इंडियन बैंक
Indian Bank

INDIAN BANK,
CORPORATE OFFICE, ESTATE DEPARTMENT
No.254 - 260, Avvai Shanmugam Salai,
Royapettah, Chennai - 600 014.
Ph: 044-28134401/4308, Fax: 044-28134021
Email: hoestate@indianbank.co.in

PART - 1

TECHNICAL BID

Tender document for Repair and Renovation (Civil, Plumbing, Roofing, Interior, Acoustic, HVAC, Electrical & Solar works) of Auditorium in IMAGE at M.R.C Nagar, Raja Annamalaipuram, Chennai - 600 028.

ISSUED TO

M/s._____

PROJECT MANAGEMENT CONSULTANT (PMC) / ARCHITECT:

M/s. Oscar & Ponni Architects No.2, Vivekananda Road, Srinivasa Nagar, Chetpet, Chennai – 600 31
Ph: 044 – 2836 1237, 2836 1962
Email : cgoscar@yahoo.com

This document contains Part- 1 (Technical Bid) From 01 to 215 pages

BLANK PAGE LEFT INTENTIONALLY

इंडियन बैंक
Indian Bank

TENDER DOCUMENT

Name of work: Repair and Renovation of Auditorium in IMAGE at M.R.C Nagar, Raja Annamalaipuram, Chennai - 600 028.

INDEX

इंडियन बैंक
Indian Bank

FORM OF TENDER

Indian Bank
Corporate Office,
Premises, Estate & Expenditure Dept,
No. 254-260, Avvai Shanmugam Salai,
Royapettah, Chennai – 600 014.

Dear Sir,

SUB: Invitation of Tender for Renovation works (Civil, Plumbing, Roofing, Interior, HVAC, Electrical & Solar works) for IMAGE AUDITORIUM, MRC NAGAR Chennai.

Having examined the plans, specifications, conditions and schedule of quantities prepared by you, and satisfying ourselves as to the location of the site and working conditions, I/We hereby offer to execute the above works at the respective rates which I/We have quoted for the items in the Schedule of Quantities.

I/We herewith deposit **Rs.8,00,000/- (Rupees Eight Lakhs only)** by crossed demand draft/ Bank Guarantee on a Bank other than the clientele, dischargeable/payable at Chennai and drawn in favour of Indian Bank as Earnest Money Deposit for the due execution of the works at my/our tendered rates, together with any variations should the work be awarded to me/us.

In the event of this tender being accepted, I/We agree to enter into and execute the necessary contract required by you. I/We do hereby bind myself/ourselves to forfeit the aforesaid Earnest Money Deposit of deposit **Rs.8,00,000/- (Rupees Eight Lakhs only)** in the event of our refusal or delay in signing the Contract Agreement. I/We further agree to complete the work within the stipulated time specified in the Appendix to General Conditions of Contract.

I/We agree to keep our tender open for **90 (Ninety) days** from the date of opening of Envelope No. 1.

I/We enclose the completed tender documents duly signed under two separate sealed envelopes and the Earnest Money Deposit Rs._____ (Rupees _____ _____only) by Bank Draft / Bank Guarantee No. ..... dated ..... Issued by .....
Thanking you,

Yours faithfully,
[To be signed by the Authorized Representative of Tenderer who has the Power to do so]

Place: Witness Signature:
Date : Name:
Address:
Seal:

इंडियन बैंक
Indian Bank

NOTICE INVITING TENDER

Indian Bank, Corporate Office, Chennai invites sealed tenders in 2 bid system (Technical bid and financial bid in two separate covers) from reputed contractors for carrying out '**Repair and Renovation (Civil, Plumbing, Roofing, Interior, Acoustic, HVAC, Electrical & Solar works) of Auditorium in IMAGE at M.R.C Nagar, Raja Annamalaipuram, Chennai - 600 028.**

Name of Work	**Repair and Renovation** (Civil, Plumbing, Roofing, Interior, HVAC, Acoustic, Electrical & Solar works) **of Auditorium**
Estimated Cost of total Work	**Rs.380.00 Lakhs** (Rupees Three Hundred and Eighty Lakhs Only), **L1 will be finalized based on Reverse auction**
Tender Fee	**Rs. 2000/- DD** in favor of **"Indian Bank"** payable at **Chennai**
riteria for contractors	Reputed firms (1) having completed during the last 5 years ending 31.03.2019 at least one similar work of Rs.304 Lakhs or two similar works of Rs.200 Lakhs each or 3 similar works of not less than Rs.190 Lakhs each, (2) having Average Annual Financial turnover of at least Rs.114 Lakhs during the last 3 years ending 31st March 2019. (3) 24 x 7 local service set –up, (4) should not have incurred any loss during the last three years ending 31st March, 2019 and (5) should have a solvency of Rs.200 Lakhs issued by a scheduled Bank on or after 01.07.2019. (6) Copy of TDS Certificates issued by the employer in support of work under eligibility criteria as in point No.2 above (value of completed works) shall also be submitted alongwith tender request letter.
Tender Documents	Tender documents can be downloaded from banks website www.indianbank.in/tender from 23/10/2019 to 13/11/2019
Earnest Money Deposit (EMD)	**Rs.8,00,000/- (Rupees Eight Lakhs Only)** Refundable; DD in favor of **"Indian Bank"** payable at Chennai.
Initial Security Deposit (S.D)	2% of the total contract value (shall be submitted within 7 days of receiving Work Order)
Retention Amount (RMD)	5% of the each Bill Amount
Total Security Deposit (SD)	7% of the total contract price [Initial S.D (2%) + RMD (5% on each bill)
Defects Liability Period (DLP)	**12** Months from the date of virtual completion

Date of Commencement	**14 days** from the date of issue of Work Order/letter of intent or Date of which the site is handed over whichever is later
Date of Completion	**90 days** from the Date of issue of Work Order/ letter of intent or Date of which the site is handed over whichever is later.
Liquidated Damages for Delay	1% per week of the Contract Value for intermediate and final deadlines subject to maximum total of 10% of Contract value
Minimum Value of work for the issue of Interim Certificates	Rs.50.0 lakhs (Rupees Fifty Lakhs Only)
Period of honoring certificate for interim payment against each running bill by Employer	**10 days** from the date of receipt of Bill payment certification from Architect/ Project Management Consultant.
Period of honoring Final Certificate	Six weeks from the date of receipt of Bill payment with certification from Architect / Project Management Consultant.
Period of Performance Guarantee for the works.	Five years from the date of Virtual completion. [Independent of defect liability period]. The tenderer shall be required to deposit 5% of the tendered value of work as performance guarantee for a period of 5 years in the form of irrevocable bank guarantee of any scheduled bank in accordance with the form prescribed or fixed deposit receipt, within 15 days of the Virtual Completion.
Start of Issue of Tender	**23 -10 - 2019**
Pre-bid meeting	**31 -10 - 2019** at 11:00 AM at Corporate office
Last date and Time of Submission of tenders	**14 -11- 2019** on or before 3:00 PM
Opening of Techno-commercial Bid	3:30 PM on **14 -11 - 2019**

Note:

1. Applications for issuance of tender without complete information and certified photocopies of documents in support of fulfilling the Pre-qualification criteria will not be entertained.

2. If any information furnished by the applicant is found incorrect at a later stage, he shall be liable to be debarred from tendering/taking up the work in Indian Bank.

3. The Bank reserves the right to verify the particulars furnished by the applicant independently.

4. Short-listing of contractors will be finalized after inspection of works and obtaining confidential reports from previous employers for only those firms who fulfill the aforesaid Pre-qualification criteria and that specified in Technical bid.

5. The bank reserves the right to reject any tender/bid without assigning any reason and to restrict the list of qualified contractors for opening of the financial bid to any number deemed suitable by it, from out of the bids received.

6. The tender document has to be downloaded from above specified websites. Bidders are advised to visit above specified websites regularly for updates /Amendments/ Corrigendum, if any. The Updates/Corrigendum/Addendum shall be followed up to submission of tender and it will be the part of tender.

7. A pre-bid meeting will be held at 31.10.2019 at the Corporate Office Premises to give clarifications and decisions in connection with any issues or doubts raised by the tenderers. The tenderers should send a list, in duplicate, of any clarifications or decisions they need, so as to reach the Employers' offices not later than 04.00 pm on 29.10.2019**.** The queries can be sent to fax no. **044-28314021** or email to hoestate@indianbank.co.in. **The purpose of the pre-bid meeting is to ensure that the bids will be submitted without any conditions and to clarify all issues raised by the bidders.** The rates quoted by the tenderer shall be based only on the specifications and conditions of the tender documents.

ASSISTANT GENERAL MANAGER (BOD/ P&E)

Indian Bank, Corporate Office,
Premises, Estate & Expenditure Dept,
First Floor, No. 254-260, Avvai Shanmugam Salai,
Royapettah, Chennai – 600 014.
Ph: 044 -2813 4300 (ext. 4401, 4304, 4305, 4308, 4498)
Fax – 044-2813 4021

1.0 Criteria for Eligibility and documents to be submitted along with Part I.

1) List of Clients for similar nature of work along with documentary evidences about award / completion of works with value, completion period, type of Buildings, name and address / contact No.

2) List of works of similar nature in hand with value, schedule date of completion.

3) List of Banker along with address, contact number of Branch.

4) Turn-over of the company for the last 5 financial years, supported by documents.

5) Solvency certificate from the Bank for the prescribed value.

6) Organizational chart of the company.

7) Organizational chart for the personnel proposed to be deployed at Indian Bank project (Engineer, Supervisor, skilled & non-skilled workers and administrative staff)

8) List of plant and machinery available with the firm & to be deployed on the project.

2.0 Documents – details to be enclosed with the Technical Bid:

- Copy of TDS Certificate issued by the employer in support of eligibility criteria.
- Form A – Financial Information
- Form B- Details of all works of similar class/ nature completed during the last five years ending 31.03.2019.
- Form B-1- Additional Information for completed works
- Form C- Project under execution or awarded as on 31.03.2019
- Form D- Performance report for works referred to in Forms B & C
- Form E – Structure and Organization
- Form E-1- Details of Key Technical and Administrative Personnel employed by the firm/company
- Form F - Pro forma on ISO certification (if available)

इंडियन बैंक
Indian Bank

FORM 'A'

FINANCIAL INFORMATION

I Financial Analysis – Details to be furnished duly supported by figures in Balance Sheet/Profit and Loss Account for the last Five years duly certified by the Chartered Accountant, as submitted by the applicant to the Income-Tax Department (Copies to be attached).

YEARS

2014-15	2015-16	2016-17	2017-18	2018-19

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 Assets/Current Liabilities (a/c)

II. Income Tax clearance Certificate

III. Solvency certificate from Bankers (Schedule Bank) of Applicant.

IV. Financial arrangements for carrying out the proposed work

SIGNATURE OF APPLICANT(S)

Signature of Charted Accountant with seal

FORM'B'

इंडियन बैंक
Indian Bank

DETAILS OF ALL WORKS OF SIMILAR CLASS COMPLETED DURING THE LAST FIVE YEARS ENDING 31ST March 2019.

SL NO	Name of work/project & location	Owner or sponsoring organizations	Agreement No	Scope of work *	Cost of work in Crores	Date of commencement as per contract	Stipulated Date of completion	Actual date of completion	Litigation/ Arbitration pending / In progress with details **	Name and address/ Tel No of Officer to whom reference may be made	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

*** indicate Number of Units and Number of floors where repair/ renovation works were carried out.**

**** Indicate gross amount claimed and amount awarded by the Arbitrator**

Signature of Applicant(s)

इंडियन बैंक
Indian Bank

FORM- B1

ADDITIONAL INFORMATION FOR COMPLETED WORKS

1. Name of work :

2. Location :

3. Client's name and address :

4. Consultants name and address :

5. Scope of work :

a. Total Number of Units :

b. Number of floors :

c. Height of the building :

6. Specialized equipment deployed for the project :

7. Project Management organization structure :

8. Number of shifts and its duration adopted in execution :

9. Systems adopted for timely completion of the project :

SIGNATURE OF APPLICANT(S)

FORM C

PROJECTS UNDER EXECUTION OR AWARDED

SL NO	Name of work/project & location	Owner or sponsoring organizations	Agreement No	Cost of work	Date of commencement as per contract	Stipulated Date of completion	Upto date percentage progress of work	Slow progress, if any, and reasons thereof	Name and address/ Tel No of Officer to whom reference may be made	Remarks (Indicate whether any show cause notice issued or Arbitration initiated during the progress of work)
1	2	3	4	5	6	7	8	9	10	11

Signature of Applicant(s)

इंडियन बैंक
Indian Bank

FORM 'D'

PERFORMANCE REPORT FOR WORKS REFERRED TO IN FORM 'B'&'C'

1. Name of the work/ Project & Location.

2. Scope of work.

a. Total Number of Units.

b. Number of floors.

3. Agreement No.

4. Estimated Cost

5. Tendered Cost

6. Value of work done

7. Date of Start

8. Date of completion

   a. Stipulated date of completion.

   b. Actual date of completion.

9. Amount of compensation levied for delayed Completion, if any.

10. Performance report based on Quality of Work, Time Management, and Resourcefulness satisfactory : Very Good/ Good /Fair/ Not

DATE

SUPERINTENDING ENGINEER/
CHIEF PROJECT MANAGER
OR EQUIVALENT.

FORM 'E'

STRUCTURE AND ORGANISATION

(i) Name and address of the applicant

(ii) Telephone No./ Fax No./ E-Mail address.

(iii) Legal Status (attach copies of original document defining the legal status)

(a) An Individual

(b) A proprietary Firm

(c) A Firm in partnership

(d) A Limited Company or Corporation.

(iv) Particulars of registration with various Government bodies (Attach attested photo-copy)

a) Registration Number.

b) Organization / Place of registration

(v) Names and Titles of Directors and officers with designation to be concerned with this work with Designation of individuals authorized to act for the organization.

(vi) Was the applicant ever required to suspend work for a period of more than six months continuously after you commenced the construction?

If so, give the name of the project and give reasons thereof.

(vii) Has the applicant or any constituent partner in case of partnership firm/company, ever abandoned the awarded work before its completion?

If so, give the name of the project and give reasons thereof.

(viii) Has the applicant or any constituent partner in case of partnership firm/Company, ever been debarred/ black listed for tendering in any organization at any time? If so, give details:

(ix) Has the applicant or any constituent partner in case of partnership firm, or any directors in case of a Company ever been convicted by a court of law? Or any criminal proceedings presently pending? If so, give details.

(x) Any other information considered necessary but not included above.

SIGNATURE OF APPLICANT(S)

इंडियन बैंक
Indian Bank

FORM F

PROFORMA ON ISO CERTIFICATION (Optional)

1. Year of Certification

2. Name and Address of Certifying Agency

3. Name of Management Representative

4. Validity of Certificate

Note : Attested copy of certificate (attested by Government Officer or Notary Public) to be enclosed.

SIGNATURE OF APPLICANT(S)

इंडियन बैंक
Indian Bank

GENERAL RULES & CONDITIONS FOR THE GUIDANCE OF TENDERERS:

1. Sealed tenders Techno-commercial bid (Part-1&2) are invited for **Repair and Renovation of Auditorium in IMAGE at M.R.C Nagar, Raja Annamalaipuram, Chennai - 600 028**

2. Tenders Techno-commercial bid (Part-1&2), which should always be placed in a sealed cover, with the name of project written on the envelope i.e. superscripted with **Repair and Renovation of Auditorium in IMAGE at M.R.C Nagar, Raja Annamalaipuram, Chennai - 600 028**.

3. The technical bid volume 1 duly filled in, signed in all the pages and stamped by the tenderer to be submitted giving the details of company profile, audited Balance Sheet for last 3 years, Proof of submission of Income Tax returns, PAN No., GST No. Work experience of similar works during the last 7 years may be submitted in a separate sealed **COVER1 with the Drawings & EMD DD** super scribing as **"Technical Bid & Name of the work"**. The Volume2 – Price bid duly filled and signed to be placed in a separate sealed **COVER2** super scribing as **"Price Bid & Name of the work"**. Both the **COVER1** and **COVER2** to be enclosed within another **COVER3** and the same may be super scribed as "Tender for **Repair and Renovation of Auditorium in IMAGE at M.R.C Nagar, Raja Annamalaipuram, Chennai - 600 028.**" and shall be submitted to Indian Bank, Corporate Office, Premises and Expenditure dept., 254-260, Avvai Shanmugham Salai, Royapettah, Chennai- 600 014 or before the date specified in the Tender notice.

4. ***The Tender / Price Bid not submitted in the prescribed format will be summarily rejected. No correspondence will be entertained in this regard.***

5. The time allowed for commencing the work is **Fourteen days (14 days)** from the date of written orders to commence work or handing over the site whichever is later.

6. The contractors should quote in figures as well in words the rates and amount tendered by them. The amount for each item should be worked out and the requisite totals to be given. When the rate quoted by the contractor in figures and in words tallies but the amount is not worked out correctly, the rate quoted by the contractor shall be taken as correct and not the amount

7. When a contractor signs a tender in any Indian language the percentage above or below and the tendered amount should be in the same language. In case of illiterate contractors the rates or the amounts tendered should be attested by a witness and his / their KYC documents to be furnished.

8. Tenders should be accompanied by Earnest Money Deposit (Refundable), amounting to **Rs. 8,00,000/- (Rupees Eight Lakhs Only)** and **Tender cost (Non-Refundable) of Rs 2000/- (Rupees Two Thousand Only)** in the form of Bank's demand draft in favour of "INDIAN BANK" PAYABLE AT CHENNAI. ***Tenders submitted without EMD and Tender Cost will be summarily rejected (other than those excepted).***

9. The EMD of the contractor, whose tender is accepted, shall be forfeited in full, in case he does not remit the Initial Security Deposit within the stipulated period or start the wok by the stipulated date mentioned in the award letter.

10. The companies who are registered with Micro, Small & Medium Enterprises and also have the NSIC Certificate under Government Store Purchase Programme having certificate clearly indicating the amount of "Quantitative Capacity Per Annum" (amount of Quantitative Capacity Per Annum shall be more than the estimated cost of Work) are exempted from the submission of Tender document fee / EMD on submission of requisite proof in the form of valid certification from MSME and NSIC.

11. The acceptance of the tender will rest with "INDIAN BANK" which does not bind itself to accept the lowest tender, and or reserves to itself the authority to reject any or all of the tenders received without the assignment of a reason. All tenders in which any of the prescribed conditions are not fulfilled or, are incomplete in any respect are liable to be rejected.

    INDIAN BANK reserves the right to accept the tender in full or in part and the tenderer shall have no claim in future for revision of rates or other conditions if his tender is accepted in parts.

12. Canvassing in connection with tenders is strictly prohibited and the tenders submitted by the contractors who resort to canvassing will be liable for rejection.

13. All rates shall be quoted on the proper form of the tender alone. The tenderers shall take care to price his tender rationally. Extreme under pricing or overpricing in item-rates, total amount will be considered adversely in the assessment of tenders. The tenderer shall on demand submit analysis of rates of some items of work if so required by the Employer.

14. An item rate tender containing percentage below / above will be summarily rejected.

15. On acceptance of the tender, the name of the accredited representative(s) of the contractor who would be responsible for taking instructions from the Employer / PMC shall be communicated to the Employer.

16. Special care should be taken to write the rates in figures as well as words and the amounts in figure only; in such a way that interpolation is not possible. The total amount should be written both in figures and in words. 'P' after the decimal figures e.g. Rs.7.55"p" and in case of words the word "Rupees" should precede and the word paise should be written at the end, unless the rate is in whole rupees and followed by the words "only". It should be invariably be up to two decimal places. While quoting the rate in schedule of quantities, the word "only" should be written closely following the amount and it should not be written in the next line.

17. INDIAN BANK does not bind itself to accept the lowest or any tender and reserves to itself the right of accepting the whole or any part of the tender and the tenderer shall be bound to perform the same as the rate quoted.

18. The tenderers shall separately specify at the end of the tender the % and value of SGST and CGST as applicable. As on date normally 9 % CGST and 9% SGST IS APPLICABLE FOR WORKS CONTRACT which is subject to existing Government norms. Regarding tax part, the tax rate at the time of billing shall rule over and above all documentations. Valid documents shall be produced if tendered/ asked for at the time before payment.

19. TDS for income tax is as applicable and shall be included in the quoted rates. The comparison for the least bidder shall be made with the basic price of items of work excluding "Goods and Service Tax" part.

20. INDIAN BANK will not entertain any other claim whatsoever in this respect.

21. The tender for the works shall remain open for acceptance for a period of **90 Days** from the date of opening of tenders. If any tenderer withdraws his tender before the aforesaid period, the bank shall be at liberty to forfeit Earnest Money Deposit paid along with the tender and no further claim in this regard will be entertained.

22. The tender for the work shall not be witnessed by a contractor or contractors who himself / themselves has / have tendered or to whom may and / have tendered for the same work. Failure to observe these conditions would render tenders of the contractors tendering as well as witnessing the tender liable to be summarily rejected. It will be obligatory on the part of the tenderer to tender and sign the tender documents for all the component parts and that, after the work is awarded, he will have to enter into an agreement for each component with the competent authority of INDIAN BANK.

