the lowest available drain points.

Again fill the system with fresh water and repeat the above procedure for another one two times proceed with the following chemical flushing procedure.

- **Chemicals Required For Flushing**

AQB 406 and AQB 333 to be used in accordance to the system volume.

After the system is flushed with water, it is to be re-filled with water and flushed with the above proposed pre-cleaning chemicals as under:

To dislodge the oily matter and loosen any silt/debris present in the piping network. The recommend product for pre-cleaning is AQB-406 at the concentration of 0.2to0.5 % on the total hold-up volume of the system (i.e. on the basis of total water content in the system) and circulate for at least 6-8 hours and heavily drain from the lowest drain points.

Later on to dislodge any mill scale fill the system with water and add AQB-333 an organic based product to dissolve any mill scale and also passivate the system. Circulate for about 8-10 hours and then heavily drain the system from the lowest possible drain points.

- **Preventive Treatment**

Once the system is cleaned, it is to be subjected to preventive treatment program with the following recommended products. However before adding the chemical treatment it is to be ensured that the system is filled with the fresh water of following specifications. To ensure that the water of following specifications is filled in the system.

It is recommended to hire the services of water treatment vendor having own laboratory with UV-VIS spectrophotometer analytical facilities and the vendor should have at-least 10 years' experience in the similar field. If the services are hired from the dealer of the water treatment company, it is to be ensured that the dealer is having own laboratory with UV- VIS spectrophotometer analytical facilities and the dealer / dealers field engineer should have at-least 10 years' experience in the similar field.

- **Water Quality Recommended For System Filling**

Turbidity NTU	Conductivity M.Mho/cm	PH	Total Hardness CaCO ₃	Calcium Hardness as CaCO ₃ ppm	Chloride as Cl ppm	Iron as Fe ppm
<10	<500	7-8.0	<200	<120	<300	<0.3

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- **Recommended Water Treatment Program For The Closed Chilled Water System**

Aqua Bird’s Correctol Package Treatment Program or Equal Is Recommended with Following Specified Components

COMPONENT NAME	DESCRIPTION
<p>CHEMICAL FEED SYSTEM</p> <p>(Aqua Meter And Components) handling assembly electronic dosing pump</p>	<p>Chemical feed system (AQUA METER – ID-B1 - 04-05 OR AQUA METER IMB-05-10OR EQUAL) should be designed with specific components of liquid</p> <p>suitable to handle the chemical products Chemguard - 12000, Chemguard -2100, AQB 406 and AQB-333. The feed system must operate on 220 – 240 V – single phase power supply and should not consume power of more than 60 watts. It should be weather resistant, easy to install and operate and be supplied with 50 litre capacity HDPE/ PE solution tank. The system should be provided with canopy to provide shed protection against rain water to the feeding unit. The unit to be supplied should be suitable for outdoor installation and the electronic circuit and or internal electric components of dosing pump in normal case should be protected against rain water.</p>
<p>CHEM GUARD -12000</p>	<p>Chemical to provide protection to the system against severe corrosion, deposit formation under the circulating water conditions having corrosive Ryznar Index of 6.5 and above. The product should also have components to provide protection to the system against scale formation if the Ryznar index shifts on the lower side below 6.5 (scaling side) due to little seasonal change in the make-up</p>

CHEM GUARD -2100	Combination product to be used with Chem Guard- 12000 only to afford added protection against fouling as well as microbial attack to the system. This product is to be used only in combination with our product Chem
TEST KIT dosages of Chem Guard-12000.	Test kit to Test and monitor the
AQB-406 and AQB-333	Chemicals For Pre Cleaning

• Periodic Testing And Corrective Actions

Once the treatment chemicals are charged into the system, the following controls will be maintained for which periodic testing and monitoring is essential. It is recommended that once in 15 days water samples be tested by the operator with the test kit provided with the treatment package and once every three months the overall situation and status on the water quality and treatment practices be crossed checked by the company having specialization in the field of water treatment so that any corrective action required is taken accordingly.

Control Parameters for` Water

Turbidity NTU	PH	Chloride as	Product Level	Total Hardnes s	Iron as Fe	Bacterial (TVC)
			Lower limit	CaCO ₃ , ppm		
<20	Above 8.	<500	300 - 400 (800-	<300	<1	<1 x 10 ⁵
			Max limit			

Of the above recommended parameters, product level factor can be tested by the operators once in 15 days and the chemical dosages be adjusted accordingly to compensate the losses of chemicals due to the normal leakages in the system. However the other tests can be conducted by the water treatment vendor once in three months in the vendor’s laboratory.

• Scope Of Water Treatment Vendor And Air Cond. Contractor

The water treatment vendor should be involved in the advisory capacity to supervise the pre-cleaning operation especially to check the water quality to be filled in the system after the system is initially flushed with water by the A.C. contractor. Proper instructions for chemical flushing should be taken by the A.C. contractor from the water treatment vendor and flushing be carried out as per the instructions of water treatment vendor. Finally after the system is thoroughly flushed and fresh water is finally filled in the system the water treatment vendor should be called to check the water quality fed into the system and then the treatment chemicals with the supplied feeding equipment be added by the A.C. contractor as per the suggestions and advice given by the water treatment vendor. Power supply of 220-240 v, single phase and water line vide 20 mm dia. pipe to prepare any solution to the installation point of chemical feeding equipment to be supplied by the A. C. contractor. Also a 25 mm dia. Socket with brass valve shall be provided by the A.C. contractor to enable the water treatment vendor to install and fix chemical injection assembly (injection valve) into this socket.

9 SHEET METAL WORK

9.1 ALTERNATE: I (FOR DUCTS FABRICATED IN FACTORY AS PER “SMACNA” STANDARDS)

9.1.1 AIR DISTRIBUTION

9.1.1.1 Scope

The scope of this section comprises supply fabrication, installation and testing of all sheet metal / aluminum ducts, supply, and installation, testing and balancing of all grilles, registers and diffusers. All are to be in accordance with these specifications and the general arrangement is shown on the Drawings.

9.1.1.2 Duct Materials

- RAW MATERIALS

Galvanizing shall be Class VII – light coating of zinc, nominal 180gm/sq. m surface area and Lock Forming Quality prime material along with mill test certificates. In addition, if deemed necessary, samples of raw material, selected at random by owner’s site representative shall be subject to approval and tested for thickness and zinc coating at contractor's expense.

- GAUGES, BRACING BY SIZE OF DUCTS

All ducts shall be fabricated from galvanized steel / aluminum of the following thickness, as indicated as below:

- A. For Ducts with external SP up to 250 Pa (**To be used for Hotels & Commercial Projects**)

Rectangular Ducts G. S	Pressure 250 Pa Duct Section Length 1.2 m (4 ft)
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Maximum Duct Size	Gauge	Joint Type	Bracing Spacing
1-750 mm	26	C & S/ SS	Nil
751 - 1000 mm	26	Bolt Transverse Duct Connector- (TDC) / Slip-on E	Nil
1001 - 1200 mm	24	4 Bolt TDC / Slip-on E	Nil
1201 - 1500 mm	24	4 Bolt TDC / Slip-on F	Nil
1501 - 1800 mm	22	4 Bolt TDC / Slip-on H	Nil
1801 - 2100 mm	20	4 Bolt TDC / Slip-on I	Zeebar Stiffener 1-S
2101 - 2700 mm	18	4 Bolt TDC / Slip-on I	Zeebar Stiffener 1-S

B. For Ducts with External SP up to 500 Pa (**For Hospital & Clean room jobs, where AHU SP is specified as 75 mm and above. Not Suitable for OTs**)

Rectangular Ducts G. S	Pressure 500 Pa Duct Section Length 1.2 m (4 ft)		
Maximum Duct Size	Gauge	Joint Type	Bracing Spacing
1 - 600 mm	26	C & S/ SS	Nil
601 - 750 mm	26	4 Bolt Transverse Duct Connector- (TDC) / Slip-on E	Nil
751 - 1000 mm	24	4 Bolt TDC / Slip-on E	Nil
1001 - 1200 mm	22	4 Bolt TDC / Slip-on F	Nil
1201 - 1300 mm	20	4 Bolt TDC / Slip-on H	Nil
1301 - 1500 mm	18	4 Bolt TDC / Slip-on I	Zeebar Stiffener 1-S
1501 - 1800 mm	18	4 Bolt TDC / Slip-on I	Zeebar Stiffener 1-S
1801 - 2100 mm	18	4 Bolt TDC / Slip-on I	Zeebar Stiffener 2-S
2101 - 2250 mm	18	4 Bolt TDC / Slip-on I	Zeebar Stiffener 2-S
2251 - 2400 mm	18	4 Bolt TDC / Slip-on I	Zeebar Stiffener

			2-S
2401 - 2700 mm	18	4 Bolt TDC / Slip-on I	Zeebar Stiffener 2-S

'C'-cleat; 'S'-S cleat; 'SS'-Standing S cleat;

Distance of reinforcement/bracing from each joint. Bracing material to be same as of material used for joining of duct sections.

For Aluminum Ducts Material Shall Be One Commercial Gauge Higher With 22 GAs Minimum

9.1.1.3 Fabrication Standards & Equipment

All duct construction and installation shall be in accordance with SMACNA standards. In addition ducts shall be factory fabricated utilizing the following machines to provide the requisite quality of ducts.

- Coil (Sheet metal in Roll Form) line to facilitate location of longitudinal seams at corners/folded edges only, for required duct rigidity and leakage free characteristics. No longitudinal seams permitted along any face side of the duct.
- All ducts, transformation pieces and fittings to be made on CNC profile cutter for requisite accuracy of dimensions, location and dimensions of notches at the folding lines.
- All edges to be machine treated using lock formers, flanges and rollers for turning up edges.

9.1.1.4 Duct Construction

All ducts shall be fabricated and installed in workmanlike manner, conforming to relevant SMACNA codes.

- Ducts so identified on the Drawings shall be acoustically lined and insulated from outside as described in the section “Insulation” and as indicated in schedule of Quantities. Duct dimensions shown on drawings, are overall sheet metal dimensions inclusive of the acoustic lining where required and indicated in Schedule of quantities. The fabricated duct dimensions should be as per approved drawings and care should be taken to ensure that all connecting sections are dimensionally matched to avoid any gaps.
- Ducts shall be straight and smooth on the inside with longitudinal seams shall be airtight and at corners only which shall be either Pittsburgh or snap button as per SMACNA practice, to ensure air tightness.
- All ducts up to 75cms width within conditioned spaces shall have slip and drive (C & S/SS) joints. The internal ends of slip joints shall be in the direction of airflow. Care should be taken to ensure that S/SS Cleats are mounted on the longer side of the duct and Cleats on the shorter side. Ducts and accessories within ceiling spaces, visible from air-conditioned areas shall be provided with

two coats of mat black finish paint.

- Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Air- turns (vanes) shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.
- Ducts shall be fabricated as per details shown on Drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees, or angles, of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.
- All sheet metal connection, partitions and plenums, required to confine the flow of air to and through the filters and fans, shall be constructed of 18 gauge GSS / 16gauge aluminium, thoroughly stiffened with 25mm x 25mm x 3mm galvanized steel angle braces and fitted with all necessary inspection doors as required, to give access to all parts of the apparatus. Access doors shall be not less than 45cm x 45cm in size.
- Plenums shall be shop/factory fabricated panel type and assembled at site. Fixing of galvanized angle flanges on duct pieces shall be with rivets heads inside i.e. towards GS sheet and riveting shall be done from outside.
- Self-adhesive Neoprene rubber / UV resistant PVC foam lining 5mm nominal thickness instead of felt shall be used between duct flanges and between duct supports in all ducting installation.

9.1.1.5 Installation Practice

All ducts shall be installed generally as per tender drawings, and in strict accordance with approved shop drawings to be prepared by the Contractor:

- The Contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these Specifications and Drawings. The work shall meet with the approval of Owner's site representative in all its parts and details
- 1. All necessary allowances and provisions shall be made by the Contractor for beams, pipes, or other obstructions in the building, whether or not the same are shown on the drawings. Where necessary to avoid beams or other structural work, plumbing or other pipes, and conduits, the ducts shall be transformed, divided or curved to one side (the required area being maintained) all as per the site requirements.
- If a duct cannot be run as shown on the drawings, the contractor shall install the duct between the required points by any path available in accordance with other services and as per approval of owner's site representative.
- 3. All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with trapeze hangers formed of galvanized steel rods and galvanized steel angle/channel or a pair of brackets, connected by galvanized steel rod under ducts. The spacing between supports should be not greater than 2.0 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates left in

slab at the time of slab casting. Galvanized steel cleat with a hole for passing the hanger rods shall be welded to the plates. Trapeze hanger formed of galvanized steel rods shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Hanger rods shall then hang through the cleats or fully threaded galvanized rods can be screwed into the anchor fasteners.

- Ducting over furred ceiling shall be supported from the slab above or from beams after obtaining approval of Owner's site representative. In no case shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other contractor's work in the building.
- Where ducts pass through brick or masonry openings, it shall be provided with 25mm thick TF quality expanded polystyrene around the duct and totally covered with fire barrier mortar for complete sealing.
- All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge. Flexible connections shall be constructed of fire retarding flexible heavy canvas sleeve at least 10cm long securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting ductwork rigidly held by independent supports on both sides of the flexible connection. The flexible connection shall be suitable for pressure at the point of installation.
- Duct shall not rest on false ceiling and shall be in level from bottom. Taper pieces shall taper from top.

9.1.1.6 Dampers

- All duct dampers shall be opposed blade louver dampers of robust 16 G GSS construction and tight fitting. The design, method of handling and control shall be suitable for the location and service required.
- Dampers shall be provided with suitable links levers and quadrants as required for their proper operation. Control or setting device shall be made robust, easily operable and accessible through suitable access door in the duct. Every damper shall have an indicating device clearly showing the damper position at all times.
- Dampers shall be placed in ducts at every branch supply or return air duct connection, whether or not indicated on the Drawings, for the proper volume control and balancing of the air distribution system.

9.1.1.7 Fire & Smoke Dampers

- 3. All supply and return air ducts at AHU room crossings and at all floor crossings shall be provided with Motor operated Fire & smoke damper of at least 90 minutes rating as per UL555/1995 tested by CBRI. These shall be of multi-leaf type and provided with Spring Return electrical actuator having its

own thermal trip for ambient air temperature outside the duct and air temperature inside the duct. Actuator shall have Form fit type of mounting, metal enclosure and guaranteed long life span.

- Fire damper blades and outer frames shall be of 16G galvanized steel construction fitted with 18 gage extended sleeves on both sides. The damper blade shall be pivoted on both ends using chrome plated spindles in self-lubricated bronze bushes. Stop seals shall be provided on top and bottom of the damper housing made of 16G galvanized sheet steel. For preventing smoke leakage metallic compression seals will be provided.
- The electric actuator shall be energized either upon receiving a signal from smoke detector installed in AHU room supply air duct / return air duct or temperature sensor. The fire damper shall also close upon sensing temperature rise in supply air ducts thru the electronic temperature sensor.
- Each damper shall be provided with its own control panel, mounted on the wall and suitable for 240 VAC supply. This control panel shall be suitable for spring return actuator and shall have at least the following features:
 - A. Potential free contacts for AHU fan ON/ off and remote alarm indication.
 - B. 3. Accept signal from external smoke / fire detection system for tripping the electrical actuator.
 - C. Test and reset facility.
 - D. Indicating lights / contacts to indicate the following status:
 - E. Power Supply On
 - F. Alarm
 - G. Damper open and close position
- Actuators shall be mounted on the sleeve by the damper supplier in his shop and shall furnish test certificate for satisfactory operation of each Motor Operated Damper in conjunction with its control panel. Control panel shall be wall mounted type.
- 5. It shall be HVAC Contractor's responsibility to co-ordinate with the Fire Alarm System Contractor for correctly hooking up the Motor Operated Damper to Fire Detection / Fire Management System. All necessary materials for hooking up shall be supplied and installed by HVAC Contractor under close co-ordination with the fire protection system contractor.
- 5. HVAC Contractor shall demonstrate the testing of all Dampers and its control panel after necessary hook up with the fire protection / fire management system is carried out by energizing all the smoke detectors with the help of smoke.
- 5. HVAC Contractor shall provide Fire retardant cables wherever required for satisfactory operation and control of the Damper.
- 5. HVAC Contractor shall strictly follow the instructions of the Damper Supplier or avail his services at site before carrying out testing at site.

- Fire/smoke damper shall be provided with factory fitted sleeves; however, access doors shall be provided in the ducts within AHU room in accordance with the manufacturer's recommendations.
- The Contractor shall also furnish to the Owner, the necessary additional spare actuators and temperature sensor (a minimum of 5% of the total number installed) at the time of commissioning of the installation.

9.1.1.8 Fire Dampers

- Whenever a supply/return duct crosses from one fire zone to another, it shall be provided with approved fire damper of at least 1½ hour fire rating as per UL555/1995 tested by CBRI. This shall be curtain type fire damper.
- Fire damper blades shall be one piece folded high strength 16 gage galvanized steel construction. In normal position, these blades shall be gathered and stacked at the frame head providing maximum air passage and preventing passing air currents from creating noise or chatter. The blades shall be held in position through fusible link of temp 70o C.
- In case of fire, the intrinsic energy of the folded blades shall be utilized to close the opening. The thrust of the suddenly released tension shall instantly drive the blades down and keep it down without the use of springs, weights or other devices subject to failure.
- Fire damper sleeves and access doors shall be provided within the duct in accordance with the manufacturer's recommendation.
- The contractor shall also furnish to the Owner, the necessary additional fusible links (spares), as recommended by the manufacturer, at the time of commissioning of the installation.

9.1.1.9 Supply and Return Air Registers

- Supply & return air registers shall be of either steel or aluminium sections as specified in schedule of quantities. Steel construction registers shall have primer Coat finish whereas extruded aluminium registers shall be either Anodised or Powder Coated as specified in Schedule of Quantities. These registers shall have individually adjustable louvers both horizontal and vertical. Supply air registers shall be provided with key operated opposed blade extruded aluminium volume control damper anodised in matt black shade.
- The registers shall be suitable for fixing arrangement having concealed screws as approved by Architect. Linear continuous supply cum return air register shall be extruded aluminium construction with fixed horizontal bars at 15 Deg. inclination & flange on both sides only (none on top & bottom). The thickness of the fixed bar louvers shall be minimum 5.5 mm in front and 3.8 mm in rear with rounded edges. Flanges on the two sides shall be 20 mm/30 mm wide as approved by Architect. The grilles shall be suitable for concealed fixing. Volume control dampers of extruded aluminium anodised in black colour shall be provided in supply air duct collars. For fan coil units horizontal fixed bar grilles as described above shall be provided with flanges

on four sides, and the core shall be & suitable for clip fixing, permitting its removal without disturbing the flanges.

- All registers shall be selected in consultation with the Architect. Different spaces shall require horizontal or vertical face bars, and different width of margin frames. These shall be procured only after obtaining written approval from Architect for each type of register.
- All registers shall have a soft continuous rubber/foam gasket between the periphery of the register and the surface on which it has to be mounted. The effective area of the registers for air flow shall not be less than 66 percent of gross face area.
- Registers specified with individually adjustable bars shall have adjustable pattern as each grille bar shall be pivot able to provide pattern with 0 to +45 degree horizontal arc and upto 30 degree deflection downwards. Bars shall hold deflection settings under all conditions of velocity and pressure.
- Bar longer than 45 cm shall be reinforced by set-back vertical members of approved thickness.
- All volume control dampers shall be anodised aluminium in mat black shade.

9.1.1.10 Supply and Return Air Diffusers

Supply and return air diffusers shall be as shown on the Drawings and indicated in Schedule of Quantities. Mild steel diffusers/dampers shall be factory coated with rust- resistant primer. Aluminium diffusers shall be powder coated & made from extruded aluminium section as specified in schedule of quantities.

- Rectangular Diffusers shall be steel / extruded aluminium construction, square & rectangular diffusers with flush fixed pattern for different spaces as per schedule of quantities these shall be selected in consultation with the Architect. These shall be procured only after obtaining written approval from Architect for each type of diffuser.
- Supply air diffusers shall be equipped with fixed air distribution grids, removable key- operated volume control dampers, and anti-smudge rings as required in specific applications, and as per requirements of schedule of quantities. All extruded aluminium diffusers shall be provided with removable central core and concealed key operation for volume control damper.
- Linear Diffuser shall be extruded aluminium construction with removable core, one or two way blow type. Supply air diffusers shall be provided with volume control/ balancing dampers within the supply air collar. Diffusers for different spaces shall be selected in consultation with the Architect, and provided as per requirements of schedule of quantities. All diffusers shall have volume control dampers of extruded aluminium construction anodised in mat black shade.
- Slot Diffuser shall be extruded aluminium construction multisport type with air pattern controller provided in each slot. Supply air diffusers shall be provided with Hit & Miss volume control dampers in each slot of the supply

air diffusers. Diffusers for different spaces shall be selected in consultation with the Architect and provided as per requirement of Schedule of Quantities.

9.1.1.11 Documentation & Measurements for Ducting

All ducts fabricated and installed should be accompanied and supported by proper documentation viz:

- Bill of material/Packing list for every duct section supplied.
 - A. Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge- wise.
 - B. Each and every duct piece to have a tag number, which should correspond to the serial number, assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement and verification.
 - C. Unless otherwise specified, measurements for ducting for the project shall be on the basis of centreline measurements described herewith
 - D. Ductwork shall be measured on the basis of external surface area of ducts. Duct measurements shall be taken before application of the insulation. The external surface area shall be calculated by measuring the perimeter comprising overall width and depth, including the corner joints, in the centre of each duct section, multiplying with the overall length from flange face to flange face of each duct section and adding up areas of all duct sections. Plenums shall also be measured in a similar manner.
 - E. For tapered rectangular ducts, the average width and depth shall be considered for perimeter, whereas for tapered circular ducts, the diameter of the section midway between large and small diameter shall be adopted, the length of tapered duct section shall be the centreline distance between the flanges of the duct section.
 - F. For special pieces like bends, tees, reducers, branches and collars, mode of measurement shall be identical to that described above using the length along the centreline.
 - G. The quoted unit rate for external surface of ducts shall include all wastage allowances, flanges and gaskets for joints, nuts and bolts, hangers and angles with double nuts for supports, rubber strip 5mm thick between duct and support, vibration isolator suspension where specified or required, inspection chamber/access panel, splitter damper with quadrant and lever for position indication, turning vanes, straightening vanes, and all other accessories required to complete the duct installation as per the specifications. These accessories shall NOT be separately measured nor paid for.
- Special Items for Air Distribution shall be measured by the cross-section area perpendicular to air flow, as identified herewith :

- A. Grilles and registers - width multiplied by height, excluding flanges. Volume control dampers shall form part of the unit rate for registers and shall not be separately accounted.
- B. Diffusers - cross section area for air flow at discharge area, excluding flanges. Volume control dampers shall form part of unit rate for supply air diffusers and shall not be separately accounted.
- C. Linear diffusers - shall be measured by cross-sectional areas and shall exclude flanges for mounting of linear diffusers. The supply air plenum for linear diffusers shall be measured with ducting as described earlier.
- D. Fire dampers - shall be measured by their cross sectional area perpendicular to the direction of air flow. Quoted rates shall include the necessary collars and flanges for mounting, inspection pieces with access door, electrical actuators and panel. No special allowance shall be payable for extension of cross section outside the air stream.
- E. Flexible connection - shall be measured by their cross sectional area perpendicular to the direction of air flow. Quoted rates shall include the necessary mounting arrangement, flanges, nuts and bolts and treated-for-fire requisite length of canvas cloth.
- F. Kitchen Hoods - shall be measured by their cross sectional area at the capture point of fumes, parallel to the surface of kitchen equipment. Quoted rates shall include the grease filters, provision for hood light, suspension arrangement for the hood, profile to direct the air to ventilation ducts and provision for removable drip tray.

9.1.1.12 Testing and Balancing

After the installation of the entire air distribution system is completed in all respects, all ducts shall be tested for air leaks by visual inspection.

The entire air distribution system shall be balanced using an anemometer. Measured air quantities at fan discharge and at various outlets shall be identical to or less/excess than 5 percent in excess of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancing is completed so that these can be restored to their correct position if disturbed at any time. Complete air balance report shall be submitted for scrutiny and approval, and four copies of the approved balance report shall be provided with completion documents.