23. The tenderer, apart from being a competent contractor must associate himself with other agencies of the appropriate class deployed by him for (a) electrical work (b) Air-conditioning (c) Civil/ Sanitary and Water supply installations (d) Acoustics/ Interior (e) Fire fighting and / or any other related work. **The nominated sub-contractors/ Agencies have to be declared and approved by the employer/ PMC.** Any clarifications on the design and drawings may be sought from office **of The Assistant General Manager (P&E), 254-260, Avvai Shanmugam Salai, Royapettah, Chennai 600 014 or contact through email id: hoestate@indianbank.co.in.**

24. If the contractor or his representatives are found to be absent from the site for more than 3 days the contract is deemed to be terminated by him without any prior notice.

25. The tenderers are advised to inspect the site before quoting for the job. The site will be available for inspection on all working days between **10:00 AM & 5:00 pm between 25/10/2019 to 13/11/2019 with prior intimation to the Dept..** Hence, the tenderers are advised to inspect the site in this regard before quoting for the job.

26. The Employer is not liable for the cost incurred in the inspection and preparation of tender and submission / participation and also not liable for any other cost what so ever may be.

27. Tenders can be submitted in person or through post / courier so as to reach on or before the due date and time. Bank will not be responsible for any postal delays or any other reason for not submitting the bid in the specified time and resulting in disqualification / rejection of any bid and no claim whatsoever will be entertained in this regard.

28. During evaluation of the bids, the Bank may, at its discretion, seek clarification from the Bidder/s. The request for clarification and the response shall be in writing.

29. **"The bank is not bound to accept the lowest tender & reserves the right to accept or reject any or all the tenders without assigning any reasons whatsoever"**

Signature of the competent authority

इंडियन बैंक
Indian Bank

SPECIAL CONDITIONS OF CONTRACT

1. Scope of Work:

The scope of work for the purpose of this tender constitutes **Repair and Renovation of Auditorium in IMAGE at M.R.C Nagar, Raja Annamalaipuram, Chennai - 600 028**

2. Price Basis:

a. The unit rates mentioned in schedule of rates shall remain firm and shall not be subjected to any escalation throughout the currency of the contract.

b. The quoted rates shall be inclusive of supply of all materials required for completing the item works.

c. Payment shall be made on the actual quantum of work executed, duly certified by Architect / Project Management Consultant.

d. The rates quoted shall be based on laws, levies, taxes and duties applicable on the date of LOI. Any statutory variations thereto and / or new levies due to an act or enactment, after the date, shall be to the employer's account against documentary evidence within the contractual completion date. Any such variation/imposition of new taxes and levies beyond the contractual completion date shall be to the contractor's account.

e. Contractor shall satisfy himself on the applicability of various taxes, duties, levies etc. as applicable for such work and quoted prices shall be inclusive of all such liabilities. Employer / Project Management Consultant shall not be liable to any liability of the Contractor on this account. Contractor shall periodically produce documentary proof for having fulfilled the above obligations in time, including proof of payment, proof of filing of returns, etc. failing which Employer / Project Management Consultant reserve the right to take appropriate action at the cost and consequence of the Contractor.

f. Income Tax, at applicable rates, shall be deducted from the Contractor's Bills, as per Income Tax Act and TDS Certificate issued thereof.

g. e-Reverse Auction: e-Reverse Auction shall be conducted to arrive at the L-1 bidder. Detailed guide lines regarding e-Reverse Auction are provided at Annexure-1 & Annexure-2 of the bid documents.

3. Terms of Payment:

Progress Payment:

a) 70% of cost of material on completion of delivery of same (Pro-Rate) covered under the order and on submission of invoice, duly certified and verified by our Engineer in-charge / PMC.

b) Balance 25% shall be released on progress of work and submission of certification by the PMC , submission of all final technical documents in the required number of sets

and as also on statutory approval from relevant statutory Authorities & submission of invoice duly certified by Engineer-in-charge / PMC.

c) Balance 5% of retention amount will be retained from each bill and will be released after the defects liability period of 1 year.

d) The Employer / PMC will entertain only Two running bill per month and for a minimum gross amount of Rs.50,00,000/- (Rupees Fifty Lakhs only).

e) Employer may withhold payment on account of any defect/deficiency in the work already executed and payment released, based on subsequently discovered evidence, failure to make payments to Sub-Contractors, damage caused by the Contractor to Owner's property, properties of other agencies within the premises, unfulfilled statutory obligations, etc.

f) Employer may permit the release of 1st RA bill of contractor for value less than the minimum bill value of Rs.50 lakhs but not less than Rs.35 lakhs subject to approval of PMC.

4. Effective date, Time schedule and Liquidated damages for delay:

a. The date of Letter of Intent issued by Indian Bank shall be deemed as the "Effective Date" of contract.

b. The entire work covered under the contract shall be completed in all respects within **90 days** from the Effective Date.

c. Time is the essence of this project and hence completion schedule of **90 days** should be strictly adhered to.

d. However, at the option of the EMPLOYER, such delayed completion may be accepted subject to levy of liquidated damages @ 1.00% of the final contract value per week of delay or part thereof, subject to a maximum of 10.00% of the final contract value.

e. The effective date shall be reckoned from **14 days** from the date of issue of Work Order/ letter of intent or date of which the site is handed over whichever is later.

5. Measurement:

The Quantities set out in the schedule of items and rates are estimated quantities of work. The final quantities of work executed by the Contractor in fulfillment of his obligations under the contract shall be jointly measured by the Contractor and the Architect / Project Management Consultants. The Architect / Project Management Consultants will be final authority for the measurement relating to bills.

6. Responsibility:

Bank / Architect / Project Management Consultant reserve the right to inspect the execution of work at the Contractor's Works as per the technical specifications and the equipment shall be dispatched only after receipt of a Release Order issued by the Architect / Project Management Consultant.

Unless otherwise specified in the contract / Work order / Purchase Order, the completion of work shall not be deemed to have been achieved until all the works required to be carried out under the contract have been completed to the entire satisfaction of the Bank / Architect / Project Management Consultant, in all respects and virtual Completion Certificate is issued.

It is the responsibility of the contractor to obtain all statutory approval from the Electrical Inspector/ government departments etc. and hand them over to the Bank through the Project Management Consultant.

7. Progress Report:

The Contractor shall submit to the Employer / Project Management Consultant once in two weeks progress report for the previous period showing up-to-date cumulative progress and progress during the preceding period alone on all progress items of each section or portion of the works in the proforma prescribed by the Employer / Project Management Consultant along with photographs.

8. Contractor's Engineer:

The Contractor shall keep qualified and experienced Engineer(s) for full time during execution of work for entire Contract period.

9. Equipment:

The Contractor shall make his own arrangement to procure all constructional plant and equipment for his work. He shall also submit with the tender, the type and number of different equipments with their capacities in good working conditions, which he will use on the site to ensure smooth completion of the work in specified time. All materials, construction plant and equipment etc., once brought by the CONTRACTOR on the site are not to be removed from there without the written approval from the Bank / Architect / Project Management Consultant.

10. Extra Items:

Extra items, if any, shall be paid on the basis of analysis of rate of cost of materials and labour produced by CONTRACTOR, and the item-rates agreed upon with the Architect / Project Management Consultant.

The execution of extra item is compulsory in order to complete the project work. In case the Contractor fails to execute extra item, Bank / Architect / Project Management Consultant will have the right to execute these items through other agency / agencies at the risk and cost of the Contractor.

While arriving at the agreed rate of extra items, the Plant & Machinery / Overheads / profit shall be considered to the tune of 15% of cost of materials and labour.

Bank / Architect / Project Management Consultant reserve the right to verify the price of material through market survey.

11. Guarantees / Liabilities:

The Works / Installation including all components and accessories **shall be guaranteed for a period of 12 months from the date of Virtual Completion of the same against defective material** (including Manufacturer's guarantee for equipments etc.), shortfall in performance and faulty workmanship. The contractor shall immediately make free replacement of any of the parts or components that might go out of order within this period and Bank / Architect / Project Management Consultant's decision in this regard will be final and binding on the contractor.
The work shall be carried out in a workmanlike manner.

12. Shut down work:

If needed the work has to be carried out on bank holidays. Since there is need to take shut down of 415V electrical system for working inside the panels. At least one week before notice to be given for arranging such electrical shut downs which will not affect the power supply to continuously energized equipments like UPS units, air conditioning units in server room, UPS room etc.

13. INSURANCE

Contractor shall obtain and maintain any and all necessary insurance cover for the entire work, which may be required under any law or regulations applicable, including but not limited to the following:

a. Contractor's All Risk Policy, for Contractor's Scope of Work.
b. All materials and Contractor's own machinery, equipment, tools & tackles, vehicles, etc.
c. Third Party liability.
d. Workmen Compensation
e. ESIC
f. Employer's Liability

The quoted price shall be inclusive of all costs for such insurance coverage including transit insurance and till it is handed over to the employer after its full completion. In all such policies, Employer shall be made 'Co-insured'. Also other Contractors, working at the Site, are covered under the policy.

14. Termination:

i. Bank reserves the right to down size the project or add some works in the project to suit the completion or cancel the entire project or in part depending on their administrative reasons. In such case the value of works done upto that stage will be measured and paid at the tender rates.

ii. Bank also reserves the right to terminate the contract after giving a notice of 30 days to the contractor in case the contractor could not produce good / considerable progress in work execution within the contract period or in the extended period.

15. GENERAL

These Special Conditions of Contract (SCC) shall be read in conjunction with the terms and conditions stipulated in the General Conditions of Contract (GCC). However, if there is any contradiction between the terms and conditions mentioned in this SCC and those in the GCC, stipulations of SCC shall prevail to that extent.

GENERAL CONDITIONS OF CONTRACT

Except where provided for in the description of the individual item in the schedule of quantities and in the specifications and conditions laid down in after and in the drawings, the work shall be carried out as per standard specifications and under the direction of Employer/PMC.

1. INTERPRETATION

In constructing these conditions, the specifications, the schedule of quantities, tender and agreement, the following words shall have the meaning here in assigned to them except where the subject or context otherwise requires.

Employer: The term Employer shall denote INDIAN BANK, Corporate Office, 254-260, Avvai Shanmugam Salai, Royapettah, Chennai – 14, for or any of its employee's representatives authorized on their behalf.

PMC / Architects: The term PMC/ Architects shall mean **M/s. Oscar & Ponni Architects No.2, Vivekananda Road, Srinivasa Nagar, Chetpet, Chennai – 600 031, Tamilnadu** or in the event of his/their ceasing to be the Architects for the purpose of this contract such other person/s as the employer shall nominate for the purpose.

Contractor: The term contractor shall mean _____and includes his/their heirs, legal representative, assigns and successors.

Site: The site shall mean the site where the works are to be executed as shown within boundary in red border on the site plan including any building and erections thereon allotted by the employer for the contractor use. The site here mentioned is at Indian Bank's **IMAGE Auditorium at** MRC Nagar, Raja Annamalaipuram, Chennai - 600 028. India

Site engineer: The site engineer shall be appointed by the employer. The employer may also determine the number of site engineers and the supporting staff at site office to assist them and also whether the site engineer shall be temporary or permanent as far as possible, the site engineer should assume charge of his post before the contractor reports on site of work. When more than one site engineer is appointed, one of them shall be designated as senior site engineer by the premises department and the other site engineer shall be reporting to the senior site engineer.

Drawings: The work is to be carried out in accordance with drawings, Specifications, the schedule of quantities and any further drawings which may be supplied or any other instruction, which may be given by the employer during the execution of the work. All drawings relating to work given to the contractor together with a copy of schedule of quantities are to be kept at site and the employer/ architects shall be given access to such drawings or schedule of quantities whenever necessary.

In case of any detailed drawings are necessary the contractor shall prepare such detailed drawings and /or dimensional sketches there for and have it confirmed by the employer/architects prior to taking up such work.

The contractor shall ask in writing all clarifications on matters occurring anywhere in drawings, specifications and of quantities or for additional instructions at least 10 days ahead from the time when it is required for implementation so that the employer may be able to give decision thereon.

"The works" shall mean the work to be executed or done under this contract

"Act of insolvency" shall mean any act as such as defined by the Presidency Towns Insolvency Act or in Provincial insolvency Act or any amending statutes.

"**The schedule of Quantities"** shall mean the schedule of quantities as specified (forming part of this contract) duly priced with the accepted quoted rates of the contractor.

2. SCOPE

The work consists of construction of employer's (details of work) in accordance with the **"drawings" and the "schedule of quantities".** It includes furnishing all materials, labour, tools and equipment and management necessary for and incidental to the construction and completion of the work, during its progress and upon completion, shall conform to the lines elevations and grades as shown on the drawings furnished by the employer/ PMC. Should any detail essential for efficient completion of the work be omitted from the drawings and specifications it shall be the responsibility of the contractor to inform the employer / PMC detail with employer/ PMC concurrence, so that upon completion of the proposed work the same will be acceptable and ready for use.

Employer/PMC may in their absolute discretion issue further drawings and or written instructions, details, and explanations, which are, hereafter collectively referred to as "the Employer's/ PMC Instructions" in regard to:
a. The variation or modification of the design quality or quantity of works or the addition or omission or substitution of any work.

b. Any discrepancy in the drawings or between the schedule of quantities and / or drawings and / or specification.

c. The removal from site of any defective material brought thereon by the contractor and the substitution of any other material thereof.

d. The demolition, removal and /or re-execution of any work executed by the contractor.

e. The dismissal from the work of any persons employed thereupon.

f. The opening up for inspection of any work covered up.

g. The rectification and making good any defects under clauses herein after mentioned and those arising during the maintenance period (retention period).

The contractor shall forthwith comply with and duly execute any work comprised in such employer's / Architects instruction, provided always that verbal instructions, directions

and explanations given to the contractor or his representative upon the works by the Employer/Architects shall if involving a variation be confirmed in writing to the contractors within seven days. No works for which rates are not specifically mentioned in the priced schedule of quantities shall be taken upon without written permission of the Employer/Architects. Rates of items not mentioned in the price schedule of quantities shall be fixed by the employer in consultation with the architects as provided in clause "variation".

Regarding all factory made products for which BIS (Bureau of Indian Standards) marked products are available, only products bearing BIS marking shall be used in the work.

3. TENDERER SHALL VISIT THE SITE

Intending tenderer shall visit the site and make themselves thoroughly acquainted with the local site condition, nature and requirements of the works, facilities of transport condition, effective labour and materials, access and storage for materials and removal of rubbish, traffic regulations, NOC required if any from any authorities / societies etc.,. The tenderer shall provide in their tender for cost of carriage, freight and other charges as also for any special difficulties including police restriction for transport etc., for proper execution of work as indicated in the drawings. The successful tenderer will not be entitled to any claim of commencement of work or which in the opinion of employer/ PMC might be deemed to have reasonably been inferred to so exist before commencement of work.

4. TENDERS

The entire set of tender papers issued to the tenderers should be submitted fully priced and also signed on the last page together with initials on every page. Initial/ signature will indicate the acceptance of the tender papers by the tenderer.

The schedule of quantities shall be filled as follows:

I. The rate columns to be legibly filled in ink both in figures and English words. **Any rates / filled in pencil or any other mode shall make the tender as "In-eligible" and will be rejected.**

II. Amount column to be filled in for each item and the amount for each sub head as detailed in schedule of quantities.

III. All corrections are to be initiated.

IV. The rate column for alternative items shall be filled up.

V. The amount column for alternative items for which the quantities are to be mentioned shall not to be filled up.

VI .In case of any errors, the rates given in the tender marked 'original' shall be taken as correct rates.

VII. When the amount of an item is not worked out by the contractor or it does not correspond with the rates quoted by the contractor in figures as well as in words, the rate quoted in words shall be taken as correct

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

No notifications, writings or corrections can be made in the tender papers by the tenderer, but may at his option offer his comments or modifications in a separate sheet of paper attached to the original tender papers. The employer reserves the right to reject the lowest or any tender and also to discharge any or all of the tenders for each section or to split up and distribute any item of work to any specialist firm or firms, without assigning any reason.

The tenderers should note that the tender is strictly on the item rate basis and their attention is drawn to the fact that the rates for each and every item should be correct, workable and self-supporting. If called upon by the Employers/ PMC detailed analysis of any or all the rates shall be submitted. The Employer/PMC shall not be bound to recognize the contractor's analysis.

The works will be paid for as: "measured work" on the basis of actual work done and not as "lump sum" contract unless otherwise specified.

All items of work described in the schedule of quantities are to be deemed and paid as per complete works in all respect and details including preparatory and finishing works involved, directly, related to and reasonably detectable from the drawings, specifications and schedule of quantities and no further extra charges will be allowed in this connection. In the case of lump sum charges in the tendering respect of any item of works, the payments of such items of work will be made for the actual work done on the basis of lump sum charges as will be assessed to be payable by the Employer/ PMC.

The employer has the power to add to, omit from any work as shown in drawings or described In the specifications or include in the schedule of quantities and intimate the same in writing, but no addition, omission or variation shall be made by the contractor without authorization from the Employer. No variation shall vitiate the contract.

5. AGREEMENT:

The successful contractor may be required to sign an agreement as may be drawn up to suit local conditions and shall pay for all stamps and legal expenses, incidental thereto.

6. TAXES AND DUTIES:

The tenderers shall separately specify at the end of the tender the % and value of SGST and CGST as applicable**.**

As on date 9 % CGST and 9% SGST IS APPLICABLE FOR WORKS CONTRACT. Regarding tax part, the tax rate at the time of billing shall rule over and above all documentations. Valid

documents shall be produced if tendered/ asked for at the time before payment. TDS for income tax is as applicable and shall be included in the quoted rates. **The comparison for the least bidder shall be made with the basic price of items of work excluding "Goods and Service Tax" part.**

7. PROVISIONAL SUMS:

All provisional sums described in the schedule of quantities as P.S. shall be exclusively allotted to the purchase of materials and not for any handling and fixing to be done by the contractor. Such costs of handling and fixing with profit (including transport charges if required) shall be separately included in the contract price as described in the schedule of quantities. The disposal of amounts covered under this head will be absolutely at the discretion of the employer.

Contractor is to make payments for these materials to the suppliers on certificate or order issued by the Employer/PMC and realizes them through his bill from the Employer.

8. QUANTITY OF WORK TO BE EXECUTED:

The quantities shown in the schedule of quantities are intended to cover the entire work indicated in the drawings / tender but the Employer reserves the right to delete any item from the scope of work, execute only a part or the whole or any excess thereof without assigning any reason there for.

9. OTHER PERSONS ENGAGED BY THE EMPLOYERS:

The employer reserves the right to execute any part of the work included in this contract or any work, which is not included in these contract by other agency or persons and contractor shall allow all reasonable facilities and use of his scaffolding for the execution of such work. The main contractor shall extend all cooperation in this regard.

10. EARNEST MONEY AND SECURITY DEPOSIT:

The tenderer will have to deposit an amount of **Rs. 8,00,000/- (Rupees Eight Lakhs Only)** for **Repair and Renovation works in IMAGE Auditorium**, in the form of bank draft in favour of **"Indian Bank" payable at Chennai** at the time of submission of tender as an earnest money deposit. The Employer is not liable to pay any interest on the EMD. The Earnest Money of the unsuccessful tenderers will be refunded without any interest soon after the decision to award the work is taken or after the expiry of the validity period of the tender.

The successful tenderer to whom the contract is awarded will have to deposit as initial security deposit a further sum to make up 2% of the value accepted tender including the earnest money. On acceptance of the DD or Bank Guarantee by the Employer, the Earnest Money Deposit shall be refunded to the Contractor.

The initial security deposit will have to be made within **7 days** from the date of **issue of work order**, failing which the employer at his discretion may revoke the letter of acceptance and forfeit the EMD furnished along with the tender. The initial security

deposit will be refunded after satisfaction and completion of work (as certified by the architect / PMC).

Apart from the initial security deposit made as above, retention money shall be deducted from progressive running bill @ 5 % of the gross value of each running bill. This, together with the initial S.D. of the 2% referred to above, will constitute the total Security Deposit and on virtual completion of work the employer shall refund 50% of the total Security Deposit. The remaining 50% will be refunded after completion of the **Defect Liability Period of 12 months,** provided he has satisfactorily carried out all the work and attended to all the defects in accordance with the conditions of the contract. No interest is allowed on retention money.

11. CONTRACTOR TO PROVIDE EVERYTHING NECESSARY:

The contractor shall provide everything necessary for the proper execution of the work according to the intent and meaning of the drawings, schedule of drawings, schedule of quantities and specifications taken together whether the same may or may not be particularly shown described therein provided that the same can reasonably be inferred there from. The contractor shall provide himself for ground and fresh water for carrying out of the works at his own cost. The employer shall on no account be responsible for the expenses incurred by the contractor for hired ground or fresh water obtained from elsewhere.