10 INSULATION

10.1 Scope

- The Scope of this section comprises supply and fixing of insulation as specified.
- All insulating materials in the form in which it is used and under the condition anticipated shall not ignite, burn, support combustion or release toxic gases when subject to fire or heat.

- All adhesives used to stick insulation shall also be non-flammable.
- All materials used for thermal and acoustical insulation shall be resin bonded fibre glass of density and thickness as specified or indicated on the drawing.
- All sun exposed roof shall have Phenotherm under deck insulation of the density and thickness specified.
- Manufacturers' recommendation for application & safety shall be strictly adhered to.

10.2 Duct Insulation

10.2.1 Fibre Glass Insulation

- Ducts shall be insulated with resin bonded fibre glass having a density of 24 Kg/cum furnished in rolls and faced on one side with a suitable vapour retardant foil reinforced Kraft (FRK).
- The insulation material thickness is as follows:

Type	Locatio	Insulation
Supply	Conditioned Space	25 mm
Supply	Unconditioned Space	50 mm
Return	Conditioned Space	25 mm
Return	Unconditioned Space	50 mm

* When specified / indicated

- The insulation shall be applied as follows: Duct Insulation – Thermal Fibre Glass

- Clean all duct surfaces thoroughly
- Install self-adhesive pins spaced along the duct at no greater than 300 mm centres at the bottom of duct. The pin should be located no less than 75 mm from each edge or corner.
- Apply a coat of Foster Duct fans Adhesive 81-22 on the duct surfaces as per manufacturer's recommendations.
- Impale insulation through the pins and ensure insulation is stuck to the adhesive.
- Fix self-retaining washers on to the pins to hold the insulation. Do not compress insulation more than 3 mm.
- Bend the pins so as to prevent protrusions or tears.
- Apply vapour seal pressure sensitive sealing tape to all joints and protrusions. The sealing tape should be minimum 75 mm wide.
- Provide nylon strapping at 600 mm centres to prevent sag. Strapping to be applied to widths of all ducts. Ensure strapping do not tear the aluminium

foil.

- I. Wrap 24G x ¾" G I chicken wire mesh around the insulation. Prevent any damage or tear to the insulation facing.

10.2.2 Nitrile rubber class 'O'

- Insulation material for ducts shall be close cell elastomeric nitrile rubber class 'O'. Thermal conductivity of nitrile rubber shall not exceed 0.036 w / m 0 C. Density of material shall not be less than 0.04 gm / cm3.
- The insulation shall be applied as follows: Duct Insulation – Thermal
 - A. Clean all duct surfaces thoroughly to remove grease, dirt etc.
 - B. The measurement of surface dimension shall have to be taken properly to cut nitrile rubber sheets
 - C. The rubber sheets size to cut with sufficient allowance in dimension. A single sheet should be cut, so as to provide only one seam at the top of the duct. No small patches shall be allowed.
 - D. Apply a thin coat of non-flammable adhesive recommended by manufacturer on ducts and on the insulation material
 - E. When adhesive is tack dry, insulation shall be placed in position with compression and no stretching of insulation shall be permitted to achieve a good bond.
 - F. All longitudinal and transverse joints shall be sealed with 3mm thick and 25mm width self-adhesive Armaflex class 'O' tape.

10.3 Acoustical Insulation

10.3.1 Acoustical Insulation for Ducts

- All connecting ducts to Package Units / AHUs shall be sound insulated to a distance of 6 m or as specified or as shown on the design.
- Acoustical insulation shall be 50 mm thick 32 Kg/cum Fibre Glass Insulation finished with dimensionally stable Black Glass Tissue (BGT) facing & 24 G perforated aluminium sheets as specified or shown on the drawings.
- application:
 - A. Clean all internal duct surfaces
 - B. Pre-cut the insulation to the size desired, allowing 50 mm excess at downstream joints.
 - C. Install self-adhesive pins spaced along the inner face of duct. The pins should start within 75 mm of upstream transverse edges of the liner and 75 mm from longitudinal joints and should be placed at a maximum of 300 mm on centres around the perimeter of the duct, except that there may be a maximum of 300 mm from a corner break.
 - D. Apply coat of Foster Ductfas Adhesive 81 - 22 on the duct surfaces as

per manufacturer’s recommendations.

- E. Impale insulation through the pins and assure insulation is stuck to the adhesive.
- F. Fix self-retaining washers on to the pins. Do not compress insulation more than 3 mm.
- G. Bend the pins so as to prevent protrusions or tears

- It is recommended that all exposed leading edges & joints be coated with Foster Ductfas Adhesive 81- 22.

10.3.2 Acoustical Insulation for AHU / Package Unit Rooms

- Acoustical insulation shall be 50 mm thick 32 Kg/cum Fibre Glass Insulation finished with dimensionally stable Black Glass Tissue (BGT) facing & 24 G perforated aluminium sheets as specified or shown on the drawings.
- Application:
 - A. Fix 50 mm x 50 mm GI / Al. angle frame at 600 mm centres.
 - B. Fix insulation + BGT & finish with 24G perforated aluminium sheets.

10.4 Under-deck Roof Insulation

- All air-conditioned areas with roof exposed to the sun shall be provided with under-deck insulation of 30 / 50 mm thick Phenotherm having density of 32 Kg/cum. The insulation shall be sandwiched between fire retardant Kraft papers. On one layer of Kraft paper factory bonded aluminium foil shall be provided.
- Under-deck insulation shall be applied as follows:
 - A. Clean the surface and make it free from dust and loose particles.
 - B. Hold the Phenotherm slab in position.
 - C. The insulation shall be screwed to RCC slab with nylon rawal plugs and 65 mm screws fixed through 75 mm x 75 mm washers at 600 mm centres and securely tied with GI binding wire with final layer of chicken wire mesh.
 - D. Seal all intra slab joints with self-Adhesive PVC tapes.

10.5 Piping Insulation

- All pipes operating at temperatures lower than ambient shall be insulated with rigid pre-formed sections of Phenolic Foam with factory laminated glass cloth finish with overlap and having a K value of not more than 0.02 Kcal/m/Hr. /Deg. C. at 10 Deg. C mean temperature. Density shall be 35 kg/m³+/- 2 %
- Thickness of pipe insulation shall be as follows:

Temperature Range (Deg. C)	Pipe Diameter (mm)	Thickness (mm)
5 - 12	All sizes	40

- All tests like pressure testing should be complete and all systems approved by the engineer before insulation is applied to the equipment and piping. Insulation material shall be manufactured by approved manufacturers and should be of approved type specifically intended for the service specified.
- Pipe insulation application shall be as follows:
 - A. Pipes shall be thoroughly cleaned with wire brush and rendered free from all rust and grease and painted with primer and anti-corrosive paint.
 - B. One coat of shalikota primer shall be applied over the entire surface of pipe and fitting and accessories like valves etc.
 - C. Two coats of industrial hot bitumen 85/40 or 85/25 as per IS 702-1961 shall be applied on the cleaned pipe surface uniformly at the rate of 1.5 Kg/sq. m,
 - D. Rigid pipe sections of insulation shall be fixed tightly to the surface. Insulation shall be 50 mm thick TF quality thermocol. Seal all the transverse and longitudinal joints using hot bitumen.
 - E. Cover insulation with polythene (800 gauge) sheet. Seal all joints with bitumen and tape.
 - F. Every 300 mm provide PVC bands over polythene sheet covering.
 - G. Cover polythene sheet with glass cloth dipped in Foster compound 30-36 whether proof grade.
- All valves, fittings, strainers etc. for chilled water piping and drain piping shall be insulated to the same thickness as specified for the main run of pipes and applied generally in the manner specified for chilled water piping. Valves, joints, yokes and spindles shall be insulated in such a manner as not to cause damage to the insulation when the valves are used or serviced. All valves, fittings, strainers etc. shall be insulated and finished with Al. cladding for chilled water piping. Serviceable component of valves and strainers to have removable boxes with locking arrangement.
- Drain piping shall be insulated with 13 mm tubular Armaflex applied as per specifications for refrigerant piping.
- All outdoor piping exposed to weather or where specified, insulation shall be finished with Aluminium cladding. Application shall be as follows
 - A. Pipes shall be thoroughly cleaned with wire brush and rendered free from all rust and grease and painted with primer and anti-corrosive paint.
 - B. One coat of shalikota primer shall be applied over the entire surface of pipe and fitting and accessories like valves etc.
 - C. Two coats of industrial hot bitumen 85/40 or 85/25 as per IS 702-1961 shall be applied on the cleaned pipe surface uniformly at the rate of 1.5 Kg/sq. m,
 - D. Rigid pipe sections of insulation shall be fixed tightly to the surface. Insulation shall be 50 mm thick TF quality thermocol. Seal all the

transverse and longitudinal joints using hot bitumen.

- E. Fabricate and fix 24 SWG Aluminium sheet with proper groves and overlaps. The sheet joints shall be sealed with suitable non-hardening sealants.

10.6 Refrigerant Piping

- Insulation should be Armaflex and of closed cell tubing type.
- All refrigerant pipes from indoor to outdoor units (both suction and liquid line) shall be insulated with insulation materials approved by the Consultants or any other equivalent material.
- Thickness of pipe insulation shall be minimum 25 mm tubular Armaflex or as specified.
- Clean the outer surface of refrigerant copper piping. Insert the pipes in tubular Armaflex. Join two ends of tubular Armaflex insulation using suitable adhesive. Tape the joints with masking tapes.

10.7 Equipment Insulation

- Insulation (resin bonded fibre glass wool - 32 Kg/cum density) shall be cut and metered wherever necessary to fit the contour of the equipment / vessels etc. Insulation shall be applied with edges tightly butted and secured with wires and / or bands. The insulation shall be applied and finished similar to chilled water pipe insulation.
- Nitrile rubber class 'O' can also be used with adequate thickness to prevent condensation. The insulation shall have a protective layer of 'unshielded' or as specified by the manufacturer and approved by Consultant.

10.8 Painting and Identification

After the piping work is completed, all insulation clad pipes shall be labelled and provided with 300 mm wide band paint along the circumference at every 1200 mm distance for colour coding. The direction of fluid flow shall also be marked. All painting shall be as per agreed colours.

11 VARIABLE REFRIGERANT VOLUME SYSTEM

11.1 VRV SYSTEM

- All Variable Refrigerant Volume Air Conditioners shall be fully Factory assembled, charged with refrigerant, wired, piped, filters etc. and tested at the factory.
- The System shall comprise of Air Cooled Multi Split type Outdoor units, and a variety of indoor units connected by Common Refrigerant Piping and Power and Control Cabling.
- All bolts, nuts, screws, washers, plates, etc. and all other fittings on all VRV system components shall be plated or passivated to resist corrosion. Any item

found corroded during defects liability period shall be replaced by the VRV Contractor with improved material and the defects liability for that item shall be extended a further 12 months (and if corrosion re-appears the process is repeated with further defect liability extension).

- When indicated, all outdoor units where the ambient is aggressive, the unit shall have E-coat or equivalent. The complete cu. piping from the outdoor unit to the indoor unit shall also be coated with thermos guard paint or equivalent.

11.2 VRV SYSTEM

- The VRV System shall provide stable, trouble free and safe operations, and provide flexibility in operation of Indoor Units with independent control of each Indoor Unit, including steeples partial operation.
- It shall be possible to switch on only those Indoor Units that require Cooling/Heating in individual Areas.
- The capacity of Indoor and Outdoor Units shall be matched, stepless, and shall include multi Compressor cut off / speed control, by pass or any other means of capacity Control for stable operations of System.
- The System shall be capable of automatic operation even with varying Outdoor and Indoor requirements and make up of low Outdoor Temperatures to achieve lower Power Consumption, without any manual adjustments.
- All Systems shall be modular in nature and easily upgradeable / inter connectable for larger capacities.
- Units shall have hermetically sealed Scroll Compressors, to ensure high EER.
- The refrigerant gas shall be R 410a
- All Units shall be Air Cooled type.
- Modular System shall incorporate all required controls for parallel operation of Compressors, Condensers, Fans, and Indoor Units as well as Refrigerant liquid control.

11.3 POWER SUPPLY

All the units shall be suitable for operation with 415V+ 10%, 50Hz + 3%, 3 phase, and 4 Wire A.C. supply.

11.4 OUTDOOR UNITS

- Units shall be able operate over a range of Outdoor Ambient Temperatures suitable for Indian conditions & give necessary cooling capacities as specified at those other conditions.
- Units shall have backup Systems built into the Units, to prevent total shut down of System, in case of individual Component failures, even when part of the Units is out of Order.
- The noise level shall not be more than 55 dB (A) at normal operation measured horizontally 1 M away.

- All provision in Piping, cabling and Controls shall be available for repair of part of the system when the rest of the System is operational.
- Units shall have multiple Piping and Cabling connection options, for ease of installation and flexibility.
- The Units shall be capable of being mounted without structural modifications to Slab.
- Units shall be suitable for mounting outdoors, without any covers, etc.
- Units shall be suitable for connection to multiple Indoor Units of different capacities.
- All Equipment located outdoors shall withstand Rain, wind and Solar Radiation as prevalent in Tropical Countries.
- The Casing etc shall be suitably UV stabilized.
- The condenser aluminium fins shall be coated with special acryl pre-treatment for increased durability to salt corrosion.
- Outdoor units shall employ system of equal run time for all compressors, inverters or ON/OFF type within each outdoor unit single or multi module system.
- Outdoor units shall conform to technological guidelines for harmonic suppression and shall have in- built harmonic filters to work with inverters.
- Units shall have standard Ant vibrations connectors, mounts etc.
- Air Cooled Condensers shall have sub cooling section.
- All Outdoor Units shall be field serviceable.
- All Units shall be factory assembled, wired, piped and tested.
- The entire system should be able to be diagnosed from one point. The software for the same shall be included in the system.

11.5 COMPRESSOR

- The unit shall have multiple Scroll Compressors and shall be able to operate even if the inverter compressor is out of order.
- The inverter shall be IGBT (Insulated Gate Bipolar Transistor) type to be efficient & quiet.
- Compressor shall have continuous capacity control to meet load fluctuation & indoor unit individual control.

11.6 HEAT EXCHANGER

- The Heat Exchanger shall be constructed with copper tubes mechanically bonded to aluminium fins to form a cross fan coil and larger surface area.
- The fins shall have anticorrosion treatment for Heat Exchanger Coil. The treatment shall be suitable for areas of high pollution and salt laden air.
- The casings, fans, motors etc. shall also be with anticorrosion treatment as a standard feature.

11.7 REFRIGERANT CIRCUIT

- The Refrigerant Circuit shall include an accumulator, liquid & gas shut off valves and a solenoid valve. All necessary safety devices shall be provided to ensure the safety operation of the system.
- The system shall also include safety devices like HP – LP cut-off switches, fuse, crank case heater, fusible plug, over current protection for inverter, short recycling guard timer, single phase preventer etc.

11.8 PIPING

- All connections of Refrigerant Piping shall be in high grade Copper of Refrigeration quality of “York Shire Imperial” make / equal as indicated with Eddy Current Testing and Material Test Certificates.
- All connections, Tees, Reducers etc shall be standard make fittings.
- Insulation of cold lines shall be carried out with “Class 0 - Armaflex” / equal insulation sheets and tubes of appropriate thickness so that condensation does not occur.
- For individual Piping 50 μ [?] 100mm wide Aluminium Tape shall be used at joints of Piping with Bands for identification.
- For Outdoor Piping, the finish shall be woven GRP Mat finished with coloured Epoxy paints to withstand outside Ambient conditions and UV Radiation.

11.9 OIL RECOVERY SYSTEM

- Units shall be equipped with an oil recovery system to ensure stable operation with long refrigerant piping.
- System shall be designed for proper oil return to compressor along with the distribution of oil to individual compressor.
- The refrigerant piping shall be extended up to 100 M with 50 M level difference without oil traps.

11.10 INDOOR UNITS

- Units shall be factory assembled, wired, piped and tested.
- Units shall have DX Coils with Copper Tubes and bonded Aluminium Fins for highly efficient Heat transfer.
- Units shall have Centrifugal Fans for proper amount of Air circulation and low Noise.
- Units shall have Inlet Filters, which are easily cleanable or replaceable.
- All components of Units shall be easily accessible for connection, repairs and maintenance.
- Units shall have very low noise.
- Units shall have provision for connecting Fresh Air Ducts.

- Provision of Drain Pump is necessary for all Models with Ceiling or Wall Mounts.
- All Units with Factory manufactured Unit, Grills shall have auto swing feature for proper Air distribution.
- All Units shall be controlled by Electronic Expansion Valves only.
- All Units mounted inside the Ceiling shall have Fans capable of sustaining Duct connections, and special Filters if necessary.
- Visible Indoor Units shall have wireless remotes.
- Anti-corrosion treatment for avoiding corrosion of coils.
- All Units shall have adequate Insulation or Lining to avoid condensation.

11.11 CONTROLS

- All Units shall have Microprocessor Controls.
- Setting of addresses for each Unit should be automatic and need not be programmed.
- Microprocessor should have 'Auto Check Function' to indicate Piping and cabling errors to avoid malfunction.
- Control wiring shall be in FRLS grade, and simple with control and transmission wiring being common.
- Control Units shall be central, suitable for ON/OFF and Temperature control of zones, including scheduling.
- Malfunction and status display shall be available.
- Control Units shall be compatible with BMS of standard makes.
- Individual Controllers with wired or wireless remote for operation, status etc. shall be used.
- Precision Temperature Control shall be mandatory with Electronic Expansion Valves adjusting to Load fluctuation and operating load fluctuation to maintain ± 0.5 deg C, of set point with PID control Algorithm.
- Microprocessor to control speed or switching or by pass of Compressors, Condensers, Fans and Liquid management functions along with the System for proper oil Return and Stable and safe operation of System, shall be part of standard control System.
- Units shall have automatic Restart in case of Mains failures.
- Microprocessor shall have pre-set memory, which shall not be erased on power failures.
- All Units shall have "Self-Diagnostic Function" to pre warn of failures or problems, with function codes.
- All Controllers shall have digital indication.
- Power to the Control System shall be generated inside the Units from common Power source only.
- Control / communication wiring shall run in 25mm PVC conducts with markers.

11.12 CONDENSATE DRAIN PIPING

1" dia hard PVC insulated Drain pipe shall be used to remove condensate from Evaporator Unit to drain point. The joints shall be properly sealed so that there is no water leakage. U-trap shall be provided at the end. Additional insulated Drain tray shall be provided below the Evaporator Unit, if required.

11.13 AIRCONDITIONING MANAGEMENT SYSTEM

- The VRV system must be provided with PC based air-conditioning management system. The required hardware must be selected, suitable for minimum 128 indoor units.
- The complete operation, monitoring and diagnosis of VRV system shall have to be possible through this PC system.
- The system shall be capable to take external signals from security, fire, DG & Building Management System.

11.14 BUILDING MANAGEMENT SYSTEM

The VRV system shall have to be suitable for communication between VRV and intelligent Building Management System of Siemens / Honeywell / Johnson Controls / Invensys through BAC Net gateway.

11.15 MOUNTING

All Indoor Units shall be mounted with Brackets, Hangers etc. with proper size anchor Fasteners.

12 WINDOW / SPLIT AIRCONDITIONERS**12.1 SCOPE**

The scope of this Section comprises supply, installation, testing and commissioning of Window /Split Air conditioners.

12.2 WINDOW / SPLIT AIR CONDITIONERS

- The units shall be complete with compressor, motors, fans, cooling coils, condenser coils, control package, cleanable filter, facia grille and casing.
- The compressor shall be hermetically sealed, mounted on vibration isolators.
- The cooling and condenser coils shall have copper tubes with aluminium fins.
- The fans shall be properly balanced to provide a vibration free service.
- The filters shall be cleanable type and shall be easily removable.
- The control package shall consist of thermostats, speed control and fresh air and exhaust air adjustments.
- 3. Electricals shall be complete with capacitors, relays and safeties.

- Split units shall have a remote mounted condensing unit. All interconnecting refrigerant piping, power and control cabling between the indoor and the outdoor units shall be provided by the Air conditioning Contractor.
- All casings / cabinets exposed to the outdoors shall be corrosion resistant metal duly painted.
- All mounting frames for indoor and outdoor units shall be provided by the Air conditioning Contractor.

13 ELECTRICAL INSTALLATIONS

13.1 SCOPE

3. Scope of this section comprises the supply and installation of all electrical equipment such as motors, motor control centres, starters, cables, interlocks, etc. as required.

13.2 CODES, STANDARDS AND STATUTORY REGULATIONS

Codes, standards and statutory regulations to be used for design and constructions are given below. In general all equipment, material as well as design and constructions shall be in accordance with the latest issues of Indian and relevant standards currently in force. The installation shall be carried out in accordance with the Indian Electricity Act and Rules.

13.3 ELECTRIC SUPPLY SYSTEM/RATED VOLTAGE

- 15 volts, 3 phase, 4 wire, 50 Hz with solidly grounded neutral.
- Variation in electric supply under which motor shall be operated continuously without any adverse effect will be as follows :
 - A. Voltage : +/- 5%
 - B. Frequency : +/- 5% variation
 - C. Any combination of voltage and frequency

13.4 EQUIPMENT AND MATERIALS

- All equipment shall be as per specifications, and/or drawings supplied along with the tender documents. Equipment/materials shall be suitable for local climatic conditions as specified in the tender.
- All equipment shall be of robust construction. Enclosure of equipment shall be dust, damp and vermin proof. Equipment for outdoor installation shall have weather proof enclosures requiring no further protection by the purchaser.

13.5 APPROVAL

The Contractor shall be responsible for obtaining approval of drawings from statutory/local authority as required.

13.6 MOTOR CONTROL CENTRE

- Motor control centre shall consist of incoming switch fuse units/isolator and a starter mounted inside the wall or floor mounting type cubicle made out 2 mm thick MS sheet. Anti-corrosion and phosphatising treatment shall be given to the sheets by a standard 5 tank/7 tank process.
- All feeders shall be provided with two position (on-off) isolators, load break and quick make and break type. All isolators shall be suitable for front of board operation. Isolators for motor feeders shall preferably be of the 'motor duty' type i.e. capable of interrupting the locked rotor current of induction motors, which will be 6/8 times the full load current. Incomer with earthing will be provided by owner for main and A.H.U. panel.
- Isolators shall be interlocked with door to prevent opening or closing of the door in the closed ('ON') position of the isolator, in case of compartmental type of feeders. All live terminals on the isolators shall be adequately shrouded to prevent accidental contact and danger to the personnel.
- Caution name plate "CAUTION LIVE TERMINALS" shall be provided at all points where the terminals are likely to remain live and isolation if possible only at remote end e.g. Incoming Terminals of Incomer.

13.6.1 FUSES & FUSE FITTINGS

All fuses shall be of the non-deteriorating, high rupturing capacity, link, mounted in suitable fuse carriers or fuse bases.

13.6.2 CONTACTORS

- Contactors shall be magnetic, air break type, generally in accordance with BS 775/IS 2959.
- All contactors in power circuits of motor starters or other feeders shall be adequately rated for the duty required and operating conditions.
- Contactor coils shall preferably be of draw out type for easy replacement. Coil voltage shall be 220V AC. Contactor coils shall operate satisfactorily between 110% and 85% of the nominal coil voltage. Drop off voltage for AC coils shall be between 80% and 45% of the nominal voltage.
- Making and breaking capacities of the contactors shall be suitable for AC2 and AC3 categories of duty as per IS 2959 unless the contactors are required for special duty such as inching or plugging duty or capacitor duty, in which case, they will be suitably de-rated.
- Each contactor shall be provided with 4 normally open and 4 normally closed auxiliary contacts or as required by the control scheme. If necessary, auxiliary relays or contactors may be provided to obtain necessary number of auxiliary contacts. Auxiliary contacts shall preferably be convertible from NO to NC and vice versa.