The rates quoted against individual items will be inclusive of everything necessary to complete the said items of work within the contemplation of the contract, and beyond the unit price, no extra payment, will be allowed for incidental or contingent work. Labour and / or materials inclusive of all taxes and duties whatsoever except for specific items, if any stipulated in the tender documents.

The contractor shall supply, fix and maintain at his own cost, for the execution of any work, all tools, tackles, machineries and equipments and all the necessary centering, scaffolding, staging, planking, timbering, strutting, shoring, pumping, fencing, boarding, watching and lighting by night as well as by day required not only for the proper execution and protection of the said work but also for the protection of the public and safety of any adjacent roads, streets, walls, houses, buildings, all other erections, matters and things and the contractor shall take down and remove any or all such centering, scaffolding, staging, planking, timbering, strutting, shoring, etc., as occasion shall be required or when ordered so to do, and shall fully reinstate and make good all matters and things disturbed during the execution of works to the satisfaction of the employer / architects. The contractor shall also provide such temporary road on the site as may be necessary for the proper performance of the contract and for his own convenience but not otherwise. Upon completion, such roads shall be broken up and levelled where so required by the drawings unless the employer shall otherwise direct.

The contractor shall at times give access to workers employed by the employer or any employed on the buildings and to provide them with water and lighting and leave or make any holes, grooves etc., in any work. Where directed by the employer as may be required to enable such workman to lay or fix pipes, electrical wiring, special fittings etc. the quoted rates of the tenderers shall accordingly include all these above mentioned contingent works.

12. TIME OF COMPLETION/EXTENSION OF TIME & PROGRESS CHART

1. **Time of completion:** The entire work is to be completed in all respect within the **stipulated period of 90 days.** The work shall deem to be commenced within **14 days from the date of acceptance letter or date of handing over of site**, whichever is later. Time is the essence of contract and shall be strictly observed by the contractor. The work shall not be considered as complete until the Employer/ Architects / PMC have certified in writing that this has been complete and the defects liability period shall commence from the date of such certificate.

2. **Extension of time:** If in the opinion of the Employer/ Architects / PMC the works be delayed (a) by reason of any exceptionally inclement weather or (b) by reason of instructions from the employer in consequence of proceedings taken or threatened by or disputes, with adjoining or neighboring employers or (c) by the works, or delay of other contractors nominated by the employer and not referred to in the specification or (d) by the reason of authorized extra and additions or (e) by reason or any combination or works men or strikes or lock-out affecting any of the building trade or (f) from other causes which the employer may consider are beyond the control of the contractor, the employer at the completion of the time allowed for the contract shall make fair and reasonable extension of time for completion in respect therefore. In the event of the employer failing to give possession of the site upon the day specified above, the time of completion shall be extended suitably.

   In case of such strikes or lockouts as are referred to above, the contractor shall, immediately give the employer, written notice thereof. Nevertheless he shall use his best endeavours to prevent delay, and shall do all that may be reasonably required, to the satisfaction of the employer for any extension of time for completion hereunder (which shall be final and binding on the contractor) shall be promulgated at the conclusion of such strike or lock-out and the employer shall then, in the event of an extension being, granted, determine, and declare the final completion date. The provision in clause 13 with respect to payments of liquidated damages shall be construed as if the extended date fixed by the employer were substituted for and the damages shall be deducted accordingly

3. **Progress of work:** During the period of construction the contractor shall maintain proportionate progress on the basis of programme chart submitted by the contractor immediately before commencement of work and agreed to by the employer/Architects / PMC. Contractor should also include planning for procurement of scarce material well in advance and reflect the same in the programme chart so that there is no delay in completion of the project.

13. LIQUIDATED DAMAGES

Should the work be not completed to the satisfaction of the employer/Architects /PMC within the stipulated period, the contractor shall be bound to pay to the employer a sum calculated as given below by way of liquidated damages and not as penalty during which the work remains un commenced or unfinished after the expiry of the completion date.

a. For contracts having time for completion **upto 6 months** and less 1% of the estimated amount shown in the tender per week subject to a ceiling of 10% of the accepted contracted sum.

b. For contracts having time for completion exceeding 6 months & less than 2 years 0.50% of the estimated amount in the tender per week subject to ceiling of 7.5% of the accepted contracted sum.

14. NOTICE AND PATENTS OF APPROPRIATE AUTHORITY AND OWNERS

The contractor shall confirm to the provisions of any acts of the legislature relating to the work, and to the regulations and Bye laws of any authorities and/or any water, lighting and other companies, and/or authorities with whose systems the structures were proposed to have connection and shall before main and variation from the drawings or specification that may be associated to so confirm give the employer/Architects written notices specifying the variations proposed to be made and the reasons for making them and apply for instruction thereon. The employer/Architects on receipt of such intimation shall be giving a decision within a reasonable time.

The contractor shall arrange to give all notices required for by the said Acts. Regulations or Byelaws to be given to any authority and to pay such authority or to any public officer all fees that may be properly chargeable in respect of the work and lodge the receipt with the employer.

The contractor shall indemnify the employer against all claims in respect of patent rights, royalties, damages to building, roads or members of public in course of execution of work and shall defend all actions arising from such claims and shall keep the employer saved harmless and indemnified in all respects from such actions, costs and expenses.

15. ACCESS

Any authorized representative of the employer shall at all reasonable times have free access to the workshop, factories or other place where materials are being prepared or constructed for the works and also to any place where the materials are lying or from where that are being obtained, and the contractor shall give every facility to the bank or their representative everything necessary for inspection and examination and test of the materials and workmanship. Except the representative of the employer no person shall be allowed at any time without the written permission of the employer.

16. MATERIALS, WORKMANSHIP, SAMPLE, TESTING OF MATERIALS

All the works specified and provided for in the specification or which may be required to be done in manner with materials of the best and approved quality of the respective kinds in accordance with the particulars contained in and implied by the specifications as any from their entire satisfaction. If required by the employer/architects during the execution of the work, and to their entire satisfaction. If required by the employer/Architects the contractor shall carry out tests on materials and workmanship in approved materials testing laboratories or as prescribed by the employer/Architects at his

own cost to prove that the materials etc. under test conform to the relevant B.I.S or as specified in specifications. The necessary charges for preparation of mould (in case of concrete cube) transporting, testing etc, shall have to be borne by the contractor. No extra payments on this account should in any case be entertained.

All the materials (except where otherwise described) stores equipment required for the full performance of the work under the contract must be provided through normal channels and must include charge for import duties, sales, tax octroi and other charges and must be the best of their kind available and the contractor/s must be entirely responsible for the proper and efficient carrying out of work. The work must be done in the best workmanlike manner. Samples of all materials to be used would be submitted to the employer/Architects when so directed by the employer/Architects and written approval from employer/architects must be obtained prior to placement of order.

During the inclement weather contractor shall suspend concreting and plastering for such time as the employer / architects may direct and shall protect from injury all work when in course of execution. Any damage (during constructions) to any part of the work for any reasons due to rain, storm, or neglect of contractor shall be rectified by the contractor in an approved manner at no extra cost.

Should the work be suspended by reason of rain, strike, lock-outs or any other cause the contractor shall take all precautions necessary for the protection of work and at his own expenses and shall make good any damage arising from, any of these causes.

The contractor shall cover up and protect from damage from any cause, all new work and supply, temporary/doors, protection to windows and any other requisite protection for execution of the work whether by himself or special tradesmen or sub contractor and any damage caused must be made good by the contractor at his own expense.

17. REMOVAL OF IMPROPER WORK

The employer shall during the progress of the work have power to order in writing from time to time the removal from the work within such reasonable time or time as they be specified in order of any materials which in the opinion of the employer/Architects are not in accordance with specification or instructions. The substitution or proper re-execution of any work executed with materials or workmanship not in accordance with the drawings and specification or instructions, in case the contract or refuses to comply and pay other agencies to carry out the work and all expenses consequent thereon or incidental thereon or incidental thereto as certified by the employer/Architects shall be borne by the contractor or may be deducted from any money that may become due to the contractor. No certificate which may be given by the architects shall relieve contractor from his liability in respect of unsound work or bad materials.

18. SITE ENGINEER

The term "site engineer" shall mean person appointed and paid by the employer to superintend the work. He shall have a minimum education qualification of Diploma in Civil Engineering + 5 years of experience. The contractor shall afford the site engineer every facility and assistance for examining the works and materials and for checking and

measuring work and materials. The site engineer shall have no power to revoke, alter, enlarge or relax any requirements of the contractor or to sanction any day work, addition, alterations, deviations or omissions or any extra work whatsoever except in so far such authority may be specifically conferred by a written order of employer/ Architects.

The site engineer shall have power to give notice to the contractor or to his foreman for non-approval of any work or materials and such work shall be suspended or the use of such materials shall be discontinued until the decision of the employers is obtained. The work will from time to time examined by the engineer from the premises department of the employer and by the architects. But such examinations shall not in any way exonerate the contractor from the obligation to remedy any defects which may be found to exist at any stage of the work or after the same is complete subject to the limitations of this clause, the contractor shall take instructions only from the architects/employer.

19. CONTRACTOR'S EMPLOYEES

i. The contractor shall employ technically qualified and competent supervisor for the work who shall be available (by turn) throughout the working hours to receive and comply with instructions of employer/Architects. The contractor shall engage at least one experienced engineer as site-in-charge for execution of the work. The contractor shall employ in connection with the work persons having the appropriate skill or ability to perform their job efficiency.

ii. The contractor shall employ labourers on the work as far as possible.

a. No labourer below the age of sixteen years and who is not an Indian national shall be employed on the work.

iii. Any labourer supplied by the contractor to be engaged on the work on day-work basis either wholly or partly under the direct order or control of the employer or his representative shall be deemed to be a person employed by the contractor.

a. The contractor shall comply with the provision of all labour legislation including the requirements of:
b. The payment or wages act
c. Employer's liability act
d. Workmen's compensation act
e. Contract labour (Regulation & Abolition) Act, 1970 and Central Rules 1971.
f. Apprentices act 1961.
g. Any other act or enactment relating thereto and rules framed there under from time to time.

iv. The contractor shall keep the employer saved harmless and indemnified against claims if any of the workmen and all costs and expenses as may be incurred by the employer in connections with any claim that may be made by any workmen.

v. The contractor shall comply at his own cost with order of requirement of any health officer of the state or any local authority or of the employer regarding the

maintenance of proper environmental sanitation of the area where the contractors' labourers are housed or accommodated for the prevention of small pox, cholera, plague, typhoid, malaria and other contagious diseases. The contractor shall provide, maintain and keep in good sanitary condition adequate sanitary accommodation and provide facilities for pure drinking water at all times for the use of men engaged on the works and shall remove and clear away the same on completion of the works. Adequate precautions shall be taken by the contractor to prevent nuisance of any kind on the works or the lands adjoining the same. The contractor shall arrange to provide first aid treatment to the labourers engaged on the works. He shall within 24 hours of the occurrence of any accident at or about the site or in connection of execution of the works, report such accident to the Employer and also to the Competent Authority where such report is required by the law.

20. DISENGAGEMENT / DISENGAGE OF WORKMEN

The contractor shall on the request of the employer immediately disengagement / disengage from works any person employed thereon by him without any prior notice, who any in the opinion of employer be unsuitable or incompetent or who may misconduct himself. Such discharges shall not be the basis of any claim for compensation damages against the employer or any of their officer or employee.

21. DAMAGE TO PERSONS AND PROPERTY INSURANCE ETC.

i. The contractor shall be responsible for any injury to the work or workmen to persons, animals or things and for all damages to the structural and/or decorative part of property which may arise from the operations of neglect to himself or of any sub-contractor or of any of his or sub-contractor's employees, whether such injury or damages arise from carelessness, accident or any other cause whatsoever in any way connected with the carrying out of this contract. The cause shall be held to include inter-alia, streets, footpath or ways as well as damages caused to the buildings and the works forming the subject of this contract by rain, wind or other inclemency of the weather. The contractor shall indemnify the employer and hold harmless in respect of all and any expenses arising from any such injury or damages to persons or property as aforesaid and also in respect of any claim made in respect of injury or damage to persons or property as aforesaid under any acts of compensation or damage consequent upon such claim.
The Employer / PMC is not responsible for the above mentioned points.

ii. The employer shall be at liberty and is hereby empowered to deduct the amount of any damages, compensations, costs charges and expenses arising or accruing from or in respect of any such claim or damage from any sums due or to become due to the contractor.

22. INSURANCE

a. Unless otherwise instructed the contractor shall insure the works and keep them insured until the virtual completion of contract against any loss or damages by fire and/or earthquake flood. The insurance must be placed with a company approved by the employer, in the joint names of the employer and the contractor for such amount and

for any further sum if called to do by the employer, the premium, of such further sum being allowed to the contractor as an authorized extra.

b. **The contractor shall deposit the policy and receipt for premiums paid with the employer within 7 days from the date of issue of work order unless otherwise instructed.** In default of the contractor insuring as provided above, the employer on his behalf may so insure and may deduct the premiums paid from any bills, which may become due to the contractor. The contractor shall as soon as the claim under the policy is settled or the work reinstated by the insurance company should they elect to do so, proceed with due diligence with the completion of the works in the same manner as though the fire has not occurred and in all respects under the conditions of the contract. The contractor in case of rebinding or reinstatement after fire shall be entitled to extension of time for completion as the employer may deem fit.

c. From commencement to completion of works, the Contractor shall take full responsibility for the care of the work and for taking precautions to prevent loss or damage to the work to the maximum extent possible and shall be liable for any damage or loss that may arise to the works or any part thereof from any cause whatsoever including causes of fire, lightning, explosion, earthquake, storm, hurricane, floods, inundation, subsidence, landslides, rock slides, riots (excluding Electrical war, rebellion, revolution and insurrection) or any latent defect or damage and shall at his own cost repair and make good the same so that at all times the work shall be in good order and condition and in conformity in every respect with the requirements of the Contract.

d. For the purpose of this condition this expression "from commencement to completion of works" shall mean the period starting with the date of issue of Work Order or date of handing over of site whichever is later and ending with issue of Virtual Completion Certificate.

e. Without limiting the obligations and responsibilities under this condition, the Contractor shall insure and keep insured the works from commencement to completion, as aforesaid, for the full contract value including Price Variation Adjustment if any against the risk of loss or damage from any cause whatsoever including the causes enumerated in the foregoing Clause (a). In the event of there being a variation in the nature and extent of the works, the Contractor shall from time to time increase or decrease the value of the insurance correspondingly. All the premia for the insurance shall be borne and paid by the Contractor.

f. The said insurance shall also provide cover for the removal of debris of the lost or damaged works. The said insurance shall be in the joint names of the Employer and the Contractor, Employer's name being mentioned first in the policies and the Contractor shall deposit with the Employer the said policy or Policies within 15 days from issue of Work Order. All money payable by the insurer under such Policy/Policies shall be recovered by the Employer only and may be paid to the Contractor or any other agency of Employer's choice in installments for the purpose of rebuilding or replacing or repairing the works and/or goods destroyed or damaged as the case may be.

g. The Contractor shall at all times indemnify and keep indemnified the Employer against all losses, claims, damages or compensation including under the provisions of the payment of the Wages Act 1936, Minimum Wages Act 1948, Employer's Liability Act 1938,Workman's Compensation Act 1923,the Maternity Benefit Act 1961,the Bombay Shops and Establishments Act 1947, Industrial Disputes Act 1947, and Contract Labour (Regulation and Abolition)Act 1970 and Employees State Insurance Act 1948, Motor Vehicles Act 1988 or any modifications thereof or under any other law relating thereto and rules made thereunder from time to time or as a consequence of any accident or injury to any workman or other person in or about the work whether in the employment of the Employer or Contractor or not, and also against all costs, charges and expenses of any suit, action or proceedings whatsoever out of such accident or injury or combination of any such claims.

h. Before commencing the work, the Contractor shall without limiting his obligations and responsibilities under this condition, insure against any loss of life or injury to any personnel in the employment of Contractor. For this purpose, insurance shall be taken by the Contractor. Such insurance shall be taken to include both employees/workmen covered by the Workman's Compensation Act 1923, as well those employees/workmen not covered by the said Act. Separate insurance policies may be taken for employees/ workmen covered by Workman's Compensation Act 1923, and employees / workmen not covered by the said Act. All the premia shall be paid by the Contractor. Policy/Policies taken under this para for the personnel in employment with the Contractor may be in their Employer's names of the Contractor. In the event of any loss or injury to personnel in employment with the Contractor, the Employer and Contractor shall recover directly from the Insurance Company and ensure that payment of the same is made to the affected parties including the Employer. The policy in original shall be deposited with the Employer.

i. The Contractor shall at all times indemnify and keep indemnified the Employer against all losses and claims for injuries or damage to any person or any property whatsoever which may arise out of or in consequence of the construction and maintenance of the work and against all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect of or in relation thereto. Before commencing the execution of the works, the Contractor shall without in any way limiting his obligations and liabilities under this condition, insure at his cost and expense against any damage or loss or injury which may be caused to any person or property including the employees and directors of the Employer / Electrical Project Management Consultant and their property by or in the course of the execution of the works. Such insurance to be known as the Third Party Insurance shall be in a sum of **Rs 5.0 Lakhs (Rupees Five Lakhs Only)**. The Insurance policy to be so obtained by the Contractor shall be deposited by the Contractor with the Employer within fifteen days of its issue by the Insurer.

j. The Contractor shall provide the Employer with documentary evidence from time to time, that he has taken all the insurance policies mentioned in the foregoing paragraphs and renewed them if required and that he has paid the necessary premia for keeping the policies valid till the works are completed and handed over to Employer.

k. The Contractor shall ensure that similar insurance policies are taken out by his sub Contractors or nominated Contractors, if any. The Contractor shall be responsible to the Employer or to any other person for any claim or loss resulting from the failure of the Sub-contractors or nominated Sub-Contractors to obtain such insurance policy. While taking the insurance policies, Contractor should indicate clearly to the insurance companies that policies issued shall cover their Sub-Contractors and nominated Sub-Contractors also.

l. If the Contractor and/or his sub-Contractor or nominated Sub Contractor, if any, shall fail to effect and keep in force the insurance referred to above or any other insurance which he / they may be required to effect under the terms of the Contract, then in any such case, the Employer may, without being bound to effect and keep in force any such insurance policy pay such premium or premia, as may be necessary for that purpose from time to time and deduct the amount so paid by the Employer from any money due or becoming due to the Contractor or recover the same as a debt due from the Contractor.

m. All insurance to be effected by the Contractor, and/or his sub-Contractors, or nominated sub-Contractors, if any, shall be taken only with an Insurance Company approved by the Employer.

n. Without prejudice to any of its obligations and responsibilities under this condition, the Contractor shall, within 30 days from the date of the Work Order and thereafter at the end of each quarter submit a report to the Employer in Proforma 'C' annexed hereto the detailed information on the Insurance Policies as prescribed in the said proforma together with relevant documentary evidence.

o. No work shall be commenced by the Contractor unless and until he has obtained the insurance or insurances required to be obtained by him under or by the foregoing clauses and no work shall be carried out or continued by the Contractor unless and until such insurance is current and valid at that time. All the receipts in original along with two photo copies thereof, for the payment of the premia shall be furnished by the Contractor to the Employer. The original receipts will be returned to the Contractor after verification. The Employer reserves the right for payment for works done subject to fulfillment of this condition and shall instruct the Architect accordingly.

p. In the event of any claim for insurance becoming due on account of any eventuality covered by the respective insurance policy/policies, the Contractor shall reinstate the installation, replace the materials or equipments or pay compensations to the affected personnel/Employees without waiting for settlement of the claim from insurance company.

q. If the Contractor shall not perform and observe any of the duties and obligations devolving upon him hereunder, and such omission or breach by the Contractor shall involve the Employer in any liability tortuous or otherwise and/or loss or damage, the Employer shall be entitled to the restitution of such loss or damage and shall be entitled to recover the amount of restitution from any moneys due to the Contractor from the Employer under this Contract or any other Contract.

23. ACCOUNTS RECEIPTS AND VOUCHERS

The contractor shall, upon the request of the employer/Architects / PMC furnish them all the invoices, accounts, receipts and other vouchers that they may require in connection with the works under this contract. If contractor shall use materials less than what he is required under the contract, the values of the difference in the quantity of the materials he was required to use and that he actually used shall be deducted from his dues. The decision of employer shall be final and binding on the contractor as to the amount of materials the contractor is required to use for any work under this contract.

Before taking any measurement of any work, the site engineer or subordinate deputed by him shall give reasonable notice to be contractor. If the contractor fails to attend at the measurements after such notice or fails to countersign or to record the difference within a week from the date of measurement in the manner required by the site engineer than in any such event the measurement after such notice taken by the site engineer or by subordinate deputed by him as the case may be is final and binding on the contractor and contractor shall have no right to dispute the same.

24. PAYMENTS

All bills shall be prepared by the contractor in the form prescribed by the employer/Architects/PMC. **Interim bills shall be prepared subject to minimum value for interim certificate as stated in these documents.** The bills in proper forms must be duly accompanied by detailed measurements in support of the quantities or work done and must show deductions for all previous payments, retention money etc.