13.6.3 PROTECTIVE DEVICES

- All feeders shall be protected by appropriate protective devices such as fused, combined bimetallic thermal overload and single phasing prevent or relays.
- Current transformer, when specified, shall be of bar primary, ring type or wound type, and in accordance with IS 2705 or BS 2046 or BS 81. Class and ratio of CTs shall be specified. VA burden of CTs shall be suitable for the load burden.
- Ammeters (96 square) voltmeters, PF meters, Run Hour meters and Kilowatt Hour meters shall be provided and shall be of industrial grade accuracy, suitable for flush mounting and in accordance with IS 1248. Suitable selector switches shall be provided in conjunction with ammeters and voltmeters.
- Indicating Neon lamps used shall be of low voltage, low burden type with series resistor to increase lamp life and to protect equipment from short circuits caused by broken filaments. Lamp covers shall be provided with interchangeable coloured lenses of perspex or equivalent unbreakable materials. Lenses should not get discoloured in course of time, due to the heat generated by the lamps. Name plates showing the condition indicated by the lamp shall be affixed near to the lamps.
- Rating of terminal blocks for power and control circuits shall be at least 30 Amps and 15 Amps respectively. Terminals in control circuits shall be suitable for receiving one conductor per terminals of specified sizes. Terminals for power circuits shall be designed for receiving aluminium conductors and shall be screw clamp type or equal. Terminals for control circuit shall be suitable for receiving copper conductors. Star/Lock/Shake proof or Spring Washers shall be provided to prevent sparking due to vibrations. Special terminals with copper strips mounted on insulating supports may be provided for large cables. Where terminals, suitable extension bars with off- set may be provided.
- Location of controls for motor starters or other feeders shall be specified. Normally one 'stop' push button with stay-put feature (lockable) and one reset push button for hand resetting of BMR shall be provided on the door of the compartment. Colours used for push buttons shall be as follows:

Stop push button	-Red	Start push button	-Green	Reset push button	-
				Black	

(Note: In case 'Stop', and 'Reset' are combined, only red colours will be used.) Name plates indicating the function of the push button shall be affixed near to the push buttons.

13.6.4 WIRING

- Internal wiring of MCCs for power and control shall be carried out with copper conductor PVC insulated cables of PVC covered copper/ aluminium tapes.
- Wiring of components mounted on doors shall be carried out with single strand 2.5 sq. mm copper conductor flexible cables. Wires and cables shall be neatly arranged and bunched together with suitable clamps made of insulating material. Wire harnesses shall be adequately supported along the MCC metal work.

- Identification ferrules or tags shall be attached to each wire at each point connection.
- Sizes of conductors for power wiring shall be determined by the manufacturers on the basis of full load current under specified conditions, protective fuse rating and appropriate rating factors as applicable. Minimum size of conductor shall be 2.5 sq. mm Minimum size of conductor for control wiring shall be 1.5 sq. mm.
- The following colour code shall be used for determining the colours of wires used for internal wiring. Manufacturer shall obtain specific approval of the purchases, if this colour coding cannot be observed for any reason what so ever:

Earth - Green

Neutral -Black

230V, A.C. phase to neutral -Red/Yellow/Blue, Black

All wiring shall be carried out in accordance with approval and certified panel wiring diagrams. Vendor shall check all wiring from point to point for correctness. All wires shall be numbered and the numbers shall be indicated on the relevant drawings.

13.6.5 EARTHING

All metal work of the MCC and non-current carrying metallic parts of the equipment in the MCC shall be securely bonded together by adequate means e.g. use of earthing washer for bolted connections or tapped holes for mechanical connections. One copper earth bus running through the entire length of the MCC shall be provided preferably along with the terminal chambers. Size of the earth bus shall be such as to withstand phase to earth or 2 phases to earth short circuit for one second. The minimum size of the busbar shall be 25 x 3 mm. The terminals complete with hardware and cable sockets shall be provided on the earth bus for connection to external system.

13.6.6 NAME PLATES AND LABELS

- One name plate giving designation of the MCC shall be affixed prominently on to the MCC. (Details of designation will be given). Each feeder shall also be labelled giving following details:
 - A. Feeder No.
 - B. Feeder Designation (Eqpt. Ref. No.etc.)
 - C. Description
 - D. Rating (HP/KW/Amps)
- All components whether mounted inside the MCC or on the door shall be permanently and clearly labelled with their reference number and/or letter or their function (rating of fuse shall form part of the fuse designation).
- Labels for feeder designation shall be of laminated plastic or rear engraved perspex with white letters on black background.

- Labels for feeder designation shall be fixed on the doors on respective feeders with chrome-plated self-tapping screws. Designation labels shall be identical in size to permit interchanging if required later.

13.6.7 MISCELLANEOUS

All hardware used shall be plated or passivated to resist corrosion. Type of plating or passivation shall be subject to the approval of the Engineer. All fixing screws shall preferably be raised head type.

13.6.8 DRAWINGS

- Contractor shall furnish the following to the Engineer for his approval before commencement of fabrication :
 - A. General Arrangement Drawing showing overall dimensions, arrangement of feeders, foundation plan, positions of cables entries, weight of MCC and sections in which MCC will be despatched.
 - B. Single Line Diagram for the MCC showing rating of various components used for all feeders complete with feeder numbers, designations, descriptions, ratings, etc.
 - C. Schematic and panel wiring diagrams for all feeders.
 - D. Terminal plan for MCC, showing feeder numbers, terminal numbers and terminal markings.
- After the final approval, six prints and one clear film reproducible of each of the above drawings shall be furnished.
- The Contractor shall note that he shall bear full responsibility for any error, discrepancies, omissions, etc. in the drawings irrespective of whether such drawings have been approved or not. Approval of drawings shall not relieve the Contractor of his liability to complete the work in accordance with the specifications and other conditions of contract nor shall it exonerate the vendor from any of his guarantees.

13.6.9 TESTING AND INSPECTION

- The following tests shall be carried out on the Motor Control Centres after completion of all work:
 - A. All power and control circuits for MCCs shall be tested for insulation resistance with a 500 volt megger, before and after the high voltage test.
 - B. High voltage test shall be carried out on all power and control circuits at 2000 volts A.C. voltage applied for one minute.
 - C. Low voltages continuity test on all power circuits shall be carried out from bus bars to the outgoing terminals of each feeder with switches and contactors in closed position.
 - D. All control circuits and operations of equipment for all feeders shall be checked with only control supply made available to ensure satisfactory operation of all equipment such as push buttons, BMR reset, indicating lamps, timing relays, etc. All contactor coils shall be checked for presence of humming or chattering. Special requirements for various feeders indicated in the purchase data sheets shall also be checked.

- E. Earth continuity test shall be carried out with a low voltage supply of not more than 6 volts, between various non-current carrying metallic parts of equipment, steel work, etc. and the earth bus provided in the MCC.
- F. Operation of all instruments and meters provided on the MCC shall be checked.
- All the tests listed above shall be carried out in the presence of Owner's representative, during final inspection. Contractor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests.
- Contractor shall give a notice of not less than two weeks for inspection and testing by the Engineer's representative.

13.7 ELECTRIC MOTORS

13.7.1 Rating & Duty

- Rating of the motors shall be as indicated in the Schedule of Equipment. Where the equipment supplied needs a higher rated motor, the Contractor shall clearly point out and motors shall be offered accordingly.
- All motors shall be rated for continuous duty at maximum output.
- Rated voltage for three phase motors shall be 415 volts.

13.7.2 Design Features

- Motor body shall be of close grained cast iron construction and shall be provided with lifting hooks or eye bolts. The motor along with the fan and half coupling shall be dynamically balanced.
- Fan provided for fan cooled motor shall be non-directional type.

13.7.3 Enclosure/Protections:

- Enclosure for motors shall be totally enclosed fan cooled (TEFC) unless otherwise specified – SPDP motors shall be used only where the desired output is not obtainable in a TEFC frame.
- All outdoor motors shall be TEFC weather proof type.
- Degree of protection for all motors shall be IP 44 as per IS 491.
- Two earthing terminals comprising terminals studs, two plain washers, one spring washer and nut shall be provided on opposite sides of the frame. Studs shall be suitable to receive appropriate size of earth conductor.

13.7.4 Bearings:

- All motors shall have ball and/or roller bearings with limit lubricators.

13.7.5 Terminal Box:

- Terminal box shall be of ample size, suitable for termination of aluminium conductor cables (with cable sockets) which may be substantially de-rated for conditions of installation.
- Motor terminals shall be of stud type, substantially designed and well insulated

from the frame. Each terminal shall be complete with two flat washer's one lock nut.

- Number of terminals shall be as given below :
 - A. Squirrel Cage Motors up to 3.7 KW -3 Nos.
 - B. Squirrel Cage Motors above 3.7 KW
(With tinned copper links for delta connection) -6 Nos.
- Terminal boxes of all motors shall be rotatable in steps of 90 degrees, without disturbing the motor winding connections to the terminal block. Separate terminal box shall be provided for connections to anti-condensation heaters in case of motors about 50 HP. If heater terminals are provided in the main terminal box, then insulating barrier shall be provided between them with caution name plate affixed on the terminal box."CAUTION - LIVE HEATER TERMINALS."
- Separate terminal boxes for starter and motor leads to be provided for slip ring motors. Where it is not feasible, an approved type of insulating barrier to be provided.

13.7.6 Temperature Rise

The temperature rise of motors when tested in accordance with IS 325 shall not exceed the limits specified therein.

13.7.7 Starting of Motors

- All squirrel cage motors shall be suitable for full voltage starting. Motors of 10 HP and above will generally be started with star/delta or auto transformer starters which, in addition to protective devices, shall be provided with single phasing preventer.
- Starting current at full voltage of slip ring motors shall be limited by the rotor resistance starter. Motor manufacturer shall furnish appropriate value of external resistance required to limit the starting current as well as to obtain the required torque. However, starting current with slip rings shorted shall not exceed 600% of full load current. Starting current of squirrel cage motors with full voltage starting shall not exceed 600% of the full load current with tolerance specified in IS 325.
- Starting torque of squirrel cage motor started on full voltage shall not be less than 200% of the full load torque. Pull out torque of motors shall not be less than 200% of the full load torque.

13.7.8 Insulation

- All motors shall have Class 'D/F' insulation unless the ambient temperature or other conditions necessitate another class of insulation.
- All materials used in the construction of motors shall be non-hygroscopic.

13.7.9 Painting

All motors shall be painted in an approved manner using two priming coats and two finish coats. The final colour shall be to the Owner's requirements.

13.7.10 Performance Particulars

Following performance particulars for all motors to be furnished well in advance before finalising orders for motors:

- A. Make
- B. Type
- C. Enclosure
- D. Class of Insulation
- E. Temperature Rise above 40 Deg. C ambient
- F. Rated Output
- G. Speed
- H. No load current
- I. Full load current
- J. Locked rotor current
- K. Starting torque (DOL)
- L. Efficiency at full load, 3/4 load, 1/2 load
- M. Power factor at full load, 3/4 load, 1/2 load
- N. Details of rating for space heater
- O. Max. size of aluminium conductor cable which could be connected to motor
- P. Rotor current at rated output
- Q. Value of rotor resistance for different torque values

13.8 MV DISTRIBUTION BOARDS**13.8.1 Construction**

The salient features of constructions panels shall be as follows:

- B. Sheet Steel -CRCA Sheet of 2 mm thick for frames, cable gland plates and equipment mounting plates and 1.6 mm thick for front and rear doors and covers
- C. Welded construction, with shipping section bolted together. All such joints to be gasketed. Lifting lugs to be provided.
- D. The cubicles shall be totally dust and vermin proof conforming to IP 54 of IS 2147.
- E. All doors to be hinged type except busbar chamber covers which shall be bolted type. The panel shall be of flush front design, suitable for access from front and rear.
- F. The construction shall be such as to facilitate easy extension at both ends.
- G. The design shall be such as to have individual feeders in separate compartments, with proper barriers between adjacent feeders, busbar chamber and cable box chambers.

13.8.2 Painting

All sheet steel work shall be properly cleaned and degreased. Rust and scale shall be removed by picking and phosphatising. After phosphatising, two coats of primer shall be applied followed by two coats of finishing synthetic enamel paint of approved shade as per IS-5. The painting shall be stove enamelled.

13.8.3 Air Circuit Breakers

- The circuit breaker shall be air-break, horizontal draw-out feature shall show 3 positions viz. SERVICE, TEST and ISOLATED. These positions along with 'OPEN' and 'CLOSE' positions shall be visibly marked.
- All positions shall have provisions for locking. The ACB shall have shutter assembly and arc- chutes and mechanical trip features.
- The ACB shall have 6 NO + 6 NC auxiliary contacts rated at 10A, 240 V, AC.
- 'RED' and 'GREEN' indicating lamps shall be provided on the cubicle.
- The ACB door shall not have any lamps or instruments. All such accessories shall be mounted on a separate compartment.
- The ACB shall have proper interlocks such that it cannot be 'plugged in or out' 'SERVICE' position, if the breaker is in 'ON' condition. It shall not be possible to operate as circuit breaker unless it is properly engaged in any of the three positions.
- The ACB shall have series CI operated over- current and short-circuit releases with facilities to mount the under voltage and shunt-trip releases.
- The operating mechanism shall be independent, manual spring charged stored energy type. The mechanism shall ensure quick-break, quick make action and the ACB shall be trip- free in operation.

13.8.4 Air Break Switches

- The air break switches shall be of AC23, (heavy) duty, quick make-quick break, fault- make type as per IS 4047. The contacts shall be silver plated.
- The switches shall be capable of withstanding the mechanical and thermal stresses produced by overloads and short circuits.
- All switches of all ratings shall have inter- locks with the compartment doors. Switches of 250A and above shall be lockable in the 'OFF' position. All live parts shall be shrouded. It shall be possible to intention- ally defeat the interlocks if required.
- 'RED' indicating lamp shall be provided for 'ON' indication.

13.8.5 Fuses

All fuses shall be of HRC cartridge fuse-link type having a certified rupturing capacity of not less than 46 KA at 415 volts AC. The HRC fuses shall conform to IS 9224 1979. All fuses shall have visible indication to indicate 'Blown' condition.

13.8.6 HRC Fuse Carriers

- The HRC fuse carriers/bases shall be of high grade phenolic mouldings. The

contacts shall be silver plated and the contact blocks shall be suitable to receive the rated conductors of aluminium.

- The fuse carriers shall have an aperture to view the conditions of HRC fuse mounted inside.

13.8.7 Contactors

- The motor starter contactors shall be of the electro-magnetic, double-break, non-gravity type rated for uninterrupted duty suitable for operation under AC 3 utilisation category as per IS 2959. The contacts shall be silver plated.
- 2 NO and 2 NC auxiliary contacts shall be included.
- The operating coils shall have Class 'E' insulation of wire and shall be suitable for operation of any specified control supply system.

13.8.8 Thermal Overload Relays

- The thermal overload relays shall be 3 element, positive action, ambient temperature compensated with a time lag and adjustable settings. The setting range shall be selected in accordance with the ratings of the motor. Thermal overall relays shall be provided with inbuilt single phasing preventer.
- The relay shall be self-reset/hand reset as called for in the case of hand-reset, the reset button shall be fixed on the compartment door.
- The relay shall have at least one 'NC' and one 'NO' or one change-over contact.

13.8.9 Moulded Case Circuit Breakers (25 K breaking capacity)

- The moulded case circuit breakers, MCCBs shall be provided where certified. The MCCBs shall conform to the latest applicable IS 2516-1977.
- For AC Circuits the MCCBs shall be triple pole construction and shall have independent manual opening and closing mechanism. The mechanism shall be quick-make and quick-break type and the breakers shall be trip-free in operation. The 'ON', 'OFF' and 'TRIP' mechanism shall be clearly indicated.
- Bolted type neutral link to be provided with TP MCCB.
- It shall be possible to mount accessories on the MCCBs like shunt-trip and under voltage release, alarm contacts, etc.
- The MCCBs shall have thermal/static trip devices.
- The MCCBs shall have rupturing capacities as specified in BOQ/Single Line Diagram.

13.8.10 Miniature Circuit Breakers

- The MCBs shall be of single pole, double pole, triple pole or four pole as required. The MCBs shall be of magnetic type with a maximum rupturing capacity of 10 KA at 415 V.

13.8.11 Current Transformers

- The CTs shall be of dry type and shall have short-time withstand rating equal to the short-time withstand rating of the associated switchgear for 1 second.
- The measuring instrument CTs shall be of 15 VA, minimum accuracy class

1.0 and an instrument safety factor of 5.

- The protection relay CTs shall be of 15 VA, minimum accuracy class 5P and an accuracy limit factor of 10.

13.8.12 Indicating Instruments and Meters

- 3. Electrical indicating instruments shall be 72 mm/96 mm/144 mm square size, suitable for flush mounting.
- The zero adjustment shall be done from outside the cover.
- The dials to be parallax free with black numerals on a white dial.

13.8.13 Indicating Lamps

- Indicating lamps shall be of the filament type and of low watt consumption, provided with series resistors and HRC fuse link for protection.
- The lens shall be easily replaceable from the front.

13.8.14 Control and Selector Switches

- The control and selector switches shall be of rotary type, adequately rated for the application but with a minimum rating of 10 Amps at 240 V AC and 1 Amp at 220 V DC. The plates shall have clear position markings.
- The control switches shall have pistol grip handles spring return to normal. The selector switches shall have oval knobs and shall be contact stay-put type.

13.8.15 Push Buttons

- The push buttons shall be of the momentary contact, push to actuate rated for 10 A at 240 V AC and 1 A 220 V DC. The 'START' push buttons shall be green and shrouded. The 'STOP' push button shall be red and unshrouded. All other push buttons shall be black.
- The elements shall be enclosed with 1 'NO' and 1 'NC' contacts. It should be possible to add on easily extra elements to increase the number of 'NO' and 'NC' contacts.

13.8.16 Main and Auxiliary Buses

- The busbar shall be of high conductivity aluminium alloy of E91E grade. The busbar shall be of uniform cross-section throughout the length of the panels.
- All main and auxiliary busbar shall be insulated with sleeves. The sleeves shall be of high dielectric strength, non-corrosive and of phase and neutral colours.
- The busbar shall be supported on cast epoxy/ resin/DMC/Fibreglass insulators and the spacing of the supports shall be such as to withstand the stresses of the short circuit currents. The busbar spacing shall be adequate for 3 phase voltage upto 600 V.
- The busbar shall be chosen for specific current ratings with a minimum density of 1 amp for sq.mm area.

13.8.17 Internal Wiring

- All internal wiring shall be carried out with 1100 V/650 V grades PVC insulated, stranded conductor copper wires. The minimum size of wires shall be 2.5 sq.mm copper and for CTs also 2.5 sq.mm copper.
- All individual control and CTs wiring shall be labelled with engraved identifications ferrules, yellow in colour with black letters.
- All wiring shall be terminated on stud type terminal blocks through crimping sockets. No more than one connection shall be made on any one terminal block.
- All spare auxiliary contacts of contactors and relays shall be wired to control terminal blocks.

13.8.18 Terminal Blocks

- Terminal blocks for power and control shall be of reputed make stud type, with washers, nuts and lock-nuts. All adjacent terminals shall have insulating barriers.
- All power terminal blocks shall be appropriately rated for current with a minimum of 30 Amps. The control terminal blocks shall be rated for a minimum of 10A and suitable for at least 2 conductors each of 2.5 sq.mm.
- All sets of power and control power terminal blocks shall be identified with engraved plastic labels, black background and white letters.

13.8.19 Identification Labels

All labels shall be black plastic with white engravings of letters of minimum 6 mm sizes.

13.8.20 Earthing

All switchgears shall have continuous run of earth busbar. The size and materials of the earth bus- bar shall be specified.

13.8.21 Tariff Advisory Committee and CPRI Tested

The switchgear shall be approved by the Tariff Advisory Committee (for Fire Insurance) and CPRI tested for short circuit test and enclosure test.

13.8.22 Tests

- High Voltage test at 2.5 KV.
- Power and Control Circuits Continuity Tests.
- Insulation Resistance Test with 1000 V Megger.
- Operational Test.
- Three Sets of Test Certificates to be submitted

13.8.23 Drawings:

- Three sets of general arrangement drawings and wiring diagrams of all types of feeders shall be submitted.

13.9 CONTROL STATIONS

Control station shall be of cast iron or cast aluminium enclosures, consisting

of 'START' and 'STOP' push buttons and shall have stayput feature of twist unlock type.

13.10 CABLE AND ACCESSORIES

All cables shall be heavy duty PVC insulated armoured and PVC sheathed of 1.1 KV grade. Aluminium conductor cables shall be used for power and copper conductor cables shall be used for control wiring.

13.11 GLANDS

- Glands used for termination shall be compression type. Cable glands shall be with single/double seal and cone and clamp for armoured clamping.
- For safe and indoor areas, glands with single seal and for outdoor installation and hazardous areas, gland with double seals will be used. For use in corrosive areas, glands shall be coated with rust proofing lacquer after installation and provided with PVC hoods.
- Cable lugs shall be of Dowell or equivalent approved make, suitable for connection of aluminium conductor cables. The cable lugs shall be of tinned copper and of soldering type for solid conductor cables. For stranded conductor cables, crimping type, tinned copper cable lugs shall be used.

13.12 CONDUITS AND ACCESSORIES

Conduits wherever used with prior approval of the client/Consultant shall be of GI heavy gauge/black enamelled MS/ Heavy duty FR PVC. All accessories, such as junction boxes, shall be duly approved by competent authorities. Terminal blocks of adequate rating are to be provided in the junction boxes.

13.13 SADDLES

Saddles to be used for cleating cables or conduits shall be fabricated from MS or aluminium strips. Fabricated MS Saddles to be galvanised or painted with galvanize aluminium paint before installation.

13.14 CABLE TAGS AND IDENTIFICATION FERRULES

Cable tags and identification ferrules provided on cable cores/wires shall be of PVC/plastic. Cable tags shall be provided at every 15 meters and at all bends or change in routes.

13.15 STRUCTURAL STEEL

This shall include MS angles, channels, flats, etc. required for fabrication of cable trays, local supports for cables, control stations, etc. All steel sections shall be new and conform to IS 226.

13.16 MISCELLANEOUS MATERIALS

These shall include solders, fluxes, adhesive insulating tapes, PVC sleeves, petroleum conducting jelly, etc.

13.17 EARTHING MATERIAL

- Copper strips or wires of suitable sections shall be used for earthing in accordance with IS 3403.
- All 3 phase 415 Volts equipment shall be earthed at two points and all single phase equipment at one point.

13.18 PAINTING

All metal work and metal parts of the MCC shall be thoroughly cleaned to remove rust, scale grease or any other matter. Suitable anti-corrosion treatment such as phosphatising shall be given to the metal work. All exposed surfaces of the metal work shall then be given a priming coat of zinc chromate or equivalent and finished with two coats of paint of specified shade.

13.19 DRAWING

Contractor shall submit 3 copies of control of schematic wiring diagram for refrigeration unit showing all protections and interlocks for Consultant's review and approval. After the final approval six prints and one clear reproducible of each drawing shall be furnished.

13.20 INSTALLATION**13.20.1 Motor Control Centres**

- Motor Control Centres shall be installed on welded construction channel framework. Framework shall be properly grouted by means of foundation bolts or anchor fasteners.

13.20.2 Cable Laying

- As far as possible, cable shall be run in built up trenches and on walls/ceiling thru perforated/ladder type cable trays. Cable trays installed shall be fixed by means of MS/GI cable supports to walls/ceiling with anchor fasteners. Cables shall be dressed and clamped to the cable trays by means of GI strap saddles of minimum 3 mm thickness. Cables shall be kept away from wall ceiling by saddle bars of at least 6 mm thickness. Cables running in built-up trenches shall also be properly clamped when cable run is on side walls of trench. Cable entry into the building shall be through suitable GI pipes or Hume pipes or trenches. All cable entry openings into the buildings shall be properly sealed with cold setting, PVC compound or other approved materials.

13.20.3 Cable Termination

- PVC cables shall be terminated with compression type glands. For outdoor installation double seal compression glands shall be used. All cables shall be connected by means of suitable crimping type cable lugs. All connections shall be secure and vibration proof. All contact surface shall be coated with petroleum conducting jelly before connections are made.

13.20.4 Earthing

- 3. All metallic frame work and non-current carrying metallic parts and enclosures of electrical equipment such as MCCB, motors, control station, etc. shall be bonded to one another and earthed by means of two separate earth conductors and connected to the plant earthing system.