The employer/Architects/PMC shall issue a certificate after due scrutiny of the contractor's bill stating the amount due to the contractor from the employer and the contractor shall be entitled to payment thereof, within the period of honouring certificates named in these documents.

The amount stated in an interim certificate shall be the total values of work properly executed as per tender up to the date of the bill less the amount to be retained by the employer as retention money vide **clause 10** of these conditions, recovery of TDS and less installments previously paid under these conditions, provided the certificate shall only include the value of said materials and goods as from such time as they are reasonably, properly and not prematurely brought and placed adjacent to the work and then only if adequately protected against weather or other casualties.

The employer will deduct retention money as described in clause 10 of these conditions. The refund of retention money will be made as specified in the said clause.

If the employer has supplied materials or goods to the contractor, the cost of any such materials or goods will be progressively deducted from the amount due to the contractor, in accordance. All the interim payment shall be regarded as payments for work actually done and completed, and imperfect or unskilled work to be removed and taken away and reconstructed or re-erected or be considered as an admission of the due performance of the contract, or any part thereof in any respect or the

according of any claim, nor shall, it determine or affect in anyway the power of the employer under these conditions or any of them as to the final settlement and adjustment of the accounts or otherwise or in any other way affect the contract. The final bill shall be submitted by the contractor within one week of the date fixed for completion of the work or of the date of certificate of completion furnished by the site engineer. All final payments shall be made within 3 months.

25. FINAL PAYMENTS

The final bill shall be accompanied by a certificate of completion from the Architects. Payments of final bill shall be made after deduction of retention money as specified in **clause 10** of these conditions, which sums shall be refunded after completion of defects liability period after receiving the architect's certificate that the contractor has rectified all defects to the satisfaction of employer. The acceptance of payment of the final bill by the contractor would indicate that he will have no further claim in respect of the work executed.

26. VARIATION / DEVIATION

The price of all such additional items/non-tendered items will be worked out on the basis of rates quoted for similar items in the contract wherever existing or on engineering rate analysis based on prevalent fair price of labour, material and other components as required.

27. SUBSTITUTION

Should the contractor desire to substitute any materials and workmanship, he/they must obtain the designated in this specification indefinitely by such terms as "Equals" or "Other approved" etc. specific approval of the employer/Architects has to be obtained in writing.

28. FACILITIES TO SUB-CONTRACTORS AND OTHER CONTRACTORS

(a) The Contractor is to allow for general attendance upon sub-Contractors; including the free use of plant and scaffolding(and the provision of any special scaffolding required) and is to allow their operatives use of latrines, W.C's. Mess Rooms, Shed and covered space for plant or storage of materials etc.

(b) The Contractor shall at his own cost (unless otherwise specified) give full facilities and co-operation to other Contractors employed by the Employer and for affording them reasonable opportunity for introduction and storage of their materials and the execution of their works and for properly connecting and co-ordinating their works with the work of other Contractors. The decision of the Employer on any points of dispute between the various Contractors shall be final and binding on all parties concerned.

The Contractor shall:

i. Give control lines and level B.M's as instructed by Employer for other Contractors working on site.

ii Provide electricity and water at reasonable rates to be jointly decided by Employer.

iii Provide hoist and crane facility if available for lifting of materials at times convenient to Main Contractor and at prices and terms to be mutually agreed.

iv Adjust the work schedule and site activities in consultation with the Employer and other Contractors to suit the overall schedule.

v. Co-ordinate with other contractors for leaving inserts, making chases, alignment of services on site etc.

vi. Co-ordinate site operations and sequence of construction closely with other Contractors in consultation with the Employer.

29. PREPARATION OF BUILDING WORKS FOR OCCUPATION AND USE ON COMPLETION

The whole of the work will thoroughly be inspected by the contractor, deficiencies and defects put right. On completion of such inspection the contractor shall inform the employer/Architects that he has completed the work and it is ready for inspection.

On completion the contractor shall clean all windows and doors including the clearing and oiling if necessary, of all hardware, inside and outside, all floors, staircases, any every part of the building. He will leave and clean and ready for immediate occupation and to the satisfaction of the employer.

30. CLEARING SITE ON COMPLETION

On the completion of the works the contractor shall clear away and remove from the site all construction plans, surplus materials, rubbish and temporary works of every kind and leave the whole of the site and the works clean and in a workman like condition to the satisfaction of the Employer / Architects.

31. DEFECTS AFTER COMPLETION

The contractor shall make good at his own cost and to the satisfaction of employer all defects, shrinkage, settlements or other faults which may appear within 12 months after completion of work. In default the employer may employ a person and amend and make good such damage, losses and expenses consequent thereon or incidental thereto shall be made good and borne by the contractor and such damages, loss and expenses shall be recoverable from him by the employer or may be deducted from the contractor, deduct from any money due to the contractor a sum equivalent to the cost of amending such work and in the event of the amount retained being insufficient, recover that balance from the contractor from amount retained under **clause No. 10** together with any expenses the employer may have incurred in connection there with.

32. ESCALATION

The rate quoted shall be firm throughout the tenure of the contract (including extension of time, if any, granted) and will not be subject to any fluctuation due to increase in cost of materials, labour, taxes, etc. unless specifically provided in these documents.

33. IDLE LABOUR

Whatever the reason may be no claim for idle labour, additional establishment cost of hire and labour charges of tools and plants would not be entertained under any circumstance.

34. SUSPENSION

If the contractor except on account of any legal restraint upon the employer preventing the continuance of the work or in the opinion of the employer shall or fail to proceed with due diligence in the performance of his part of the contract or if he shall more than once make default, the employer shall have the power to give notice in writing to the contractor requiring the work be proceeded within a reasonable manner and with reasonable dispatch, such notice purport to be notice under this clause.

After such notice shall have been given, the contractor shall not be at liberty to remove from the site of the works or from any contiguous thereto any plant or materials to subsist from the date of such notice being given until the notice shall have been compiled with. If the contractor fails to start the work within seven days after such notice has been given to proceed with the works as there in prescribed the employer may proceed as provided in clause 34 (Termination of contract by employer).

35. TERMINATION OF CONTRACT BY EMPLOYER

If the Contractor being an individual or a firm, commits any "Act of insolvency" or shall be adjudged as Insolvent or being an incorporated Company shall have an order for compulsory winding up or applies for voluntary winding up or subject to the supervision of the Court and of the Official Assignee or the Liquidator in such acts of Insolvency or winding up shall be unable within seven days after notice to him requiring him to do so, to show to the reasonable satisfaction of the employer/architect that he is able to carry out and fulfill the Contract, and to give security therefore, if so required by the employer/architect.

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 charge or encumber this Contract or any payments due or which might become due to the Contractor there under,

or shall assign or sub-let the Contract without obtaining the prior consent in writing of the Employer or shall suffer any payment under this contract to be attached by or on behalf of any of the creditors of the contractor,

or if in the opinion of the Employer the contractor,

(i) has abandoned the Contract, or

(ii) has failed to commence the works, or has without any lawful excuse under these conditions suspended the progress of the works for seven days after receiving from the employer / architect written notice to proceed, or

(iii) has failed to proceed with the works with such due diligence and failed to make such due progress as would enable the works to be completed within the time agreed upon, or

(iv) has failed to remove materials from the site or to pull down and replace work for seven days after receiving from the employer / architect written notice that the said materials or work were condemned and rejected by the employer/architect under these conditions, or

(v) 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, or

(vi) has to the detriment of good workmanship or in defiance of the employer / architect instructions to the contrary sublet any part of the Contract.

then in any of the said cases the Employer may notwithstanding any previous waiver, after giving **seven days notice in writing to the Contractor**, determine the Contract but without thereby affecting the powers of the Employer or the obligations and liabilities of the Contractor, the whole of which shall continue in force as fully as if Contract had not been so determined and as if the works subsequently executed had been executed by or on behalf of the Contractor (without thereby creating any trust in favour of contractor). Further, the Employer, may enter upon and take possession of the work and all plant, tools, scaffoldings, sheds, machinery, steam and other power, utensils and materials lying upon the premises or the adjoining lands or roads and seal the same as his own property or may employ the same by means of his own servants and workmen carrying on and completing the works or by employing any other contractors or other persons to complete the works, and the Contractor shall not in any way interrupt or do any act, matter or things to prevent or hinder such other contractor or other person or persons employed for completing and finishing or using the materials and plant for the works. When the works shall be completed or as soon thereafter as convenient, the Employer / architect shall give a notice in writing to the Contractor to remove his surplus materials and plant, and should the Contractor fail to do so within a period of 14 days after receipt thereof by him the Employer shall sell the same by public auction, and shall give credit to the Contractor for the amount realized after deducting there from the costs of removal and sales by the Employer for the values of the said plant and material so taken possession of by the Employer and the expense or loss which the Employer shall have been put to in procuring the works to be completed and the amount, if any, owing to the Contractor and the amount

which shall be so payable shall thereupon be paid by the Employer to the Contractor, or, by the Contractor to the Employer, as the case may be, On termination of the Contract, the Contractor shall forthwith remove himself and his workmen from the works site.

35. ARBITRATION

All disputes or differences of any kind whatsoever which shall at any time arise between the parties hereto touching or concerning the works or the execution or maintenance thereof of this contract of the rights touching or concerning the works or the execution of maintenance thereof of this contract of the construction remaining operation or effect thereof or to the rights or liabilities of the parties or arising out of or in relation thereto whether during or after determination foreclosure or breach of the contract (other than those in respect of which the decision of any person is by the contract expressed to be final and binding) shall after written notice by either party to the contract to the other of them and to the Employer hereinafter mentioned be referred for adjudication to a sole Arbitrator to be appointed as hereinafter provided.

For the purpose of appointing the sole Arbitrator referred to above, the Employer will send within thirty days of receipt of the notice to the contractor a panel of three names of persons who shall be presently unconnected with the organization for which the work is executed.

The contractor shall on receipt of the names as aforesaid select any one of the person(s) name to be appointed as a sole Arbitrator and communicate his name to the Employer within thirty days of receipt of the names. The Employer shall thereupon without any delay appoint the said person as the sole arbitrator. If the contractor fails to communicate such selection as provided above within the period specified the competent authority shall make the selection and appoint the selected person as the sole Arbitrator.

If the Employer fails to send to the contractor the panel of three names as aforesaid within the period specified, the contractor shall send to the Employer a panel of three names of persons who shall all be unconnected with either party. The Employer shall on receipt of the names as aforesaid select any one persons name and appoint him as the sole arbitrator. If the employer fails to select the person and appoint him as the Sole Arbitrator within thirty days of receipt of the panel and inform the contractor accordingly, the contractor shall be entitled to appoint one of the persons from the panel as the sole arbitrator and communicate his name to the Employer.

If the Arbitrator so appointed is unable or unwilling to act or resigns his appointment of vacates his office due to any reason whatsoever another sole Arbitrator shall be appointed as aforesaid.

The work under the contract shall, however, continue during the arbitration proceedings and no payment due to or payable to the contractor shall be withheld on account of such proceedings.

The arbitrator shall be deemed to have entered on the reference on the date he issued notice to both the parties fixing the date of the first hearing.

The arbitrator shall give a separate award in respect of each dispute or difference referred to him. The arbitrator shall decide each dispute in accordance with the terms of the contract and give a reasoned award. The venue of arbitration shall be in **Chennai**.

The fees if any, of the arbitrator shall, if required to be paid before the award is made and published, be paid half and half by each of the parties. The cost of the reference and of the award including the fees, if any, of the arbitrator who may direct to and by whom and in what manner, such costs or any part thereof shall be paid and may fix of settle and amount of costs to be so paid.

The award of the arbitrator shall be final and binding on both the parties.

Subject to aforesaid the provisions of the Arbitration Act 1992 or any statutory modification or re-enactment thereof and the rules made there under, and for the time being in force, shall apply to the arbitration proceeding under this clause.

The Employer and the contractor hereby also agree that arbitration under clause shall be condition precedent to any right to action under the contract with regard to the matters hereby expressly agreed to be so referred to arbitration.

Submitting to arbitration may be considered as an additional remedy and it does not preclude the parties to seek redressal / other legal course.

36. CERTIFICATE OF VIRTUAL COMPLETION OF WORKS:

The Contractor shall report in writing to the Architect / PMC /Employer, in the form of a Certificate as per Proforma 'C' annexed hereto as and when the works are completed in all respects. The Architect / PMC / Employer shall after the verification of the works and in consultation with Architect / PMC issue to the Contractor a certificate to be called "Virtual Completion Certificate", a copy whereof shall be submitted to the Employer to enable him to take possession of the completed works. The Defects Liability period shall commence only from the date of issue of such certificate.

DECLARATION

I / We hereby declare that I / We read and understood the above terms and conditions and that we shall abide by them if the work is awarded to us.

Contractor's Signature with Seal

ADDITIONAL CONDITIONS OF CONTRACT (ACC)

1. COMPLETION SCHEDULE

The contractor will be required to work according to a programme given to them by the consulting Architects/ PMC, based on the priorities of the employers. The contractor will be required to prepare bar charts on the basis of the programme given to them and get these approved by employer/ Architects. **The overall completion programme of the work will be 90 days.**

2. WATER AND ELECTRICAL ENERGY

The contractor has to make his own arrangements for water, storage and distribution for the work.

Electricity will be supplied by the bank at two points for the work on chargeable basis.

3. OTHER RULES AND REGULATIONS

a. All E.S.I formalities or prescriptions under Workmen Compensation Act will be adhered to by the contractor. He will have to observe the regulations prescribed under the contracts Labour-Regulations & Abolition Act, 1970 and rules formed there under.

b. The contractor shall not employ any labour below the age of 18 years and shall pay his labourers not less than the wages paid for similar work or the fair wage. Fair wage means wage whether for time or piece work as defined in the minimum wages act.

4. The Contractor shall at his own cost, obtain permission from the local bodies if any required.

5. The debris/dust or any wastage generated out of the said work shall be cleaned as frequently as required and as instructed by the Employer and the entire Quarters except the working flats to be kept clean and tidy.

6. For bringing the materials from outside to the site RTO regulations would have to be taken care.

7. The successful tenderer should prepare the layout of the work and any other working/ detail drawing related to the said Work on a 1:4 scale showing the same should be got approved from the Employer within 7 days.

8. Care shall be taken while executing the said job, If anything is damaged the same shall be rectified at no extra cost.

9. Wherever the basic rate for the material is specified, the contractor should furnish all the paid bills for Employer verification. The purchase rate shall be got approved from the Bank before purchasing. The adjustment in price shall be made only on measured quantity fixed at site. No overhead and profit shall be considered on the cost difference.

The basic prices are at site inclusive of transportation, excise duty, sales tax, octroi and all other duties levied by Local authority / Government.

10. Employer reserves the right to insist on selection of material, workmanship, detailing and finishes, which they consider, is appropriate, and suitable for the intended use. The contractor is not eligible to claim extra on this account.

11. Employer will require the contractor to produce, samples of all the materials, accessories/ finishes prior to procurement/ manufacture. The samples of the materials for the work shall be got approved from the Employer. Failure to comply with these instructions can result in rejection of the work/ materials.

12. The Tenderer should note that he should execute his part of work without causing any damage to any component of the building and also without disturbing the occupants. Any damage so caused shall be made good at the cost & risk of the tenderer.

13. The tenderer should note the tender drawings and other documents describing each item in the schedule are only indicative in nature and cannot be taken as complete in detail and finishes. Being tender for Civil, Carpentry, Plumbing HVAC, Electrical & Solar works which calls for workmanship and finish including use of good quality materials of high standard, it is expected that the tenderer should understand the intent of the tender drawings and specifications and provide for materials, workmanship, finishes and accessories appropriately so as to deliver the product of high standards in keeping with the function for which it is intended. No claim from the contractor at a later date will be entertained for his failure to understand this condition. The decision of the Bank in respect of the quality of material, type of work, workmanship, finish etc, shall be final and binding on the contractor. The contractor's claim for not providing in his tender for such materials, workmanship and finish cannot be entertained.

14. The successful contractor shall make sure that they protect their materials and the materials procured by Employer and hand them over in good shape to the Employer satisfactorily. At the time of handing over any damages, scratches, dents or such defects noticed shall be got rectified as directed without any extra charge by the Contractor to the satisfaction of the Employer.

15. The successful tenderers shall include, in the quoted price, all allied civil works such as chasing in wall, drilling holes etc to support the frames, partitions, make the surface good after grouting etc.

16. Neat housekeeping at all times is the responsibility of the successful tenderer, who shall also ensure that the removal of debris, waste materials etc from the site at their own cost and the same shall be organized at regular basis (maximum of one week).

17. The successful contractor shall also be responsible for the safety and security of all their materials and also for ensuring fire prevention steps at all times in the working premises including their part of the work. The successful contractor has to place full time representative at site, the representative should have thorough subject knowledge.

18. The Employer shall, during the progress of works, have power to order in writing from time to time the removal from, the works within such reasonable time or times as may be specified in the order, of any materials which in the opinion of the Employer are not in accordance with the Specifications or instructions of the Employer, the substitution of proper materials, and the removal and proper re-execution of any work executed with materials and workmanship not in accordance with the drawings and specifications or instructions, and the Contractor shall forthwith carry out such order, the Employer shall have the power to employ and pay other persons to carry out the same, and all expenses consequent thereon, or incidental thereto, as certified by the Employer shall be borne by the Contractor, or may be deducted by the Employer from any money due, or that may become due to the Contractor.

19. The contractor shall submit to the maximum number of labours to be engaged on a single day in the job. Any subsequent increase should be informed to the Employer without delay. If the number of labourers employed for the job is twenty or more, the contractor shall obtain the license from the Regional Labour Commissioner.

20. The contractor should ensure payment of minimum wages + VDA to all labourers / workmen staff employed by him.

21. The contractor shall maintain all registers as required by the Regional Labour Commissioner and should furnish the same to the Bank or its representative as and when required.

PREAMBLE TO SCHEDULE OF QUANTITIES

1. Tender shall be on the basis of items rates which shall include the cost of materials, labour, all taxes, duties, and all other appurtenant services required for the complete installation, testing and commissioning in accordance with relevant drawings and meeting the requirements of the specifications and relevant I.S. specification including the fees for inspection together with the liabilities and obligations as detailed in the general conditions of contract.

2. Prices shall remain firm and free from variation due to rise and fall in the cost of materials and labour or any other price variation whatsoever whether during the stipulated period of execution or during extended period of completion if any, expect direct statutory, increases by the Act of Govt. or Local bodies.

3. Item rates shall remain valid for any variations in the estimated quantities given in the schedule of quantities.

4. In order to facilitate the technical scrutiny of various quotations, the tenderer must supply with their quotations, the tenderer must supply with their quotations detailed technical particulars, make catalogues and erection drawings for various items under different parts specified in the schedule of quantities.

5. The drawings and specifications lay down minimum standards for equipment and workmanship. Deviations, if any, shall be clearly set down. In the absence of any deviations, it will be deemed that the tenderer is fully satisfied with the intents or the specifications and drawings and their compliance with the statutory and fire insurance provision including local codes. Where the drawings and specifications conflict the more stringent shall apply.

6. All installations shall be tested as specified and a test certificate in the prescribed form required by the authorities shall be furnished.

7. The entire installation shall be guaranteed against any defective materials of workmanship for a period of **12 months** from the date of installation as certified by the architects and taken over by the employer. During the guarantee period, all defects shall be rectified by the contractor, free of cost.

8. Water and power required for works may be made available at site. Use of electrical power will be on chargeable basis. If the water available at site is unsuitable for construction purpose, the contractors will make their own arrangements for water.

9. The tenderers must acquaint themselves of the site conditions and take note of all factors while quoting the rates, as no extra will be allowed on any ground.

10. The employer shall pay the contractor such sums as shall become payable hereunder at the times and in the manner specified in the said conditions.

11. The term "Consulting Architects / Project Management Consultant (PMC)/ Architect" in the conditions shall mean the said 'M/s. Oscar & Ponni Architects', The

Creative People or in the event of their death or ceasing to be the consulting architects for that purpose of this contract, such other person 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 in sufficient by the Employer. Provided always that no persons subsequently appointed to be consulting architects under this contract shall be entitled to disregard or over rule any decision or approval or direction or expressed in writing by the consulting architects for the time being.

12. The plan, agreement and documents mentioned shall form the basis of this contract and the decision of the said Consulting Engineers/Architects for the time being as mentioned in the conditions of contract in reference to all matters of dispute as to the materials, workmanship or account and as to the intended interpretation of the clauses of the agreement of any other document attached hereto shall be final and binding on both parties and may be made a Rule of Court.

13. The said contract comprises the works mentioned in the BOQ (Bill of Quantities) and all subsidiary works **(if any)** connected therewith within the same site as may be ordered to be done from time to time by the said Employer through the consulting architects for the time being, even though such works may not be shown on the drawings or described in the said specifications or the priced schedule of quantities.

14. The employer reserves to himself the right of altering the drawings and nature of the work and of adding to or omitting any items of work or of having portions of the same carried out without prejudice to this contract.