13.20.5 Motors

- All motors shall be installed on a common foundation with the driver equipment coupled through flexible couplings or belt drive.
- Levelling and alignment of motor and driven equipment to be carried out as per IS 900 to avoid undue strain on motors.
- Insulation resistance of motor shall be measured before commissioning. In no case insulation resistance should be less than one mega ohm. If it is less than one mega ohm motor should be dried out and/or windings to be revarnished as per procedure laid on IS 900. Pre-commissioning mechanical checks shall be carried out as per IS 900.
- 3. Cable termination and earthing of motors shall be carried out by Electrical Contractor.
- On commissioning of motor, any defects like excess current, bearings getting hot, undue vibration or noise etc. are observed; it will have to be made good by the Contractor without any extra cost.

13.21 TESTING AND COMMISSIONING

13.21.1 Operation Test

- Energise only control circuits and carry out closing and tripping operations. (Where AC supply derived from main supply is used for operation, the switchgear bus may be energised). Check tripping of circuit breakers by manual operation of protective relay contacts. Check operation of mechanical closing and tripping devices. Check lockout conditions for closing of circuit breakers by simulating the required conditions. Check control, indications, sequence interlocks and alarms.
- 3. Polarity and connections of instrument transformers check for correctness of CT and PT connections provided with transformer. Check electrical continuity of secondary circuits with ELV tester. Adjust spacing of arcing horns/rod gaps.
- Check operation of instruments, meters, relays and tripping of circuit breakers by primary/secondary injection as specified. This test will be carried out only if specifically called for by Contract Documents.
- Check continuity of power circuits and earth continuity of all non-current carrying metallic parts with a low voltage (6V or less) continuity tester.
- Carry out HV/IV test on power and control circuits if specifically called for in Contract Documents.

13.21.2 Motors

- Check equipment for free movement of rotor and play, lubrication and for any

other mechanical defects and direction of rotation.

- 3. Check commutators, slip rings, brushes, brush- holders, etc. for satisfactory conditions. Insulation test of motors between winding and ground. Use 500 V megger for MV motors and 1000 V megger for HV motors. Check electrical continuity with ELV tester.

13.21.3 Control Cables

- Carrying insulation test on all power and control circuits. Check all equipment for satisfactory operation and correct wiring.

13.21.4 Wiring

- Insulation test between phases, between each phase and neutral and between each phase/neutral and ground.
- DC High Voltage Test on HV Cables in accordance with the relevant Indian Standards and Code of Practice. This test shall be carried out on cables, installed in final position and all joints and terminations have been made. The cables, however, may not be connected to the equipment so that the equipment may not be subjected to the test voltage.
- In case of lighting wiring, insulation test shall be carried out on lighting feeders with branch circuits open. Branch circuits shall be tested separately with lamp holders, plug receptacles and lighting fittings in position but without lamps. In case of lighting circuits with lamp ballasts and glow starter's insulation resistance may be measured between phase and ground only.
- In case of directly buried cables, insulation resistance of cables shall be measured before and after the back filling. Test all receptacles for correct phase sequence.

13.21.5 Earthing System

- Continuity test for earth continuity conductors with ELV tester.

13.22 OPERATION TEST

After successful completion of the above tests, operational tests shall be carried out by the Contractor for checking the connections done by him and satisfactory operation of all the equipment supplied by him. This test shall be carried out initially without energising power circuits. Various control conditions shall be simulated for the purpose of this test. Any defects detected during the tests such as blown fuses, damage to devices, shall be rectified by the Contractors, free of cost.

13.23 FRLS CABLE

13.23.1 Scope

- This specification covers the requirements for design, manufacture and supply of XLPE, FRLS cables for High and Medium voltage systems and cable jointing/terminating accessories for high voltage / medium voltage systems.
- The scope under this section covers the following:

- A. Power cables HV and LV
- B. Control cables.

13.23.2 Standards

The following standards shall be applicable:

- IS: 209 : Specification of zinc.
- IS:692 : Paper insulated lead-sheathed cables for Electricity supply
- IS:692 : PVC insulated cables
- IS:1255 : COP for installation and maintenance of paper Insulated power cables (up to and including 33 KV)
- IS:1554 : PVC insulated (heavy duty) electric cables working voltage (up to and including 1100V)
- IS :1753 : Specification for aluminium conductors for Insulated cables
- IS: 2633 : Methods of testing weight, thickness and Uniformity of coating on hot dipped galvanised articles
- IS: 2982 : Specification for copper conductors in Insulated cables.
- IS: 3961 : Recommended current ratings for PVC insulated and PVC Sheathed heavy duty cables.
- IS: 3975 : Specification for mild steel wires, strips and tapes for armouring of cables.
- IS :4288 : PVC insulated & PVC sheathed solid aluminium
- IS :5755 : Mineral insulated aluminium sheathed cable with aluminium conductor
- IS:5819 : Recommended short circuit ratings for High voltage PVC cables
- IS: 5831 : Specification for PVC insulated and sheath of electric cables.
- IS :5959 : Polythene insulated and PVC sheathed (heavy duty) electric cables
- 3. IS: 6380 : Electrometric insulation and sheath of Electrical cable.
- IS: 6474 : Polyethylene insulation and sheath of electric cables.
- IS: 7098 : Specification for cross linked polyethylene Insulated PVC sheathed cables for working voltage from 1.1 KV to & including 33 KV.
- IS: 8130 : Conductors for insulated electric cables and flexible Cords.
- IS: 10418 : Wooden drums for electric cables.
- IS: 10462(PART-I) : Fictitious calculation method for determination of dimensions of coverings of elastomeric and thermoplastic insulated cables.

IS:10810(PART 58) : Oxygen Index test

IEC: 502 : Extruded solid dielectric insulated power cables for rated up to 30kV. voltages from 1kV

IEC: 540&540A : Test methods for insulation and sheaths of electric cables and cords.

13.23.3 General Requirements

- The cables shall be either copper or aluminium as indicated. The HV cables shall be of pilsca, PVC OR XLPE and the M.V cables shall be of PVC or XLPE as indicated in the drawings and schedule of materials.
- The cables shall be brand new and in good condition. These shall be suitable for laying trays, trenches ducts, conduits and underground buried installation with uncontrolled backfill and possibility of flooding by water.
- Power cables shall comply with the following:
 - A. HV cables to suit the system voltage
 - B. LV cables – 1100 V grade with standard copper conductors' upto and including 16 mm sq. and standard aluminium conductors above 16 mm sq.
 - C. Colour coded insulation
 - D. PVC inner and outer sheathing applied for extrusion
 - E. Steel armouring between inner and outer sheathing.
- Control cables shall be 600 V grade multi-core, multi strand copper conductor with PVC insulation, armouring and sheathing. The cable sizes shall be selected to carry the continuous full load current, with stand short circuit currents and bring the voltage drop within the specified limits.
- The cables shall be suitable for laying in trays, trenches, ducts, and conduits and for underground buried installation with uncontrolled backfill and possibility of flooding by water and chemicals.
- Outer sheath of all PVC and XLPE cables shall be black in colour and the minimum value of oxygen index shall be 29 at 27 ± 2°C. In addition suitable chemicals shall be added into the PVC compound of the outer sheath to protect the cable against rodent and termite attack.
- Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one metre. The embossing shall be legible and indelible.
- The overall diameter of the cables shall be strictly as per the values declared in the technical information furnished along with bids subject to a maximum tolerance of ± 2 mm.
- PVC/Rubber end caps shall be supplied free of cost for each drum with a minimum of eight per thousand metre length. In addition, ends of the cable shall be properly sealed with caps to avoid ingress of water during transportation and storage.

13.23.4 CONDUCTORS

- The copper conductors shall comply with the requirements specified in IS: 2982 and aluminium conductor IS: 1753.

13.24 XLPE CABLES

- Power cables for 3.3 kV upto and including 22 kV system shall be Aluminium conductor 5, XLPE insulated screened, sheathed, armoured and overall PVC sheathed as detailed below.
- The conductor shall be stranded and compacted circular for all cables.
- All cables rated 1.1/ 3.8/6.6kV and above shall be provided with both conductor screening and insulation screening. The conductors shall be provided with non-metallic extruded semi conducting shielding.
- The core insulation shall be with cross-linked polyethylene insulating compound applied by extrusion. It shall be free from voids and shall withstand all mechanical and thermal stresses under steady state and transient operating conditions. It shall conform to the properties given in Table - 1 of IS : 7098 (Part-II)
- The insulation shielding shall consist of non-metallic extruded semi- conducting compound in combination with non-magnetic metallic screening of copper screen shall be capable of carrying the single line to ground fault current.
- The conductor screen, XLPE insulation and insulation screen shall all be extruded in one operation by Triple Extrusion' process to ensure perfect bonding between the layers. The core identification shall be by coloured strips or by printed numerals.
- The inner sheath shall be applied over the laid up cores by extrusion and shall conform to the requirements of type ST2 compound of IS: 5831. The extruded inner sheath shall be of uniform thickness. For multicore cables, the armouring shall be by galvanised steel strips. If armouring is specified for single core cables in the data sheet, the same shall be with H grade hard drawn aluminium round wire of 2.5 sq. mm diameter.
- The outer sheath of the cables shall be applied by extrusion after the armouring and shall be of PVC compound conforming to the requirements of Type of IS: 5831. The thickness of outer sheath shall be as per amendment No.1 to Table 5 of IS:7098 part 2. (Column 3 & 5 for both armoured and un- armoured cables.)
- For multicore cables, the armouring shall be by galvanised steel strips. For single core cables, the same shall be with hard drawn aluminium round wire of 2.5 mm diameter.
- The dimensions of the insulation, inner sheath and armour materials shall be governed by values given in Tables 2, 3 and 4 (Method 'b') of IS: 7098 PAT-II.
- Power cable laying shall strictly be as follows :
 - A. In full length without joints or splices

- B. Mark the routing on drawings and at site.
- C. Cable trays to be used for cables laid indoors except for single cables. The cable trays shall be of ladder type fabricated out of structural steel or aluminium as indicated. The cable trays shall be of adequate strength to carry the weight of cables without sagging. Structural brackets grouted in the build-up trenches to support the cable such supports shall be at intervals of not less than 750 mm centres. All the structural steel work shall be finished with two coats of paint over primer.

- D. Spacing of cable support for self-supported cables on wall, ceiling or trenches shall be as follows :

	Horizontal Run	Vertical Run
Up to 10	350 mm	450 mm
16 to 95	450 mm	500 mm
120 to 400	700 mm	900 mm

- E. Plastic identification markers at every 15 m for cables laid indoors, at bends & both ends.
- F. Cables laid underground shall be at a depth not less than 600 mm with sand bedding & protective bricks or tiles extending at 10 m spacing in addition to markers above ground at bends, loops & crossings.
- G. Provide loops of minimum 500 mm radius at each ends.
- H. Cable should be bent to a radius of not less than 20 times the diameter of the cables with aluminium of 8 diameters at space restriction.
- Control cables shall be laid minimum 300mm away from the power cables & shall be on separate suitable trays.
- The power cable termination shall have necessary brass glands & shall be as follows:
 - A. Pressure clamp insertion type up to 4 sq.mm
 - B. Tinned copper termination shall be through pressure clamp insertion type lugs.

13.25 TESTING / INSPECTION

- HT & LT cables shall be tested after installation using 1000 V & 500 V insulation resistance tester respectively and the following readings recorded :
 - A. Continuity on all conductors
 - B. Insulation resistance
 - a. Between conductors
 - b. All conductors & ground
- The cables shall be tested and examined at the manufacturer works

both before and after manufacture. The manufacturer shall furnish all necessary information concerning the supply to consultant/owner's inspectors. The inspector shall have free access to the manufacture's works for the purpose of inspecting the process of manufacture in all its stages and he will have the power to reject any material which appears to him to be of unsuitable description or of unsatisfactory quality.

13.26 FOR PVC & XLPE CABLES

- After completion of manufacture of cables and prior to despatch the cables shall be subject to special tests as detailed below. Consultant/owner reserves the right to witness all tests with sufficient advance notice from vendor. The test reports for all cables shall be got approved from the Engineer before despatch of the cables.
- All routine tests, acceptance tests and type tests shall be carried out on cables as listed in IS : 1554 Part-1.
- The inner and outer sheath of XLPE cables shall be subjected to all the tests applicable for PVC cables. The test requirements for insulation and sheath of PVC cables shall be as per latest revision of IS: 5831.
- Following are the special tests to be performed on the cables and test results for similar type of cables shall accompany the offer.
 - A. Accelerated water absorption test for insulation as per NEMA-WC-5. (For PVC insulated cables) and as per NEMA WC-7 (for XLPE insulated cables)
 - B. Dielectric Retention Test: The dielectric strength of the cable insulation tested in accordance with NEMA WC -5 at 75 °C shall not less than 50% of the original dielectric strength. (For PVC insulated cables)
 - C. Oxygen Index test: The test shall be carried out as per ASTM D 2863 or applicable Indian standard specification.
 - D. Test for rodent and termite repulsion property: The vendors shall furnish the test details to analyse the property by chemical method.

14 SCHEDULE OF TECHNICAL DATA

Technical data shall be furnished as follows:

14.1 Air Handling Units and Fan Coil Units:

- General:
 - A. Manufacturer
 - B. Type of Unit - Horizontal or Vertical
 - C. Overall dimensions
 - D. Operating weight

E. Approx. noise level (dB)

- Fan Section:

A. Air quantity (cfm)

B. Total static pressure (in W.G.) C. Fan speed (rpm)

D. Fan dia. (ins)

E. Balance (static and/or dynamic) F. Fan motor (hp and make)

- Cooling Coils:

A. Coil fin material

B. Fin thickness

C. No. of fins

D. No. of rows deep

E. Tube dia. (ins)

F. Water through coil (US gpm)

G. Water velocity through coil (fps) H. Water coil pressure drop (psi)

I. Outside coil surface area (sq. ft.) F. Face area (sq.ft)

- Filter Section: A.

Type

B. Cross filter area (sq.ft.)

C. Velocity through filter (f.p.s.)

D. Pressure drop through filter when new (ins. WG) E. Efficiency

14.2 Pumps

- Manufacturer
- Overall dimensions
- Operating weight
- Size of foundation
- Speed (rpm)
- Discharge (US gpm)
- Head (ft.)
- Efficiency
- Performance curves
- Pump motor (hp) and make

14.3 Ventilation & Exhaust Fans:

- Manufacturer
- Fan discharge position

- Speed (rpm)
- Fan dia.
- C.F.M.
- Motor (hp) and make
- Static pressure (ins. WG)
- Balance (static and/or dynamic)

14.4 Insulation:

- Manufacturer
- Material
- "K" value

14.5 Controls:

- Manufacturer
- Thermostat type
- Humidistat type
- Damper motor type

14.6 Electric Motors:

- Manufacturer
- Type of motor and frame reference
- Rated output (hp)
- Range of working voltage
- No. of phases and phase connections
- Nominal frequency
- Rated speed (rpm)
- Rated current (amps)
- Class of insulation
- Temperature rise with cooling air at 40 Deg Centigrade
- Efficiency and power factor

14.7 Switch Gear:

- Circuit Breakers
 - A. Manufacturer
 - B. Symmetrical short circuit at 415 volts
 - C. Normal current (amps) D. O/L and E/F trip

15 TEST READINGS

Item	Test Results	Units
Pumps	Flow Rate	(US GPM)
	Discharge Pressure	(Kg/sq. cm)
	Inlet Pressure	(Kg/sq. cm)
	Motor Power Consumption	(Amps)
AHUs	Air Quantity	(cfm)
	Air Temperature entering	(Deg. F - D.B. /W.B.)
	Air Temperature leaving	(Deg. F D.B. /W.B.)
	Water Temperature entering	(Deg.F)
	Water Temperature leaving	(Deg.F)
	Water Pressure - entering coil	(P.S.I.G.)
	Water Pressure - leaving coil	(P.S.I.G.)
	Motor Power Consumption	(Amps)
	Rated Capacity	(TR)
Vent/Exhaust Fans	Air Quantity	(C.F.M.)
	Static Pressure - supply/discharge	(ins. WG)
	Motor Power Consumption	(Amps)
Supply air grilles	Air flow rate	(C.F.M.)
	Air Temperature entering	(Deg. F - D.B. /W.B.)
	Air Temperature leaving	(Deg. F - D.B. /W.B.)

LIST OF APPROVED MAKES-HVAC WORKS

The Contractor shall have to obtain Consultant’s approval of all makes of equipment and technical selection prior to ordering and installation. List of makes agreed during Tender negotiations supercedes all mentioned makes provided they meet specifications and are approved by Consultants.

All equipment wherever possible, should meet a minimum of 3 star rating from BEE.

The contractor has to submit at least two makes for Consultants' approval prior to placing order.

Sr. No.	Equipment / Materials	Recommended Manufacturers
1	Chilled Water Variable Speed Pump System	Armstrong / Grundfoss / Wilo
2	Differential Pressure sensor	Siemens / Honeywell / Grundfos
3	Plate Type Heat Exchanger	Alfa Laval / Platex / Bell & Gossett / wessels
4	<u>Vibration Isolators</u>	
a)	Springs, Neoprene Pads (Total rust resistant)	Easyflex / Kanwal Ind. Corp./ Polybond / Resistoflex
b)	Pipe flexible connections	Cori / Easyflex / Kanwal Ind. Corp. / Resistoflex
c)	Cushy Foot Mounts	Dunlop / Kanwal Ind. Corp / Polybond / Resistoflex
d)	Floating Foundations	Kanwal Ind. Corp / Polybond / Resistoflex
e)	Insulated flexible ducts	Century / Diamond / Klimatech
f)	Flexible duct connector / Inst. Port	Klimatech / Durodyne / Aeroduct
5	Pre-Filters & Filters (non-flammable)	Airtech / Thermodyne / Uccomech / John Fowler
6	Aluminum Cladding – 24G	Hindalco / Indalco / Balco
5	Air Handling Units (Ceiling Suspended)	Citizen / Zeco /Systemair / Edgetech
6	Air Handling Units (Floor Mounted)	Citizen / Zeco /Systemair / Edgetech
7	Fan Coil Units	Midea / Bhutoria / Caryaire / Daikin
8	Package Units (Ductable Units)	Carrier / Trane / York
9	Window / Split Units (The latest superior models available)	Daikin / Mitsubishi / O – General / LG
10	VRV System	Daikin / Mitsubishi / Samsung / LG

11	Drain pumps for Splits	Aspen
12	<u>Piping</u>	
a)	Cu piping - Soft (20G)	Kobe (Japan) / Mandev Tubes / Met tubes (Malaysia) / Nissan / Rajco
b)	Cu piping - Hard (18G)	Kobe (Japan) / Mandev Tubes / Maxflow / Nissan / Rajco / Simitomo (Japan)
c)	M.S. Chilled water Pipes upto 200mm Dia	Jindal / Tata/ Essar

d)	M.S. Chilled water Pipes above 200mm Dia	SAIL / Jindal / Essar
e)	Pre-insulated Pipes	Zeco / Seven Star / Perma-Pipe
f)	Butterfly valves	Audco / Bonomi Ventiel / Crawley & Ray / KSB / TA Hydronics
g)	Motorised On/Off Butterfly valves	Audco / Bonomi Ventiel / Crawley & Ray / KSB / TA Hydronics
h)	Pressure Independent Dynamic (Diaphragm) balancing cum 2 way motorised actuator temperature control valves	TA Hydronics / Oventrop / Frese
h)	Automatic Balancing valves	Flowcon / TA Hydronics / Caleffi
i)	Gate & Globe valves	Bankim Sarkar / Bonomi Ventiel / Kirloskar / Leader
j)	Check valves	Advance / Audco / Bonomi Ventiel/ Crawley & Ray
k)	Pot Strainers	Emerald / Trishul / Flosteer
l)	'Y' Strainers	Emerald / Trishul / Flosteer
n)	Ball valves without Strainer	Audco / Zoloto / Giacomini / TA Hydronics
o)	Ball valves with Strainer	Audco / Zoloto / Giacomini / TA Hydronics
t)	Chemical Dosing System	Aqua Bird Water Treatment Co./ ION Exchange
13	Expansion Tank (Closed – Pressurised)	Anergy / Bell & Gosset / K.D.Agency
14	Microbubble dearetor & Dirt Seperator	Bell & Gosset / Spirovent / wessels
16	Ventilation & Exhaust Fans	
a)	Centrifugal (Single inlet single width)	Comefri / Chaysol / Dyna Air / Greenheck / Kruger / Nadi / Nicotra / System Air
b)	Centrifugal (Cabinet Type Double Skin)	Comefri / Chaysol / Dyna Air / Greenheck / Kruger / Nadi / Nicotra / System Air
c)	Propeller	Alstom / Dyna Air / System Air
d)	Inline	Caryaire / Dyna Air / Greenheck / Kruger / System Air
e)	Smoke Exhaust	Chaysol / Dyna Air / Greenheck / Kruger / System Air
f)	Tube Axial	Kruger / Maico/ Dynair/ Systemair Chaysol / Comefri / Greenheck Nadi / Nicotra
g)	Jet Fans	Dyna Air / Flaktwood / Kruger / System Air
17	CO Sensors	Henoywell / Siemen / dwyer
18	Drain Piping	
a)	PVC Drain Pipe	Prince/ Supreme / Astral
b)	GI 'C' class drain pipe	Jindal / Tata / Essar
	Sheet Metal	

a)	G I Sheets Class VII - 180 gm/sq.m SMACNA Standards Factory Fabricated ducts SMACNA Standards	Sheets – Bhushen / Jindal /National / TISCO ROLASTAR Ducting System with ROLAMATE or equivalent System Components. Alphaducts / Nutech / Rolastar / Zeco with OEM standard flanges, fittings, bracings
c)	Fire dampers, extended sleeves & control panels (90 minutes rating) Damper & Sleeves - painted orange	Caryaire / Cosmos / George Rao & Co. / Greenheck
d)	Fire Damper Actuators i) Motorised ii) Fusible Linkage	Belimo – BF 24 - T / Nenutec / Siemens - GNA326.1E / Siemens - GCA326.1E Durolyne
18	Suspension / Support Systems (Fully galvanised for Ducts, Pipes, etc.)	
a)	Anchor Fasteners	Hilti/Fisher
b)	Fully threaded rods, nuts, bolts, pipe clamps etc.	Alpha duct / Diamond / Hitech / Hilte / Perfect / Rolastar / Zeco
c)	Channels / Angles – lengths with predrilled holes	Hitech / Hilte / Perfect / Rolastar
d)	Duct Flanges	Alpha duct / Rolamate / Zeco
19	Insulation	
a)	Fibreglass Foil Faced (Thermal)	Owens Corning / UP - Twiga
b)	Fibreglass (Acoustic)	Owens Corning / UP – Twiga
c)	Black Glass Tissue	U P Twiga
d)	Phenolic Foam	Aeroflex / Bakelite Hylam (Phenotherm)
e)	Phenolic foam pipe sections	Bakelite Hylam
f)	Expanded Polystyrene (TF)	Beardsell / Cooline / Modifoam
g)	Closed cell nitrile elastomeric Class ‘O’	Armaflex / Aeroflex / Eurobetex / K – Flex
h)	Open cell nitrile elastomeric Class ‘O’	Armaflex / Aeroflex / Eurobetex / K – Flex
i)	Adhesives (when dry non-flammable)	Armaflex 520 / Pidilite SR 998 / Foster IIDL
20	Grilles / Diffusers (Powder coated)/ Slot Diffusers	
a)	Aluminium	Air-Product / Air Master / Cosmos / Caryaire
b)	Aluminium opposed blade dampers / louvres	Air-Product / Air Master / Cosmos / Caryaire
21	Adhesives / Vapour Seals	
a)	Duct	Foster 81-10 / 81-22 / IIDL / Napco / Star Bond
25	Wet Scrubbers	Nutech / Zeco / Ducon
26	Dry Scrubbers	Waves Aircon / Verantis / Apzem
27	Sound Attenuators	Caryaire / Trox / Jacteco

Note:- Besides the above makes, Banks Engineer / Architect has the right to permit use of any equivalent brand / material matching the specified criteria / quality standards.

37.0 DRAWINGS

To download all the Drawings Please paste the below mentioned link in the web browser;

<https://drive.google.com/drive/folders/1F3LBlzj9wrGsKkaYEnpZ1M69mlO0CLIV?usp=sharing>

38.0 PRICE BID

Uploaded on the Portal Separately.