15. The said conditions shall be read construed as forming part of this agreement, and the parties hereto will respectively, abide by and submit themselves to the conditions and stipulations and perform the agreements on their parts respectively in such conditions contained.

16. Further, letters exchanged between the employer and the contractor after the receipt of this contract as cited shall form an integral part of this contract.

17. The successful tenderer shall supply completion drawings of the entire installations as executed at site drawn to scale approved by the employer / architects after the completion of the work. But before completion certificate is given by the employer / architects upon receipt of the completion drawings, as built drawings of the work only, the final bill will be released.

18. The materials of the first preference shall be used by the contractor may exclude himself of not doing so only if the required range as per tender specifications is not manufactured, by the particular manufacture. The evidence of such case shall be supported by a letter from the respective manufacturer. Samples of all fittings and accessories shall be approved by the employer/architects prior to their installations.

इंडियन बैंक
Indian Bank

ARTICLES OF AGREEMENT

This agreement is made at Chennai on this day of _____ Two Thousand _____, INDIAN BANK, a body Corporate constituted under the Banking Companies (Acquisition and Transfer of Undertakings) Act 1970 having Corporate Office at 254-260, Avvai Shanmugam Salai, Royapettah, Chennai 600 014, (herein after referred to as "The Employer", which expression shall unless excluded repugnant to the context be deemed to include its successors and assigns) of the one part

AND M/s_____ having its Registered office at……..…… ..... and Regional Office at ..... Chennai.
(hereinafter referred to as the "Contractor") which expression shall include its successors, legal representatives and assigns of the second part.

WHEREAS Employer intends / desirous of doing **Repair and Renovation (Civil, Plumbing, Roofing, Interior, Acoustic, HVAC, Electrical & Solar works) of Auditorium in IMAGE at M.R.C Nagar, Raja Annamalaipuram, Chennai - 600 028** and has drawings and specifications, schedule of quantities describing the work

WHEREAS the Employer has caused drawings and tender documents to be prepared by his Architect /PMC **M/s**. **Oscar & Ponni Architects No.2, Vivekananda Road, Srinivasa Nagar, Chetpet -600 031,** (hereinafter referred to as "Architect").

AND whereas the Employer has called for tenders for the above work as per Employer's NIT dated ----------and whereas the tender dt. ---------- submitted by the contractor has been accepted for such sum as may be ascertained to be payable in terms of the Bill of Quantities and which sum is estimated to be Rs. ... . (Rupees ……) hereinafter referred to as the said "Contract Sum".

AND whereas the Contractor has agreed to execute the work as per drawings, specifications, conditions of contract of the tender and work Order for the Employer's project of".

AND whereas parties herein desirous of reducing the agreed terms into writing as under:

NOW THIS AGREEMENT WITNESSETH AS FOLLOWS:-

1) In consideration of the said Contract Sum to be paid at the times and in the manner set forth in the said Conditions the Contractor shall carry out and complete all the Electrical Works as per terms and conditions herein contained and according to the general rules & conditions of the contract, notice inviting tender, special conditions of contract, general scope of work, technical specifications, schedule of rates and instructions to be given by Architect /PMC/ Employer and to the entire satisfaction of the Employer.

Further, the contractor hereby agrees and undertakes to execute and complete the said works shown in the said drawings and such further detailed drawings as may be furnished

to it by the Employer and described in the said specifications and the said schedule of quantities upon and subject to the said conditions.

The said tender and allied documents, drawings, specification, priced schedule of quantities, agreement and documents above mentioned shall form the basis part and parcel of this contract and the decision of the Employer as mentioned in the condition of contract with reference to all matters of disputes as to materials, workmanship of account and as to the interpretation of the clauses of this agreement or the said conditions shall be final and binding on both the parties.

The contract herein contained comprises of the said work above mentioned and all subsidiary works connected therewith in the same site as may be ordered to be done from time to time by the Employer even though such works may not be shown in the said drawings or described in the said specifications or the schedule of quantities. The contractor hereby agrees and undertakes to do and perform all such works in a thorough and workman like manner, with best materials and within the time limit herein mentioned.

The Employer reserves to himself the right to alter the drawings and nature of the work and of adding or omitting any item of work or of having portions of the same carried out departmentally or otherwise and such alterations or variations shall be carried out without prejudice to this contract.

The said conditions shall be read and construed as forming part of this agreement and the parties hereto will respectively abide by and submit themselves to the conditions and stipulations and perform the agreements on their parts respectively as such conditions contained.
It will be the entire responsibility of the contractor to procure all materials required for the said works.

2) **Contract Price, Taxes and Payment Terms:**

Total contract price is Rs…….. which is inclusive of cost of materials, equipment, installation charges and tools and tackles required for execution of the job. Above price is inclusive of all taxes / GST & duties including excise duty, sales tax, works contract tax, income tax, octroi etc. in respect of this contract. No claim in this respect will be entertained. Sales tax on works contract & Income tax on payments shall be levied as per prevailing rules and will be deducted and deposited by Employer in accordance with the sales tax law of the state and the provisions of tax deductions at source under Income Tax Act 1961.

However, interim payment will be made as per the site measurements on Item Rate basis and certification of the Project Management Consultant and the Employer shall for such works pay to the contractor such sums as shall become payable at time, in the manner specified in the said conditions.

3) **Completion Period:**

Time is the essence of the Contract. The work is to be completed in all respects within **90 days** from the date of receipt of the Work Order /letter of intent by the Contractor or

handing over of site whichever is later. If the Contractor fails to complete the job within the agreed time period the Contractor will have to bear liquidated damages as per the relevant clause mentioned in the Tender Documents.

The contractor shall complete the said work as specified above from the date of commencement of work as per work order for the work and will remove from the site all plants, scaffoldings, materials in use, rubbish and leave the work site clean within the said period.

4) **Earnest Money:**

The Contractor has deposited Demand Draft / Bank Guarantee for an amount of **Rs. 8,00,000/- (Rupees Eight Lakhs Only)** as Earnest Money.

5) **Inspection of Site:**

The Contractor has inspected the site before submitting his tender and has satisfied himself as to the nature of the work to be executed on the site. Any difficulties which the Contractor may come across in the course of the work shall in no way entitle the contractor to claim or receive extra payment unless the Employer is of the opinion that such difficulties could not have been foreseen and the Employer consents in writing. The site will be handed over to the contractor as per the terms of tender and in no case the contractor can claim for non suitability of site condition for extension of time unless employer opinions the other way.

6) **Supply of Material and Labour:**

The Contractor shall arrange all labour, materials, equipments, tools, tackles and everything necessary for the completion of the work as per the terms of tender and specification / BOQ etc.,. The Contractor will assume all responsibility for the safety, protection and accounting of all material and equipment and the work during construction. All materials used by the Contractor shall be of the best quality conforming to the required specification mentioned in the tender document and will be subject to the approval of the Architect / Employer. All such materials not approved by Architect / Employer shall be removed at once by the Contractor at his own expense. The Contractor shall also at his own expense arrange for carrying out any test of materials which the Architect / Employer may from time to time require or if so desired by the employer.

7) **Defective Work / Materials:**

If any part of the work done by the Contractor is found defective in workmanship or if bad or inferior materials have been used the Contractor shall at his own risk and cost demolish all such defective work and rebuild the same and / or replace the bad or inferior materials used within a time frame mentioned to the satisfaction of the 'Architect / Employer'. The decision of the Employer /Project Management Consultant in this regard shall be final and binding on the Contractor. In case of default of the contractor to remove the defective work and rebuild the same or replace bad or inferior materials as directed by the Employer, the Employer shall be entitled to employ anyone else to carry

out the same at risk and cost of the Contractor and recover all expenses incurred in this regard from the contractor.

The contractor should not damage the any existing water proofing done on the roof. They should discuss about the work they are going to carry out with Architect / Employer before they take up the work. In case of any damage done to the water proofing and detect leakage due to the same, the contractor will be made responsible to rectify the same at their cost to the full satisfaction of the bank.

8) **Inspection of Work:**

During progress of the work the site engineer of the Employer and Architect / Employer shall be entitled at all times to have access to and inspect the work. If the work is inspected by the any Government/ Bank's authorized persons, the contractor will fully co-operate and extend all help to meet the observations.

9) **Supervision:**

The Contractor shall provide one or more competent and technically qualified engineers duly and fully authorized to act on his behalf in all matters relating to the works to be carried out under or any other matter concerning this agreement and who shall at all times be present at the works while any work is in progress as per directions, explanations & instructions of Architect / Employer.

10) **Compliance with Statutory Regulations & Work Rules:**

The Contractor shall be responsible for complying with the applicable laws / bye laws / Regulations in force from time to time and shall have to bear all statuary liabilities to the workers / personnel engaged for the job. Nothing will be paid extra in this regard. If any amount is paid by the Employer in this regard the same amount shall be deducted from the Contractor's dues. The Contractor shall have to arrange insurance cover for the workers / personnel engaged by him for the job. This clause should be read in conjunction with clause mentioned in tender document, **clause no: 13 of special conditions of contract and clause no: 22, of General condition of contract**

11) **Determination of Contract:**

In the event of Contractor failing to keep / adhere to agreed schedule of work, or in the event of the Contractor failing to comply with the provisions of this contract by default and / or negligence and / or suspension of work or in the event of Contractor failing to complete the work within the stipulated period, the Employer may terminate this Agreement forthwith and employ, at the Contractor's risk and cost, another contractor or sufficient number of workmen to complete the work.

12) **Force Majeure:**

In case any Force Majeure condition herein mentioned occurs and continues for a period exceeding 15 days the parties here to undertake to sit together and devise ways for expeditious and proper performance of the obligations of the parties under this order.
This clause will be operative only if the work is delayed by

a) Acts of God
b) Earthquake or floods or similar natural calamities.

c) Serious loss or damage by fire or lightning.

13) **Arbitration:**

"In the event of any dispute or difference relating to interpretation and application of provisions of the contract and all disputes/claims whatsoever which shall either during the continuance of the contract or afterwards either between the parties to the contract or the respective representatives touching the construction/application of any provision/clause mentioned in the contract or any account or liability between the parties to the contract or as to any act or deed or omission of any party to the contract, in any way relating to these presents, shall be first at the discretion of the Bank attempted to be resolved in good faith by mutual discussion within 30 days of the dispute or question being raised failing which the same shall be settled by arbitration in accordance with provisions of Indian arbitration and Conciliation act 1996.

The Parties concerned shall designate an arbitrator on mutual consent/consensus. In the event of no consensus being arrived, an Arbitral Tribunal shall be constituted comprising three Arbitrators, each party appointing one arbitrator and a third arbitrator to be appointed by the two arbitrators so appointed by the parties. The venue of the arbitration shall be exclusively at Chennai and any award passed by arbitrator or the arbitral Tribunal shall be final, conclusive and binding upon the parties and shall be deemed to have been made between parties themselves. The parties to the dispute shall share equally the cost of arbitration as intimated by the arbitrator".

All disputes arising out of or in any way connected with this agreement shall be deemed to have arisen in Chennai and only courts in Chennai shall have jurisdiction to determine the same.

Submitting to arbitration may be considered as an additional remedy and it does not preclude the Parties to seek redressal/other legal recourse.

14) **Architect / Project Management Consultant:**

The term Architect / Project Management Consultant in the said conditions shall mean the said M/s. Oscar & Ponni Architects, Chennai or in the event of it being ordered to be wound up or in ceasing to be the Architect / Project Management Consultant for the purpose of this Contract, such other person 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 mentioned in the said Conditions provided always that no person subsequently appointed to be Architect / Project Management Consultant under this Architect / Project Management Consultant shall be entitled to disregard or overrule any provision, decision or approval or direction given or expressed by the Project Management Consultants for the time being.

15) The several parts of this contract have been read and fully understood by us.

16) Following shall be deemed to form and be read and construted as part of this agreement viz

a) The Bid No / date.
b) The award letter No / date.
c) References as mentioned in the award letter

d) All the correspondences till award of contract

IN WITNESS whereof the said contracting parties have set their hands and seals on the day and year first hereinabove witness.

Witness Address Employer

Witness Address Contractor

इंडियन बैंक
Indian Bank

APPENDIX – V

Bank Guarantee No. **Date:**

PERFORMANCE BANK GUARANTEE

Indian Bank, a body Corporate constituted under the Banking Companies Acquisition and transfer of undertaking Act, having its Corporate Office at No.254-260, Avvai Shanmugham Salai, Royapettah, Chennai 600 014 (hereinafter referred to as Indian Bank) have entered into Agreement/Contract/Order No.---------- dt ---------- (hereinafter called "the said Contract/ the said Order") with M/s ---------- [hereinafter called "the said Contractor/Supplier"] for the work of **Repair and Renovation (Civil, Plumbing, Roofing, Interior, Acoustic, HVAC, Electrical & Solar works) of Auditorium in IMAGE at M.R.C Nagar, Raja Annamalaipuram, Chennai - 600 028**.

---------- at ---------- at Indian Bank Corporate Office, Building and associated electrical and Civil works at Indian Bank, Corporate office, Royapettah , Chennai-14.

2. Where as under the terms of the said Agreement/Contract/Order, the Contractor/Supplier is required to furnish a Performance Bank Guarantee for 5% of tendered value i.e Rs. ----------/- (Rs. Amount in words) towards the due fulfillment of the terms and conditions during the agreed time period or extension thereof, and also satisfactory performance of the said equipment supplied to Indian Bank during warranty period as per the warranty terms stipulated in the Agreement/Order.

3. Accordingly, we ----------(name & Address of the issuing Bank) (hereinafter referred to as "The Surety:", which expression shall , unless repugnant to the context or meaning thereof, include all its successors, administrators, executors and permitted Assignees.) at the request of ---------- (name & Address of the contractor) do hereby undertake to pay to Indian Bank an amount not exceeding Rs. ----------/- (Rs. Amount in words) on the failure of Contractor/Supplier in performance of their obligations as per the terms and conditions of the Contract/Order including the satisfactory performance of the item during warranty period as per the warranty terms stipulated in the Agreement / Contract/Order.

4. The Surety do hereby unreservedly, irrevocably undertake to pay the amounts due and payable under this guarantee without any demur, merely on demand from Indian Bank within 10 days of such demand stating that the amount claimed is due by way of breach of terms and conditions of the Agreement/Contract/Order. Any such demand made on the bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. ----------/- (Rs. Amount in words) and We undertake to pay to Indian Bank a amount not exceeding Rs. ----------/- (Rs. Amount in words) so demanded not withstanding any dispute or disputes raised by the contractor/supplier of the equipment in any suit or proceeding pending before any Court or Tribunal relating thereto our liability under this guarantee being absolute and unequivocal.

The Surety further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract/Order and that it shall continue to be enforceable till all the dues of Indian Bank under or by virtue of the said Contract/Order have been fully paid and its claims satisfied or discharged or till Indian Bank certifies that the terms and conditions of the said Agreement/Contract/Order have been fully and properly carried out by the said Contractor/supplier(s) and accordingly discharges this guarantee.

5. The Surety further agree with Indian Bank that Indian Bank shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Agreement or to extend time of performance by the said contractor/Supplier of the equipment from time to time or to postpone for any time or from time to time any of the powers exercisable by Indian Bank against the said contractor/Supplier and to forbear or enforce any of the terms and conditions relating to the said Agreement/Contract/Order and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor/ Supplier or for any forbearance, act or omission on the part of Indian Bank or any indulgence by Indian Bank to the said Contractor/Supplier or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

इंडियन बैंक
Indian Bank

6. The Surety lastly undertake not to revoke this guarantee during its currency except with the previous consent of Indian Bank in writing and agree that any change in the constitution of the said contractor/Supplier or the said Bank shall not discharge the Bank of its liability under this deed.

The validity of Bank Guarantee shall be up to DD/MM/YY

And such date shall cover the period of warranty of all the supplies and excludes the period of defect liability. The Bank Guarantee shall remain valid for the period up to which the contractor is obliged for due performance of the said Agreement/ Contract/Order including the warranty period.

7. This Bank Guarantee shall be governed by and constitute in accordance with Indian Law and shall be subject to exclusive Jurisdiction of Indian Courts.

All the claims under this guarantee must be presented to the bank in writing.

8. Notwithstanding anything contained hereinbefore.

Our liability under this guarantee is restricted to Rs. ----------/- (Rs. Amount in words) .The guarantee is valid up to DD/MM/YY or extension there of.

Unless a claim or demand made in writing is presented to us on or before DD/MM/YY , the date of expiry of this guarantee all your rights under this guarantee shall be lapsed and we shall be released and discharged from all liabilities thereunder.

In witness where of the Bank through its officials has set its hand and stamp on ---day of --------- and the year---------- at ----------.

SIGNED AND DELIVERED For and on behalf of

For and on behalf of above named Bank. (Banker's Name and Seal)

Branch Manager
(Banker's seal)

SEAL OF THE BANK

GENERAL SPECIFICATIONS

All works should confirm to standard laid down by the Bureau of Indian Standards (BIS) Latest Edition.

Wherever detailed specifications are not given, the works shall be carried out as per CPWD specifications with latest additions and corrections.

1. SPECIFICATIONS – GENERAL REQUIREMENTS

1A. List of tender drawings is given elsewhere in the tender documents. These drawings are meant for tenders and construction also. These drawings may be revised and fresh revised copies issued to the contractor from time to time for adoption in work to suit the final designs and the physical conditions encouraged during the progress of work.

1B. Figured dimensions on drawings shall only be followed and drawings to large scale shall take precedence over these to smaller scale.

1C. Information noted on the drawings pertaining to the materials and workmanship, if contrary to that given in the specifications, shall have precedence.

1D. The contractor shall prepare, at his own cost, detailed shop drawings and shall obtain the approval of the Architect/Employer before adoption.

1E. The specification is intended for general description of quality and workmanship of materials and finished work. They are not intended to cover minute details. The work shall be executed in accordance with sound engineering and other professional practice.

1F. Where reference is made to any standard specification of Bureau of Indian Standards or any other similar body, the information and provisions of the latest revised edition of the specification on the date of submission of such standard specifications are in conflict with the provisions standard in these specifications the latter provisions shall have precedence.

1G. All materials shall be quality manufactured by renewed concerns conforming to Indian Standards or equivalent and shall have "BIS" mark as far as possible unless otherwise approved by the Architect / Employer. The contractor shall get all materials approved by the Architect / Employer prior to procurement and use.

2. MEASUREMENTS AND PAYMENTS

2A. The quantities stated in the bills of Quantities are tentative. The contractor shall be paid at the quoted rate and on the basis of actual measured dimensions of the finished work, limited however by those dimensions shown in the drawings, or as directed by the Architect / Employer.

2B. Measurement of work shall be generally in accordance with **IS: 1200** "Method of Measurement of Building and Electrical Engineering Work" except where the stipulations of the tender are contradictory.

2C. If need be the employer may employ a third party (consultant) to check the measurements at site over and above the certification by PMC and for which the contractor has to extend his support.

3. LAYOUTS AND SURVEYS.

The contractor shall be responsible for the true and proper setting out of works, for the correctness of position, levels, dimensions and alignment of all parts of the works and for the provisions of all necessary instruments, appliances and labour in connection there with. If at dimensions or alignments of any part of works, the contractor, on being required to do so, shall at his expenses rectify such errors, checking of any setting out or of any line or level by the Architect/Employer shall not in any way relieve the contractor of his responsibility for the corrections thereof.

4. CONSTRUCTION SCHEDULE AND TIME OF COMPLETION

4A. A bar chart shall be submitted by the contractor detailing out the complete construction activities for each work within 7 days of start of work at site. This chart shall be reviewed by the Architect/ PMC /Employer and alterations, if any, shall be made by the contractor. This chart will form the basis or reappraisal to evaluate the progress of work at site.

4B. The drawings shall be issued to the contractor at least one week in advance before commencement of work.

4C. No extension of time shall be granted on the plea of drawings not having been received in time provided the above time schedule is adhered to.

5. CO-OPERATION WITH OTHER AGENCIES

5A. During the course of implementation of this contract, several other agencies and contractors shall be working at site simultaneously. In order to effect proper co-ordination and avoid delays, it shall be the responsibility of the contractor of this tender to give adequate notice and exact dates of work proposed to be executed by him which requires the placement and fixation of embedment etc., by the other agencies. The safety and prevention from damage activities would remain with the contractor. In the event of damage or loss, caused, indirectly or directly by the contractor or his labour, he will be responsible to make good the same as advised/instructed by the Architect/Employer.

6. DELIVERY OF WORKS

Every portion of the work shall be kept clear of accumulation from time to time and delivered up clean and free from all defects of every kind at the conclusion of work.

7. RELATION TO OTHER DOCUMENTS

7A. The technical specifications are intended for general description of items listed in the bill of quantities. All works specified or implied in the technical specification form a part of

the items in the bill of quantities. Similarly, all indications in drawings and general description of works, whether specified or implied, form a part of the items in bills of quantities.

7B. The quoted rates in the bills of quantities shall be assumed to include all the specified and implied works of the technical specifications, drawings and general description of works even when not specifically mentioned in the bills of quantities.

8. LIFTS AND LEADS

8A. The rates quoted for all items of work shall include all lifts and leads where applicable.

8B. All debris and waste materials shall be disposed away from the site to a far off place as directed.

1) MATERIALS FOR THE CONCRETE WORK: These specifications shall apply where practicable to all sections of the contract.

(a) Cement : Cement shall be obtained only from approved manufacturers and shall conform in every respect with the relevant Indian Standard specifications for \ 'Portland Cement' Quick setting cement shall not be used without the permission in writing from the Engineer. The contractor shall supply free of charge a signed certificate for the manufacturer of the cement with each consignment slating the results of the tests and recording the date of grinding, and they shall also produce invoices of cement received at the works. If the cement arrives at the works without such a certificate the Engineer shall be entitled to refuse to accept it. If certificate shows the cement to be inferior to that specified or if the Engineer shall have any doubt as to the cement complying with the specifications the cement may be delivered but shall be stored at a separate place. If shall be used only with the written permission of the Engineer pending investigations & decision as to whether the cement complied with the specifications. The cement shall be delivered in properly sealed bags bearing the name, brand and stamp of the manufacturers if shall be delivered ready for immediate use and may be used directly from the bags. The whole of the cement shall be stored in a godown or a warehouse which shall fully protect the cement from the weather effects. The said warehouse shall be provided by the contractor's with a solid impervious floor so that cement shall not come in direct contract with the ground. The Engineer's shall from time to time, at his option, get tested the samples of cement at contractor's cost, in the Govt. recognized Laboratory, and the consignment of cement which will not stand the required test, shall be rejected.

(b) Sand : The sand to be used in the mixing -concrete of for mortar shall be clean and gritty and composed of hard coarse, siliceous grains or other materials approved be the engineer which shall be free from clay or any vegetable, animal, bituminous or other bituminous or their deleterious matter. All sand shall be cleaned thoroughly by washing it in flowing water so as not to leave any dirt or foreign matter within it, Sand having a silt content in excess of 5% shall be rejected and shall not be used without rewashing on site to the satisfaction of the Engineer. If it is M Sand the same to be got approved by the Engineer-in- charge and screened as required.

(c) Coarse Aggregates : The coarse aggregate shall pass through a mesh 2.50cm. (1") square, measured in the clear and shall be retained on 6 mm. (1/4") mesh. No hand broken metal shall be used for RCC work.

(d) Water: The water for mixing mortar, concrete work shall be clean & potable & should be free from earth vegetation or any other organic matter.

Inspection of Works

Temporary openings shall be provided at the base of columns and wall forms and other places necessary to facilitate cleaning and inspection. Immediately before concrete is placed all forms shall be carefully inspected to ensure that they are properly placed, sufficiently rigid and tight, thoroughly cleaned, properly treated and free from foreign material.

When forms appear to be unsatisfactory in any way either before or during the placing of concrete, the Architect shall order all work stopped until the defects have been corrected.

e) Joints:

Joints in forms shall be horizontal or vertical unless otherwise specified and shall be sufficiently tight to prevent any leakage. Suitable devices shall be used to hold adjacent edges together in accurate alignment. All forms shall be so, that they can be removed without hammering or playing against the concrete.

2) Specification For Structural Steel Work

Providing structural steel work in single stanchions composed of RSJ, channel, etc. with caps, bases, mild- steel plates, angle brackets, cleats, gusset plates, anchor bolts etc. as per detailed designs and drawings or as directed including cutting, fabricating, hoisting, erecting, fixing in position, making rivetted / bolt / welded connections and painting complete.

Structural steel shall conform to I.S. 226 or 1962, I.S. 2062 - Grade A, ST 42.S or I.S. 1977 of 1962 ST 420 and ST 420 and SR 320. Wherever steel is supplied by contractor, he shall on demand produce the test certificate from manufacturers. Steel for windows, ventilators shall be conforming to IS 226 of 1962.

Bolts and nuts shall confirm to IS 1363 and 1367, unless noted otherwise shop welds shall be 6 mm. continuous fillet welds and site welds shall be 8 mm. continuous fillet welds, welding shall confirm to IS : 816/ 9595 and unless otherwise specified Gusset plate shall be minimum 8 mm. thick, length of inclined members
and sizes of gusset plate shall be obtained by full scale layout. Tolerances for fabrication of steel structure shall confirm to IS 7215. Surface preparation and finishing shall be as specified in drawings / items / description / technical specification / I.S.I. Codes. Bolts holes shall be as follows :

BOLT DIA:	12	16	20	22	25
HOLE DIA:	13.50	17.50	21.50	24	27

Splicing, if required, shall be as per approved details.

Shop drawings : The contractor shall prepare shop drawings for the structural steel work to be executed as per I.S. 800-1962 at his cost. The contractor shall submit the drawings in triplicate to the Architect for this approval. No fabrication shall be taken in hand until the relevant shop drawing have been approved by the Architect. However, the contractor shall remain wholly responsible for their correct conformation to design and for accurate fabrication to meet the requirements of design and the Indian Standard. One copy of the drawing duly approved shall be carried out according to the approved design.

Fabrication : Fabrication shall be done as per IS 800-1962.

Recommended Sequence Of Erection Procedure For Roof Trusses.

Columns shall be bolted firm on to the foundations if they are in structural steel.

Start Truss erection from one of the gable ends.

After erection of gable truss, secure the truss in position by holding down bolts and tie it up with steel guy- ropes two on either side of the building columns, but to separate anchors, driven firm into the ground.

Erect the next truss adjacent to the gable truss and secure it well to the gable truss by connecting all purlins and wind bracings at tie level and rafter level before releasing the truss from erection tackles.

Erect the next truss only after completing the activity in four above and connect to the previous truss through alternative purlins, if not all.

Continue the procedure in five above for the successive trusses.

After all trusses are erected, install remaining purlins, bracings and align them.

After, all alignment is complete, grout the columns / trusses with specified grout.

The single stanchion shall be fixed in the required positions accurately vertical or with the inclination as shown in the drawing or as directed. Any connections like angle brackets, cleats, gusset plates, anchor bolts, mild steel bearing plates with beams, foundations or other members shall be as shown in the drawings or as directed by the Architect. The steel work shall be painted with one coat of red lead oil paint and two coats of oil paint of shade approved by the Architect and conforming to the relevant Indian standard.

The item shall include supply, fabrication and erection in position at site of all structural steel sections of the required dimensions and labour, material, and use of equipment required for all operations of fabrication, hoisting, erection and satisfactory completion of the item.

Item shall also include labour, materials and use of equipment required for painting the structural steel work. The item shall include besides the rolled sections of stanchion, all structural steel in connections like brackets, anchor bolts, angle, cleats, mild steel plates gusset plates, rivets, bolts etc. fully erected and painted.

Mode of measurement and Payment : In the case of rolled sections lengths shall be measured correct to a cm. and weight calculated on the standard weight per metre tabulated in the I.S.I. Hand book for structural steel sections, limited to the length shown on the plans correct up to 0.10 of a kg. weight of steel plates of each thickness shall be calculated separately on the basis of actual shape provided without taking into account wastage or cut off. In case of bolted work, weight of bolts, nuts and washers shall be added in full and no deduction shall be made for bolt holes. In riveted work only the weight shall be allowed in welding work due to welding.

Even though any steel satisfies the tensile strength test requirement, bend-rebend and any other test requirement, including weight etc., it will not be allowed to use it, if it reveals that any bar in the lot, is out of geometrical parameters in all respects as piping, slag inclusion, overlapping cracks, etc. The contractor has to immediately remove such rejected steel from the site, at his own risk and cost.

3) Grout

Cement used for grouting shall conform to relevant IS specification.
Aggregates used for grouts shall conform to the requirements as per IS specification.
Water for mixing grouts shall conform to the requirements as per IS specification.
Expanding grout Admixtures shall be used in the grout, subject to the approval of the Architect. Accelerators shall not be used. Admixtures may only be added to the grout used for filling sealed encapsulations and anchorage covers.

4) Specification For Water Proofing

General

The work of waterproofing described in the following items should be carried out by the contractor through reputed specialist waterproofing agencies using cement water proofing compounds, as approved by the Architect and as specified in the Schedule of items.

The Contractor should give with his tender detailed specifications for each item of waterproofing item works to be executed according to the specifications of the specialist agency he proposes to employ, for approval.

The contractor should give a guarantee for minimum period of 5 years and / or stated in Schedule 'B' for all the items of waterproofing done. During the guarantee period the contractor will be responsible to rectify any defect at his own cost to maintain the work in waterproof condition. The Waterproofing contractor will also have to make good all the surroundings disturbed by him during the rectification work at his own cost. The form of written guarantee shall be on legal stamped agreement acceptable to the Owner. The Guarantee shall be given within one month from the date of work order, but any delay in furnishing the guarantee will not relieve the contractor from the implications of this clause.

The contractor should provide and install at his own cost the following for his own use and remove the same after completion of work.

Sufficient pumps (electrical / diesel operated) for watering and curing of work at any level in the building. Curing for all items shall be carried out for minimum 14 days.

Temporary M.S. Water storage tanks.

Temporary G.I. piping and fittings for waterlines. Flexible hose lengths.

Cement Godown, Site office.

Injections wherever required, have to be undertaken by the contractor free of cost. Before starting waterproofing, the surface receiving treatment is to be cleaned properly.

Item of water proofing as given in schedule applied to all positions and in all floors and at all height-Lift of material will not form any criteria for extra payment.

5) Toilet

Cleaning the surface to the satisfaction of the site engineer and Architect or his Representative

Giving a coat of wash mixed with cement with minimum of 2% water proofing compound.

Providing 30 mm. thick waterproof treatment in 1:3 cement mortar mixed with minimum 2% water proofing compound to the bottom of toilet floors.

Providing 25 mm. thick cement mortar mixed with 2% water proofing compound as water proof treatment to the walls of toilets upto the height of one meter above the finished floor level.

Grouting the mouths of inlets and outlets.

Filling sunk portion with brickbats including water proof mortar and the top surface left rough to form a key for tiles.

6) Epoxy Painting

Material

Ready mixed paint of approved brand and manufacture conforming to relevant IS Codes shall be used. The primer shall be preferably of the same brand and manufacturer. Ready mixed paint as received from the manufacturer without any admixture shall be used and if for any reason thinning is necessary, the brand of thinner shall be as per manufacturer's instructions.

Preparation of Surface

Concrete/Plastered Surface

The concrete/ plastered surface shall be mace free from laitance and salt deposits and other contaminates. All loosely bonded mortars, dust/other particles are fully removed before the painting is applied.

Steel Surface

Grease, oil and other contaminates shall be removed from steel surfaces. The steel surface shall be cleaned from loose rust by manual wire brushing or blasting and to be thoroughly dusted down. The surface shall be cleaned and dried before application of

the paint.

Precautions

Use of the paint within the stipulated pot life period. Do not apply during rain, fog or mist. Brushes and spray equipment should be cleaned with thinner.

The application of paint shall be as per the manufacturer's printed instructions.

MODE OF MEASUREMENT

The mode of measurement for the partitions shall be from outer surfaces to the outer surfaces and the vertical member, to be taken upto the ceiling for the support will not be paid. Whenever the partition is in right angle to each other the partition should not be paid separately. Door shutter rate shall include Door fittings including handles, locks hinges Door closures and other required hardware's. The measurement shall be in square units.

1] The rate shall be inclusive of making & finishing holes for conduits, electrical & audiovisual fixtures, making grooves, beadings/moldings etc.

2] The false ceiling shall include vertical supporting system as per site conditions taking route of A.C ducts, light fittings, grooves extra supports for openings, diffusers supports & will be measured in Sq.ft. room wise & actual exposed surface will be measured.

3] Vitrified, wooden floor, P.V.C. flooring or carpets shall be measured in square meter with no payments for cutting, wastage, leads, different adhesives, grippers, cleaning etc.

4] Storage units will be measured in area in Sq.ft. including grooves, making holes, locks, handles, shelves as per drawing, in case of paneling the paneled surfaces only will be measured.

5] In case of furniture only the number will be taken into account. Unless otherwise stated.

6] In case of insulations the actual quantity utilised inside the partition and the paneling will be measured and no wastage will be considered.

7] In case of ceiling only the actual quantity inside the room and the hall will be measured. No extra amounts will be paid for return air additional support overlapping etc.

8] In case of counters only length along centre of service top will be measured in R.ft.

9] In case of paneling to the cupboards below the window niche the installed surfaces will only be considered. It shall be in Sq.ft.

10] In case of sofas each piece will be individually considered however the length of the Sofa will also be considered unless otherwise stated. It shall be in R.ft.

11] The timber sizes mentioned are unfinished sizes. The plywood shall be as per as specified approved company marine ply. The laminates shall be of 1.5 / 1.0 mm thickness & of recommended make. All Aluminum sections shall be Jindal or of approved company or equivalent. The glasses to be used shall be of approved company or equivalent.

12] The paint shall be of approved Company such as Dulux, Goodlass Nerolac, Asian

Paints, Jotun etc., or of approved company as specified in the item.

13] Mode Of Measurements (CIVIL WORKS)

a) Brick Masonry :

The brick walls wider than one brick length shall be priced per unit of cu.mt. And for all brick-on-edge, half brick walls or full brick wide masonry shall be priced per unit of sq.mt.

The measurement shall be their full heights (up to the soffit of the slab or beam as the case may be) , lengths (excluding the columns) and thickness.

Deductions for all opening, recess and lintels shall be made except for the following :

i. such voids and openings which measure less than 1 sqft in area on the surface and also templates, ends of beams, joints etc.

ii. posts and wall plates which do not take up the entire thickness of the walls.

No extra shall be allowed for openings and recesses mentioned in the deductions above. Measurement of brick work in arches including flat arch shall be along with the brick work of specified thickness.

The measurement of all brick cornices, architraves, bands etc. shall be measured in running feet.

The measurement of brick-on-edge coping of specified thickness shall be in sqft. on plan.

No extra shall be allowed for RCC stiffeners as specified in the bills of quantities.

b) Plaster :

Neeru finished and sand faced plaster :

Plastering on brick and concrete surface shall be measured in sqft. of the superficial area plastered.

No extra shall be allowed for beaded, chamfered or rounded arises or curved angles.

No deductions shall be made for opening less than 1 sqft and the measurements of the plastered jambs shall not be added.

Deductions for openings taken on the plastered surface shall be made on both the sides and the plastered jambs added.

The measurement of all cornices, string courses, and such molded work which shall be of sections as per drawing including finish shall be taken in running ft. along with the wall and shall be inclusive of the core.

The rate for plaster work shall include the jari finishing between the skirting tile and the

plaster work, or dado work and the plaster work. No extras shall be allowed for the jari work.

C) Flooring, Skirting, Dado :

The measurements of laying tiles, stones or patent stone to floors and wall dados shall be in the sq.mt. Of actual area covered. Areas less than 1 sqft. shall not be deducted. The measurements of floorings shall be in sq.ft. Taking horizontal measurements between side walls after the completion of the job and measurements of dados shall be in sq.ft. Of the area of the wall covered (length into height).

14] Wall Paneling :

This shall be as per the specifications and shall be measured in sq.ft. Of the actual area covered. The rate shall include wall paneling, its frame work etc.

15) Doors, Windows, Ventilators & Louvers :

Clear width between side jambs and clear height between sill/floor and bottom of lintel/beam shall be measured. Holdfasts or portions embedded in masonry or flooring shall not be measured. The measurements shall be in sqft.

16] Rolling Shutters Rolling Grilles :

Clear width between side jambs and clear height between floor and bottom of lintel/beam shall be measured. Hood shall not be measured separately. The rate should be inclusive of the cost of hood. The measurements shall be in sq.ft.

17] Glazing :

Shall be measured-in sq. ft.

18] False Ceiling :

The false ceiling or suspended ceiling shall be measured in sq.ft. of the total area covered, excluding bearings, it any. The rate to include f or the necessary cradling work and suspension work as mentioned in the Bills of Quantities. Deductions for light fixtures and air-conditioning grills shall not be made.

19) Water Proofing :

i. Toilets :

The measurement of waterproofing to toilet blocks shall be the sum of the area of the floor treated with brick bat coba and waterproofing and the area of the wall treated with only waterproof cement plaster. The measurement shall be in sq.mt.

ii. Terrace Waterproofing :

The measurements of waterproofing including the brick bat coba shall be total area of

the flooring covered. (plan area measured between parapet walls). No extra payment shall be paid for the wata. The measurement shall be in sq. ft.

20] Painting :

All painting work shall be measured in sq. ft. Net area of the surface painted shall be measured. No deductions will be made for unpainted surfaces of ends of joists, beams, posts etc. and openings not exceeding 5 sq. ft. Each and no addition shall be made for reveals, jambs, soffits, sills etc. of these openings. The measurements will be done as per IS standard.

21) Galvalume Sheet Roofing :

Shall be measured in square feet of the actual roof area covered.

22) Measurements Of The Concrete Items:

Plain & Reinforced, Ordinary & Controlled Concrete :

The cement concrete items under various heads shall- be measured in cubic mtrs. To the exact dimensions, as per the drawings or the works executed under the orders of consultants or R.C.C. specialist. The thickness of plaster finishing shall not be taken into account in measurements.

The rate for any particular item shall include Bill. Materials including all the concrete mixed as per the specifications and placing in position and curing the concrete work, including all necessary centering, shuttering and frame work. The steel reinforcement shall be measured and paid for separately.

Concrete shall be measured as executed, no deduction shall be made for the following :

i. Volume of any steel embedded in concrete.
ii. Voids not exceeding 1 sq.ft. In areas measured and 3 cubic feet in volume measurement.

23) Slab & Hollow Tile

i) Slab :

The slab shall be measured in cubic feet. The measurements of slabs shall be the area including bearing, no deductions shall be made for the portion of the slab which forms parts of the beam below (t beam or I beam) or above (inverted beams). The openings less than 1 sq. ft. shall not be deducted. Where the thickness of the slab changes, the length or width of the slab shall be measured from the center of the beam concerned. No extras shall be paid for the cantilever beams.

ii) Hollow Tile :

Shall be measured in sq.ft.

24) Floor Beams :

These shall be measured in cubic feet being the product of :

i) the length between the faces of the supporting beams of columns or the length including bearings.
ii) the breadth of the beam projecting below the s slab and
iii) the height or depth (average if varying) projecting below the underside of the slab.

In case of inverted floor beams the product is of

iv) the length from column face to column face
v) the breadth of the stem projecting above slab and
vi) the height or depth protecting above the top slab.

No extra shall be paid for cantilever beams

25] Lintels :

i. Lintels shall be measured in cubic ft. and shall be the product of length, including the bearings and the cross-sectional area.

ii. Bands :

Concrete bands of specified thickness shall be measured in sq.ft. The width shall be considered including its bearings in the masonry.

26] Steel Reinforcement :

The rates for steel reinforcement at any height shall include for the labour for cutting, hooking, cranking, placing in position and binding with binding wire complete. The rate for steel reinforcement shall include for the binding wire which will not be measured and paid for. Wastage will not be measured and paid for. Authorised overlaps only will be measured and paid for. Reinforcement shall be measured in metric tonne.

The amount of pva on steel will be calculated for the quantity of the steel reinforcement as measured and paid for in the bills for the work without any. Allowance for wastage.

Steel reinforcement shall be measured and paid for on the basis of theoretical standard weights of different sizes of bars, irrespective of actual weight.

The standard sectional weights considered for conversion of length of various sizes of M.S. Bars and tor steel bars into weight are as under:

Size (diameter) mm	weight kg./m.	Size (diameter) mm	weight kg./m.
6	0.222	25	3.855
8	0.395	28	4.836
10	0.617	32	6.316

12	0.888	36	7.994
16	1.579	40	9.869
18	1.999	45	12.490
20	2.467	50	15.424
22	2.985		

26] Structural Steel Work :

As per I.S.I. mode of measurement.

SPECIFICATION REQUIREMENTS –PUF PANEL ROOFING

Scope of work:

a) Removal of existing damaged Asbestos Cement Sheets and galvalume sheet including cladding, ridges, gutters, hips, valleys, etc. as per the directions of Engineer-In-Charge (EIC).

a) Providing and application of painting of purlin with two coats of synthetic enamel over one coat of primer including cleaning with sand papers, removal of dust, rust etc., complete as directed by the Engineer-In-Charge.

b) Providing and fixing pre-fabricated PUF Sandwich Roofing panels comprising of coated galvalume sheets in roof, cladding, gable cladding, including ridges of similar type, corner, curved sheets complete including cutting to size and shape whenever required as per the site condition and as directed by EIC including fixing using J or L hooks GI bolt PVC coated and nut or using self drilling and self tapping fasteners if any site constrains for all slope and height. Contractor to prior get approval from Engineer-In-Charge for sheeting and fixing system before starting up the job.

c) Providing and fixing rigid polycarbonate transparent roof glazing with corrugation similar to steel sheets all complete wherever required as per instruction and as directed by Engineer-In-Charge.

d) Supplying, fabrication & erecting in position structural steel for replacing the corroded members of roof truss, brackets, c clamps and other supporting members complete as directed by Engineer-In-Charge (EIC).

e) Providing rainwater down take pipe including provision of shoe in CM 1:4.

f) Providing plain GI sheets for gutters and bending them as per the existing profile with c clamps, brackets, including provision for outlets, down take spot etc and fixing as directed by Engineer-In-Charge.

g) The scope includes providing and fixing new steel members for replacement the corroded steel members.

Construction equipment:

Contractor to mobilize required resources such as tools, tackles, equipments, manpower etc to carry out the job at work site.

Records:

a) Contractor shall maintain workmen register, attendance register for workers deployed by them for obtaining gate pass for workers.

b) Manufacture data sheet and certificate for materials to be submitted to EIC by contractor before execution of job.

c) Contractor has to submit relevant test certificates for all material makes from govt. I approved laboratories as per the instructions of EIC.

d) Contractor to submit medical fitness certificate for work force for working at height/ fragile roof.

Conditions:

a) Rate shall include material cost, labour cost, all type of tools, tackles, sealant, machinery, equipments, transportation to site etc

b) Contractor to carryout job in sequence, i.e, contractor to complete entire job of sheeting jobs for allotted structure I building and subsequent other structure I building will be given after due completion.

c) No extra claim other than work order BOQ items will be accepted.

d) No minimum quantity is assured for the job.

Code reference:

a) Galvalume sheeting:

i. IS : 277 for galvanised steel
ii. IS : 1367 Technical supply conditions for threaded steel fasteners.
iii. IS 1200 (Part IX) Method of measurement of Civil Engineering Works (Sheeting & Cladding)
iv. IS 14246/ AS 2728 Class 3 for organic coating on metal sheets.
v. AS 566 Class 3 for self tapping and self drilling screws.
vi. AS 1397 steel sheet and strip for Al - Zn alloy coated
vii. ASTM A 792 M steel sheet and strip for Al - Zn alloy coated
viii. IS 15965 : 2012 for Pre Painted Aluminium Zinc Alloy Metallic Coated Steel Strip and Sheet (Plain)
ix. IS IS961 : 2012 for Hot Dip Aluminium Zinc Alloy Metallic Coated Steel Strip and Sheet (Plain)

b) Structural steel:

Mild Steel – Conforming to IS 226/ 432
Approved brand SAIL, RINL, liSCO, TISCO, Essar, Jindal, Vizag

c) Structural steel: Mild steel- Confirming to IS432, IS226
Approved brand SAIL, RINL, liSCO, TISCO, Essar, Jindal, Vizag

d) GI sheet: confirming to IS 277-2003 and as directed by the EIC

e) Poly carbonate sheet - 2mm thick rigid polycarbonate transparent roof glazing sheet.
Approved make GE or Tuffline

f) PVC pipe - conforming to IS 4985. Approved make - Prince, Finolex, Supreme, Jain.

Role of contractor:

a) Contractor shall maintain log book/ daily field report, site order book for all jobs carried out with the manpower records.

b) Contractor to prepare shop drawing for taking up the sheeting job including all sub activities and get approval before starting of job at site.
c) Contractor to submit plan I schedule for execution of job to EIC for approval within 15 days from date of issue of work order.
d) Contractor should deploy one safety supervisor having minimum 3 year experience during execution of job.

e) Site order book consisting of details of manpower, activity etc to be maintained by the contractor at site.
f) Scaffolding, cranes, Equipments, tools, tackles, manpower etc required for the completion of the work to be arranged by the contractor.
g) Contractor to seal the gap using poly sulphide sealant of approved brand as per the directions of EIC.
h) Contractor to execute the job carefully without causing damage to existing installations, electrical cables etc and has to be bring to the notice of EIC immediately, if so happened. Also contractor has to repair and rectify on his own cost.
i) Contractor should test the galvalume sheets, at Government I Approved laboratory and produce the test certificate for parameter such as thickness of member, galvanization coating, yield strength, precoated thickness in both surfaces. Test certificate for GI sheets, fasteners shall be submitted for galvanization coating, yield strength.
j) Dismantled of old fitting and usable items shall be returned to Bank as per the directions of EIC.

GENERAL INSTRODUCTIONS

1.0 SYSTEM DESCRIPTION

a) AIR CONDITIONING & MECHANICAL VENTILATION SYSTEM

The Air Conditioning system is designed as per the latest American Society of Heating, Air Conditioning and Refrigeration Engineers Standards.

Sub-contracting for HVAC works shall be awarded to Original Equipment Manufacturers (OEM).

Based on the data furnished in the Design Basis, for detail capacities refer final GFC drawings & Bill of quantities for Auditorium air-conditioned VRF system. Keeping in mind for energy efficiency, reliable product, consistent temperature maintenance & settings for Critical areas, independent ON/OFF operation and ease installation, it is planned to house Variable Refrigerant Flow System (VRF) for the Auditorium.

Also it is required that the proposed VRF system shall not be having no master/servant concept and the system should made of independent units with multiple compressors, the system will continue to function in case of units breaks down or incase of one inverter compressor malfunction in the module.

All the indoor as well as outdoor units are designed to operate on low sound level for quieter operation and precision air-conditioning. As the air is the medium of heat transfer, these systems shall be hygienically safe for applications of Auditorium. The proposed system should enable to erect & commission in parts.

The proposed system shall have self-diagnosis function detects malfunction in system & displays as type & location to allows servicing operation efficiently.

All necessary hard ware / software required for the above function should be part of selected OEM Contractors scope.

DESIGN REQUIREMENT

Location and climate

The project site is located at Chennai. The ambient conditions & inside conditions to be maintained are as follows:

a) Outside Conditions

Description	Summer	Monsoon
Dry Bulb Temperature	42°C	28.3°C
Wet Bulb Temperature	27. °C	26.7 °C

b) Inside Design Conditions

#	DESCRIPTION	Auditorium
01	Dry Bulb Temperature -Deg C	23 ± 1 Deg C
02	Relative Humidity - %	Not Exceeding 60%

Power supply

Power will be made available at 415 V 3 ph / 230 V single ph, 4 wire, 50 HZ earthed neutral system and all equipment shall be suitable for the above power supply with variation of + / -10 %. All equipment shall operate at this voltage and any equipment operating at other than this Power supply shall be provided with necessary transformer.

Codes, Regulations and Standards

The installation shall conform in all respects to ASHRAE / Indian Standard Code of Practice for Air conditioning Installation, tender specifications and drawings.
In case of discrepancy among specifications, drawings and other documents, the specifications take precedence over all other documents. In case of discrepancy between specification, drawings etc and codes & standards, the tenderer shall assume the more stringent of the two.

3.0 DRAWINGS, SPECIFICATIONS AND DEVIATIONS

The drawings and specifications lay down minimum standards of equipment and workmanship. Should the tenderer wish to depart from the provisions of the specifications and drawings either on account of manufacturing practice or for any other reasons, he should clearly draw attention in his tender to the proposed points of departures and submit such complete information, Drawings and specifications will enable the merits of the deviations to be fully appreciated. In the absence of any such deviation list, it will be deemed that the tenderer is fully satisfied with the intents of the specifications and the drawings and their compliance with the statutory provisions and local codes. All deviations or departures not brought out to the notice shall be disregarded.

4.0 TOOLS AND SPARE PARTS

All the tools and tackles, scaffolding and staging required for erection and assembly of the installation covered by the contract shall be obtained by the contractor himself and shall meet the EHS requirement. All other material such as foundation bolts; nuts etc, required for the installation of the plant shall be supplied

and included in the contract.

5.0 SHOP DRAWING, INSPECTION AND TESTING

5.1 Working and construction drawings

The contractor shall prepare shop drawings and all work shall be according to approved working drawings. Shop drawings shall give all dimensions and shall incorporate the requirements of the Builder/Architects. Approval of drawings does not relieve the contractor of his responsibility to meet the intents of the specifications. All such drawings for approval shall be submitted in 6 copies for Builder/ Architect team. In addition, the contractor shall submit manufacturer's details and get them approved before ordering. This has to be done whether the materials / equipment are one of the approved makes or not.

5.2 Testing and Inspection

The contractor shall carry out tests on different equipment and system in total as specified in various sections of the tender in the presence of Client/Pmc/Consultants in order to enable them to determine whether the plant, equipment and installation in general comply with the specifications. All equipment shall be tested after carrying out the necessary adjustments and balancing to establish equipment ratings and all other design conditions. The test data shall be submitted in Acceptance Test Form.

5.3 Calibration of instruments and meters

The contractor for testing with initial requirements of all consumables shall furnish instruments required for testing. All the instruments, meters etc to be used at site and on the system shall have a valid calibration certificate issued by the competent authority. The contractor shall maintain and make available all such calibration certificates.

5.4 Handing over requirements

The plant shall be handed over after satisfactory testing along with following documents.

- Detailed equipment data in the approved pro-forma Manufacture's maintenance and operating instructions
- Set of as built drawings, layouts, piping, ducting, cable routing, cable schedules etc.
- Approved test readings of all equipment and installations
- Inspection Certificates of approval from statutory or Local Authorities for the operation and maintenance of the installations, wherever such approval or certification is required. This shall include Application filed along with enclosures and receipts of fees paid and deposits made.

- List of recommended spares Certificate from the contractor that he has cleared the site of all debris and litter caused by him without violating the EHS norms during the construction. However, contractor has also to periodically clear the site from all the debris, which are generated from his part of scope. Undertaking that all the materials supplied by him at site are fully tax paid and shall produce all documentation for satisfaction of Builder / Architect or taxation authorities.

Submission of the above documentation shall form a precondition for final acceptance of the plant and installation and final payments.

5.5 Statutory approvals inspection

The contractor shall be fully responsible for meeting all the statutory obligations and local inspectorates wherever applicable to the works carried out by them. The contractor should prepare all working drawings and obtain approval of competent authorities and also have the equipment and installation inspected and got approved.

SCOPE OF WORK FOR HVAC SYSTEM

a) Equipment Supply, Installation, Testing & Commissioning

- Design of the equipment based on the data furnished in the document.
- Procurement of materials within the battery limits as per the schedule given by Builder / Architect
- Manufacturing as per standards & details furnished in the specifications
- Assembly
- Testing in Shop before delivery
- Inspection
- Insurance up to handing over
- Packing & Forwarding Transportation
- Installation at Site as per the schedule given by Project Managers
- Submission of method statements for execution
- Commissioning in the presence of specialized agency (manufacturer's representative) Performance Guarantee run
- Handing over

SCOPE OF SUPPLY

Supply of various equipment as per the relevant Specification & Drawings, unloading, receiving, inspection, storing, transportation to work site, handling, assembling, cleaning, mechanical erection, assisting main contractor in associated civil works which are required for ac system, Installation, alignment, testing and commissioning and handing over in working condition of all items covered below but not limited to it:

a) Indoor & Outdoor units of VRF system
b) Refrigerant pipes to interconnect IDU & ODU with necessary Y joints and headers as per the approved drawing.
c) Control cable/electrical cable if required between IDU and ODU.
d) Necessary valve packages, thermostat and refrigerant charge
e) SITC of complete VRF system for the Auditorium & Dining Rooms.
f) SITC of BMS operation of VRF system as specified in the system.
G) Any other items for successful functioning of the system whether specifically mentioned or not.

a) Associated civil works like drilling and punching holes and openings in concrete floors, slabs, chasing of brick walls, fabrication of supporting structures, drainage of water from cable trenches, cleaning and clearing of all debris like metal pieces, unused ducting, bolts etc due to HVAC installation are to be done by HVAC vendor. HVAC contractor should quantify & provide necessary details to the civil contractor for execution after obtaining the approval on the shop drawing from the consultants. Also the HVAC consultant should intimate the main civil consultant to consider the above quantities during bidding stage.

B) Preparation of execution drawings for approval and as built-in-drawings.

C) The contractor shall produce HVAC work drawings indicating all cutouts to be left open, sleeves to be provided during construction to avoid the breakage/ damage to the civil works.

D) Coordination with other subcontractors with regard to installation of items in Air Conditioning contractors' scope.

E) The water and electricity required for construction, testing and commissioning to be included under the part of scope.

F) The extent of work services under the contract include all items shown on the drawings, indicated in companion with specifications, not withstanding the fact that such items have been omitted from the BOQ. All equipment and services, which are required to complete the intent of the contract, shall also be deemed to be within the scope of the contract.

i. All electrical works related to air conditioning system (except which are listed in the scope) will be in the scope of electrical sub package. All necessary co-ordination required for the Contractor should offer executing the work.

ii. The water and electricity required for construction, testing and commissioning to be included under the part of scope.

iii. All electrical works related to air conditioning system (except which are listed in the scope) will be in the scope of electrical sub package. All necessary co-ordination required for the Contractor should offer executing the work.

iv. The extent of work services under the contract include all items shown on the drawings, indicated in companion with specifications, not withstanding the fact that such items have been omitted from the BOQ. All equipment and services, which are required to complete the intent of the contract, shall also be deemed to be within the scope of the contract.

SECTION –A

SPECIFICATION - Variable Refrigerant Flow SYSTEM WITH REFRIGERANT R410A

SCOPE

The scope of this section comprises the supply, erection testing and commissioning of Variable Refrigerant Flow System conforming to these specifications and in accordance with the requirements of Drawing and Schedule of Quantities

TYPE

The air-conditioning system shall exhibit 'Capacity Control' operating features providing very efficient energy and maximum comfort to the users. The system shall be air-cooled, variable refrigerant system consisting of modular outdoor units and multiple indoor units, each having capability to cool independently.

The system shall be equipped with Variable Refrigerant Flow controller, enable it to reduce minimum load without the aid of hot gas by-pass system.

Any oil traps shall not be required for the refrigerant piping system.

The refrigerant piping between indoor units and outdoor unit shall be extended up to 150m with maximum 50m level difference without any oil traps.

Both indoor units and outdoor unit shall be factory assembled, tested and outdoor units filled with first charge of refrigerant before delivering at site.

OUTDOOR UNIT

The outdoor unit shall be factory assembled, weather proof casing, constructed from heavy gauge mild steel panels and coated with baked enamel finish. The unit should be completely factory wired, tested with all necessary controls and switch gears:

- All outdoor units above 16HP shall have minimum two scroll compressors and be able to operate even in case one of compressor is out of order.
- In case of outdoor units above 28HP (MULTI MODULAR), the outdoor unit shall

have at least
2- inverter compressor so that the operation is not disrupted with failure of any compressor.

- It should also be provided with duty cycling for automatically switching starting sequence of multiple outdoor units/compressors.
- **The VRF/VRV air conditioner shall be selected of Inverter technology based D.C Scroll compressor type with minimum C.O.P of => 6 at 50 % load 43 deg C DBT Ambient temp. & at 27 deg C DBT / 19 deg C WBT inside Temp**
- The noise level shall not be more than 65-69 dB (A) at normal operation measured horizontally
  1m away and 1.5m above ground level.
- The outdoor unit shall be modular in design and should be allowed for side by side installation
- The unit shall be provided with its own microprocessor control panel.
- The ODU's shall have a inbuilt heat sink and oil management systems to ensure system function non- stop till 56 Degree Celcius
- The condenser should be made of factory manufactured additional Anti Corrosion Resistant Aluminimum Fins in additional to hydro filling coating with TUV certificate in compliance with ISO 21207 test method "B" standards. The heat exchangers shall consist of cooper tubing (C1220TS-OL) with thickness 0.27 and aluminium wide louvered fins with thickness 0.1 with mechanical bond with 14FPI
- Refrigerant-cooled heat sink shall inhouse inverter drive to maintain the drive at allowable temperature range
- The copper tubing shall be inner high grooved type. The fins shall have a factory applied additional corrosion resistant coating material and additional hydrophilic coating.
- Even though some Indoor units are failed, others which are connected to same outdoor unit shall be operated continuously & System is safe from Liquid compression by Discharge super heat logic
- VRF Outdoor units shall be tested in a psychrometric Laboratory in accordance with the standard ISO/IEC 17025:2005 "General Requirements for the competence of Testing & Calibration Laboratories" by the National Accreditation Board for Testing and Calibration Laboratories (NABL)
- COP/Technical Specifications under rated test conditions (outdoor) in Accredited NABL & INTERTEK Satellite Certification test Chambers
- All major components of outdoor unit should be of own OEM manufacturers. The spare support minimum of 12-15 years.
- The vendor scope includes factory inspection test in accredited NABL &

INTERTEK Satellite Certification test Chambers of outdoors units with minimum COP of => 6 at 50% load 39 deg. C DBT Ambient temp. & 27 deg. C DBT/19 deg. C WBT inside temp.

The outdoor unit should be fitted with low noise, axial flow fan with large airflow and should be designed to operate compressor-linking technology. The outdoor unit fan should also be capable to deliver 55 Pa external static pressure to meet long exhaust duct connection requirement.

Panel shall be easily removable to provide access for servicing. The condensing unit shall be fitted with its own electrical compartment with all necessary electrical and control components.

-

The condensing unit shall be modular in design and should be allowed for side-to-side installation with provision for piping connection at the front or at the bottom.

The condensing unit shall be designed to operate safely when connected to multiple fan coil units, which have a combined operating nominal capacity up to 130 % of indoor units.

COMPRESSOR

The compressor shall be highly efficient scroll with all inverter type operating on R410a environmental friendly refrigerant (HFC-R410A) and capable of inverter control. It shall change the speed in accordance to the variation in cooling load requirement:

- The inverter shall be IGBT type for efficient and quiet operation.
- All outdoor units shall be designed for automatic capacity control to meet load fluctuation and indoor unit individual control. All parts of compressor shall be sufficiently lubricated stock. Forced lubrication may also be employed.
- Oil heater shall be provided in the compressor casing.

It shall be equipped with Intelligent Power Drive Unit together with Electronic Expansion Valve in the refrigerant circuit to precisely control the refrigerant volume and maintain comfort level in accordance to the Auditorium.

The compressor shall be mounted on the sliding tray to facilitate servicing. It shall be mounted on the springs and shock absorbing rubber to reduce the vibration transmitted onto the casing.

HEAT EXCHANGER

The e-Pass heat exchanger shall be constructed with copper tubes mechanically bonded to aluminum fins to form a cross fin coil.

- The condenser should be made of factory manufactured additional Anti Corrosion Resistant Aluminimum Fins in additional to hydro filling coating with TUV certificate in compliance with ISO 21207 test method "B" standards. The heat exchangers shall consist of cooper tubing (C1220TS-OL) with thickness 0.27 and aluminium wide louvered fins with thickness 0.1 with mechanical bond with 14FPI.

- The unit shall be provided with necessary number of direct driven low noise level propeller type axial flow fans with DC motor arranged for vertical discharge. Each fan shall have an Aero- fitting grille resulting in reduced pressure loss.

Condenser Coil:

The condenser coil shall be constructed with copper tubes mechanically bonded to aluminum fins. The condenser shall have large face area to minimize noise give a high EER for heat transfer. The condensing unit shall be chemically coated with anti-corrosion fins.

Condenser Fan and Motor:

The Condenser fan shall be of multi-blade low speed noise level type and dynamically and statically balanced for minimum noise and vibration. The condenser fan shall be directly coupled and driven by drip proof permanently lubricated motor. The condenser fan and motor shall be able correspond to the heat load changes by stepping up or down according to the load requirements

REFRIGERANT CIRCUIT

The refrigerant circuit shall include an accumulator, liquid, and gas shut off valves, solenoid valves and an electronic expansion valve. All necessary safety devices should be provided to ensure the safety operation of the system.

Accumulator:

The cylindrical accumulator shall be constructed from mild steel plates

pressed into shape. The accumulator shall have sufficient capacity to prevent any liquid refrigerant from flowing back into the compressor suction.

SAFETY DEVICES

All necessary safety devices shall be provided to ensure safe operation of the

system. The following safety devices shall be part of the condensing unit:

— High and Low pressure switch
— Fuses
— Crankcase heater
— Fusible plug
— Over current relay for the compressor
— Thermal protectors for compressor and fan motor
— Recycling guard timer

Oil Recovery system
Over-current sensor

Compressor suction and discharge temperature sensor
Compressor suction and discharge pressure sensor

OIL RECOVERY SYSTEM

Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigeration piping lengths.

ENVIRONMENTALLY AWARE

R410A is a new mixed refrigerant that exhibits superior safety characteristics. Even with zero coefficient of ozone layer depletion, R410A offers a better performance to the conventional R22.

Further lead free PC Boards making its use even more environmentally conscious.
Gal barium, a material that requires no coating, is used for the bottom plate for easy recycling.

INDOOR UNIT

This section deals with supply, installation, testing, commissioning of various type of indoor units confirming to general specification and suitable for the duty selected. The type, capacity and size of indoor units shall be as specified in detailed Bill Of Quantities.

GENERAL

Indoor units shall be either ceiling mounted ductable type or floor standing type or wall mounted type or other as specified in BOQ. These units shall have electronic control valve to control refrigerant flow rate respond to lead variations of the room.

a) The address of the indoor unit shall be set automatically in case of individual

and group control b) In case of centralized control, it shall be set by liquid

crystal remote controller

The fan shall be dual suction, aerodynamically designed turbo, multi blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system. The fan shall be direct driven type, mounted directly on motor shaft having supported from housing.

The cooling coil shall be made out of seamless copper tubes and have continuous aluminum fins. The fins shall be spaced by collars forming an integral part. The tubes shall be staggered in the direction of airflow. The tubes shall be hydraulically/ mechanically expanded for minimum thermal contact resistance with fins. Each coil shall be factory tested at 21kg/sqm air pressure under water.

Unit shall have cleanable type filter fixed to an integrally moulded plastic frame. The filter shall be slide away type and neatly inserted.

Each indoor unit shall have computerized PID control for maintaining design room temperature. Each unit shall be provided with electronic expansion valve & should have microprocessor thermostat for cooling.

Each unit shall be with wired LCD type remote controller. The remote controller shall memorize the latest malfunction code for easy maintenance. The controller shall have self-diagnostic features for easy and quick maintenance and service. The controller shall be able to change fan speed and angle of swing flat individually as per requirement.

Each fan coil unit shall be equipped with a self-diagnosis remote controller and having the features of setting of the room temperature (with digital indicator of room temperature), timer, air discharge direction (for cassette units.)

COOLING COIL

The coil shall be constructed from strong clean copper tubes bonded to aluminum fins suitably spaced to ensure maximum heat transfer. The inlet of the coil shall be exceptional low to ensure quiet operation.

ELECTRONIC REFRIGERATING CONTROL VALVE

An electronic expansion valve shall be factory brazed to the inlet of the coil. It shall modulate the refrigerant volume continuously in respond to load variations of the Auditorium. Thus, maintain a precise constant temperature of +/-0.5 C.

EVAPORATOR FAN

The evaporator fan shall be of the multi-blade type with its performance designed to match the coil performance. The fan shall be statically and dynamically balanced to ensure low noise and vibration free operations. It shall be driven by a permanently lubricated mother and shall operate on 220 to 240 volts single phase 50 cycles.

CONTROL

The system shall be microprocessor controlled to achieve precise room temperature control and minimum power consumption. The controls system shall employ proportional-integral-differential temperature control and shall have an accuracy of +/-0.5 C.

The control wiring is controlled by using 2-core cable, with non-polarity multiplex transmission system
(outdoor to outdoor, outdoor to indoor, indoor to indoor).

In addition, the checking function for connection error of wiring and piping must come standard with the system.

Computerized control shall be used to maintain a correct Auditorium temperature with minimum power consumption. Unit shall be equipped with automatic fan sped and its own 3 speed fan controller, thermostat, LCD indicators.

It also is equipped with a self- diagnosis circuit for easy and quick maintenance and service. It shall also be able to indicate malfunction code

displays.

SOFT START

All condensing units shall be soft-start at to ensure low starting current.

The compressor shall be to start at the minimum load and increased to the required power (refrigerant volume) according to the actual load requirement.

A recycling guard timer shall be provided to prevent the compressor to restart again immediately after it was stopped.

AIR FILTER

Resin net (washable) type air filter shall be provided for under ceiling type, hi-wall type and floor standing type fan coil units. Long life type air filter shall be provided for fan coil unit. The return air filter shall be of approved low velocity cleanable type with the material having the following characteristics:

- Odourless
- Temperature resistant up to a continuous of 85 degree C
- Humidity resistant up to a continuous RH of 95 %

The filter shall be supported in a resin filter frame. The thickness of the filter shall be such that it possess as an efficiency rating of 15 % (AFI) as measured by the atmospheric dust spot test in accordance with JIS B9908.

The air filter shall have a minimum effective life of 2500 hours.

CENTRALIZED TYPE REMOTE (TOUCH SCREEN TYPE/Wifi/PC Monitoring System) CONTROLLER (Option if specified in BOQ)

A multifunctional compact centralized controller shall be provided with the system.

The Graphic Controller must act as an advanced air-conditioning management system to give complete control of VRF air-conditioning Equipment, It should have ease of use for the user through its touch screen, icon display and color LCD display.

It shall be able to control up to 64 groups of indoor units with the following functions:

a) Starting/stopping of Air-conditioned as a zone or group or

individual unit. b) Temperature settling for each indoor unit or zone.

c) Switching between temperature control modes, switching of fan speed and direction of airflow, enabling/disabling of individual remote controller operation.

d) Monitoring of operation status such as operation mode & temperature setting of individual indoor units, maintenance information, and trouble shooting information.

e) Display of air conditioner operation history.

f) Daily management automation through yearly schedule function with possibility of various schedules.

The controller shall have wide screen user-friendly colour LCD display and can be wired by a non- polar 2-wire transmission cable to a distance of 1 km. away from indoor unit.

UNIFIED ON / OFF CONTROLLER (OPTION IF SPECIFIED IN BOQ)

Unified ON/OFF controller shall be supplied as optional accessory.

The controller shall be able to control minimum 15 groups (each group containing maximum 16 indoor units) or 128 nos. of indoor units with the following functions:

a) On/Off as a zone or individual unit.
b) Indication of operation condition of each group. c) Select one of 4 operation modes.

SCHEDULE TIMER (OPTION IF SPECIFIED IN BOQ)

A schedule timer shall be supplied as an optional accessory.

a) The timer shall be able to set operation schedule for all indoors units.
b) The timer shall be able to set 8 pattern of schedule combined with centralized controller.

REFRIGERANT PIPING

All refrigerant piping for the air conditioning system shall be constructed from soft seamless upto
19.1mm and hard drawn copper refrigerant pipes for above 19.1mm with copper fittings and silver- soldered joints. The refrigerant piping arrangements shall be in accordance with good practice within the air conditioning industry, and are to include charging connections, suction line insulation and all other items normally forming part of pr oper refrigerant circuits.

All joints in copper piping shall be sweat joints using low temperature brazing and or silver solder. Before jointing any copper pipe or fittings, its interiors shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints through nitrogen bleeding at 1.0kg/sqcm and Subsequently; it shall be thoroughly blown out using nitrogen.

After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using nitrogen at pressure of 30Kg per sqcm. Pressure shall be maintained in the system for 24 hours. The system shall then be evacuated to minimum vacuum if 700mm hg.

The air-conditioning system supplier shall be design sizes and erect proper interconnections of the complete refrigerant circuit.

The thickness of copper piping shall not be less than 20gauge for pipes upto 19.1mmand
18guage for bigger sizes

The suction line pipe size and the liquid line pipe size shall be selected according to the manufacturers specified outside diameter. All refrigerant pipes shall be properly supported and anchored to the building structure using steel hangers, anchors, brackets and supports which shall be fixed to the building structure by means of inserts or expansion shields of adequate size and number to support the load imposed thereon.

To protect Nitrile rubber insulation of exposed copper piping from degrading due ultra violet rays & atmospheric condition, it shall be covered polyshield coating with atleast two coats of resin and hardener above Nitrile rubber insulation.

Or

Same to be covered with M.S Type / G.I.Type protection tray.

PIPE INSULATION Refrigerant Pipe Insulation

The whole of the liquid and suction refrigerant lines including all fittings, valves and strainer bodies, etc. shall be insulated with 19mm /13 mm thick elastomeric Nitrile rubber as

PVC Drain Pipe Insulation

Drainpipes carrying condensate water shall be insulated with 6 mm thick elastomeric Nitrile rubber insulation.

For proper drainage of condensate, U Trap shall be provided in the drain piping (wherever required). All pipe supports shall be of pre fabricated & pre painted slotted angle supports, properly installed with clamps etc.

e: The vendor is requested to provide/furnish the part load coefficient of performance (COP) of machine at various operating condition climatic conditions

SECTION A.1:

TESTING & COMMISSIONING PROCEDURE FOR VRF SYSTEM WITH REFRIGERANT – R
410A

When installing equipment using R410A refrigerant, there are a number of

standards that must be met: Ester oil is used for R410A (as with R407c)
It's important to work with absolute cleanliness
Brazing must be done with the use of Nitrogen (OFN)
The system must be evacuated thoroughly (triple evacuation)
A strength test in accordance with BS EN378 must be carried out
The system must always be charged in the liquid phase

To ensure problem-free operation of any air-conditioning system, it is crucial to carry out thorough evacuation of the system. During the evacuation any moisture is removed from all of the system components and the pipe work.
The importance of thorough evacuation in any refrigeration system in order to prevent the following harmful effects:

Any non-condensable product left in the system can cause the pressure in the condenser to increase and in turn, the compression temperature to rise.

Moisture will result in adverse reactions in the refrigerant circuit.
The polyester oils used in the R410A refrigeration systems are hydroscopic, which means that they absorb moisture from the air.

To prevent chemical reactions in the system, any moisture must be removed at all costs. Oxygen (air)
reacts with the refrigeration unit oil and can lead to faults such as compressor failure.

To be able to remove moisture from the system it must be evaporated.
The pressure in the pipe work must be reduced to such an extent that the ambient temperature is sufficient to evaporate the moisture.

Essential tips for good evacuation

Before evacuating a system, it is essential to check for any potential leaks. Such leaks may be discovered at brazed or flared joints. Evacuation can only start once the system has been properly pressure tested and found to be completely leak proof.

Leak Testing in 3 steps

Step 1 3.0 bar (N2) - Test for a minimum of 3 minutes
Step 2 15.0 bar (N2) - Test for a minimum of 3 minutes
Step 3 33.3 bar (N2) - Test for a minimum of 24 hours (if using R410A) Triple evacuation in 6 steps

step 1 Evacuate the system to 10 'Torr' from both service valves.
To measure the vacuum a 'Torr gauge' must be used at all times - do not use a system manifold gauge
Step 2 Break the vacuum with OFN to 1 bar
Step 3 Evacuate to 5 'Torr'
Step 4 Repeat Steps 2
Step 5 Evacuate to the lowest pressure that the pump will achieve (2 'Torr' for 1 hour minimum)
Step 6 The rise test must then be carried out for a minimum of 30 minutes

When using copper pipe work

Use only copper pipes with the correct wall thickness -please refer to your usual copper pipe supplier for detail.

Make sure you cut the copper pipe with a proper pipe cutter only. Remove

any burrs with the utmost care.

Make sure that no swarf or other impurities get into the piping. When brazing

make sure that Nitrogen (OFN) is used at all times. Brazed joints must be bare

and clean.

The importance of correct brazing

Brazed joints should only be made using Nitrogen (OFN) as without it carbon deposits are left on the pipe surface. The carbon deposits are then

washed off of the surface of the pipe when the refrigerant is circulated and it then travels with the refrigerant. Carbon deposits can cause the refrigerant and refrigeration unit oil to decompose. This is likely to result in operation defects and warranty will become null and void.

The right tools are required in to enable the refrigeration system to be

properly evacuated and dried. These include:

- R410A Manifold Gauges
- Flaring Tool
- Torque Wrench
- Vacuum Pump
- Refrigerant Weighing Scales

A solid manifold gauge specifically used for R410A. Manifold gauges with sight gauges should never be used due to the higher operating pressures, unless specified for use on R410A.

Nitrogen Pressure Gauge (up to 160 bar)
A higher range Nitrogen Regulator must be used due to the higher pressure testing requirements when strength testing to conform with BS EN378.

Torr Gauge. A Torr gauge to be used to provide an accurate evacuation

level required. Vacuum Pump

A Vacuum pump of sufficient quality and working order to be used to pull the correct vacuum to negate any moisture being present in the system (pump oil needs to be regularly changed). The refrigerant manifold gauges are not suitable for measuring vacuum.

Flaring A suitable Flaring tool to be used so as not to compromise the integrity of the copper when flared. Torque Spanners Torque spanners must be used at all times to tighten flares in accordance with manufacturers guidelines. Oxygen free nitrogen for brazing OFN to be used at all times during brazing to prevent oxidation within the copper pipe work.

Oxygen free nitrogen for strength and leak test OFN to be used for strength and leak testing with the higher-pressure regulator. Refrigerant charging weighing scales any additional refrigerant required for the installed system must be weighed in the liquid phase using charging scales.

Suitable vacuum measuring gauges

To determine accurately the pressure in the system and whether the desired vacuum has been attained, a vacuum or torr meter is indispensable. A professional evacuation requires such an instrument.

To get the best from R410A Use the correct tools

- Adhering to BS EN378
- Strength test to 1.3 x Ps (43 bar)
- Leak test to 1.0 x Ps (33 bar)
- Observe regulations (Health & Safety at work, pressure equipment etc.)
- Use correct copper pipe work with appropriate wall thickness
- Follow good working practice at all times (Nitrogen brazing, proper evacuation, etc.)

TECHNICAL DATA TO BE FILLED-IN BY THE VENDOR(IN EXCEL FORMAT):

General (Outdoor Module)-ODU		
Equipment HP		
Set Model name		
Outdoor Unit Type		
Outdoor Unit Model		
Rated Cooling Capacity		
Actual Cooling capacity @ climate Condition to maintain 23 deg. C indoor temperature		
Power supply		
Refrigerant		
Type & no. of Compressor/Module		
No. of inverter Compressor/Module		
Capacity at @ 43 degree ambient (TR)		
Capacity at nominal conditions(KW)		
Power input (KW) Nominal		
COP at nominal conditions		
IKW / TR at nominal conditions		
Ambient temperature operating range (Min - Max)		
Operating sound – dB (A) – normal mode		
Running Current (A) Power Consumption (kW)		
EER		
Starting Current (A)		
External Dimension (HxWxD) mm		
Total weight (each ODU) Kg		
Compressor		
Type		
Motor output Kw		
Condenser Fan unit		
Fan Type		
Motor output (Kw)		
Air volume (CMH/CFM)		
Sound level (db)		
General (Indoor Unit) IDU		
Model Type		
Model Name		
Cooling capacity		
Power supply		
Running Current (A)		
Power consumption (KW)		

Starting current (A)		
External Dimension (HxWxD) mm		
Total weight Kg		
Fan Type		
Air flow (CMH/CFM)		
Motor (W)		
External Static Pressure		
Sound level (db)		

B) SECTION -2

TECHNICAL SPECIFICATIONS FOR SHEET METAL DUCTING WORKS (FABRICATION AS PER SMACNA STANDARDS)

FABRICATION OF DUCT AS PER SMACNA STANDARDS WITH A PRESSURE OF 500 PA

AIR DISTRIBUTION **SCOPE**

The scope of this section comprises supply fabrication, installation and testing of all sheet metal ducts, supply, installation, testing and balancing of all grilles, registers and diffusers. All to be in accordance with these specifications and the general arrangement shown on the Drawings.

DUCT MATERIALS

Raw Materials

Galvanizing shall be Class VII – light coating of zinc, nominal 120 gm / sqm surface area and Lock Forming Quality prime material alongwith 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 of the following thickness, as indicated below

STANDARD WITH NO INTERMEDIATE BRACING

Rect.	
Ducts G.I.	Duct Section Length 1.2 m (4 ft)

Maximum Duct Size (mm)	Gauge	Joint Type
1-750	24	ROLAMATE
751-1500	22	ROLAMATE
1501-2200	20	ROLAMATE
2201-above	18	ROLAMATE

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.

1. Coil 9Sheet metal in Roll Form) lines 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.
2. 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.

3. All edges to be machine treated using lock formers, flanges and rollers for turning up edges.

DUCT CONSTRUCTION

All ducts shall be fabricated and installed in workmanlike manner, conforming to relevant SMACNA
codes.

a) 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
care should be taken to ensure
that all connecting sections are dimensionally matched to avoid

b) Ducts shall bee straight and smooth on the inside with longitudinal seams shall be airtight and air corners only which shall be either Pittsburgh or snap button as per SMACNA practice, to ensure air tightness.

c) All ducts irrespective of sizes shall have DUCTMATE joints. The internal ends of slop joints shall be in the direction of air flow. Care should bee 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 including insulation within ceiling spaces, visible from air-conditioned areas shall be provided with two coats of mat black finish paint.

d) All ducts, over 750 mm duct size for pressure class 1' / 250 Pa (W.G.) and over 550 mm duct size for pressure class 2"/500 Pa (W.G) shall have transverse joints of ROLAMATE type as specified in Annexure I.

a) 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.

f) 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 angels, of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

g) 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 / 16 Gauge aluminum, thoroughly stiffened with 25 mm x 25 mm 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 45 cm x 45 cm in size.

h) Plenums shall be shop / factory fabricated panel type and assembled at site. Fixing of galvanized angle flanges on duct pieces shall be with rivers heads inside i.e. towards GS sheet and riveting shall be done from outside.

i) Self adhesive Neoprene rubber / UV resistant PVC foam lining 5 mm nominal thickness instead of felt, shall be used between duct flanges and between duct supports in all ducting installation.

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.

a) 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.

b) 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 require area being maintained) all as per the site requirements.

c) 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.

d) All ductwork shall be supported using support system brackets bolted directly on the top corner pieces of ROLAMATE type transverse joints. Threaded rods anchored from the ceiling are fixed to these brackets each having a slot for minor lateral adjustments.

e) 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 2.4 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through 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 ro fully threaded galvanized rods can be screwed into the anchor fasteners.

f) 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.

g) Where ducts pass through brick or masonry openings, it shall be provided with 25 mm thick phenotherm insulation around the duct and totally covered with fire barrier mortar for complete sealing. The cost of the phenotherm shall be part of ducting & shall not be covered separately in BOM. It can also be executed with a layer of neoprene around the ducting

h) All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, air handling units or blower oil 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 10 cm long securely bonded and bolted on both sides. Sleeve shall bee made smooth and the connecting ductwork rigidly held by independent supports on both sides of the flexible connections. The flexible connection shall be suitable for pressure at the point of installation.

i) Duct shall not rest on false ceiling and shall be in level from bottom Taper pieces shall taper from top.

TES :

*1 – SMACNA – Sheet Metal and Air conditioning Contractors National Association Inc – "HVAC Duct
Construction Standards – Metal and Flexible" – 1995, U.S.A.

*2 – Under SMACNA, alternative configurations of the duct gauge and flange system an be used to obtain an equivalent structural rigidity of the duct system. As shown here, the bracing alternative is usually the more time-consuming and but is generally more economical one on a direct cost basis. Contractors will have to determine the optimum choice for themselves.
*3 – Slip-and-Drive (C and S / SS) cleats are generally used for class connectors in most normal comfort cooling applications. The C class flange will be available from March 2002 onwards. A higher class flange can always bee substituted for a lower class (e.g. class "I" for class "H", class "H" for Class "F")

REINFORCEMENT CLASSES FOR ANGLE IRON FLANGES

Under SMACNA – 1995, the approximate Reinforcement Classes for duct assemblies with companion Angle
Iron Flanges are :

REINF. CLASS NEAREST ANGLE IRON SIZE (NOMINAL)-(MM)

F 25 X 25X 3
H 40 X 40 X 3
I 40 X 40 X 6

A completely galvanized system consisting of fully threaded rods and bottom brackets, nuts, washers and anchor bolts conformed to SMACNA and DW 142 standards.

Installation

The duct fabrication and installation shall generally conform to IS 655-1963 or latest edition.

The Contractor shall provide and neatly erect all sheet metal work as shown on drawings or as may be required to arry out the intent of those specifications and drawings and this work shall meet with the approval of the Engineer in all its parts and details. Hanger supports (10 mm min.) shall be fixed to the ceiling through expansion fasteners 2 Nos. for each leg. The anchor fasteners shall be

of approved make.

All necessary allowances and provisions shall bee made by this 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 or plumbing or other pipes or conduits the ducts shall bee transformed, divided or curved to one side, the required area being maintained, all as approved or directed by the Engineer.

All metal work in dead or furred down spaces shall be created in time to occasion no delay to other contractors on the building.
Ducting over furred ceiling shall be supported from the slab above, or from beams. In no case shall the duct be supported from the ceiling hangers or be permitted to rest on a hung ceiling.

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, subject to the approval of the Owner/ Project Managers.

All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees or angle of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

All joints shall be made tight and all interior surfaces shall be smooth. Bends shall be made within raidus not less than one-half of the width of the duct or with scientifically designed interior curved vanes as approved by the Engineer. Two vanes shall be spaced so that the aspect ratio of each of the individual elbows formed by the vanes will be about five to one.

All sheet metal connections, partitions and plenums required to confine the flow of air to and through the filters and fans, shall be constructed from No.18 galvanised iron, thoroughly
stiffened with 25 mm x 255 mm angle iron braces and fitted with all necessary doors as required by the Engineer to give access to all parts of the apparatus. Doors shall not be less than 46 cm
x 71 cm.

Where metal ducts or sleeves terminate in wood work, brick or masonry openings, tight joints shall be made by means of closely fitting heavy flanged collars.

Doors shall be set in ducts and air plenums for access to pipes, dampers, coils, valves, etc.,

Air handling units shall be connected to duct work by inserting a double canvas sleeve air inlet and air outlet. Each sleeve shall be minimum 150 mm long, securely bonded and bolted to duct and units. Each sleeve shall be made smooth and the connecting duct work rigidly held in line with unit inlet or outlet.

All gaskets shall not be non-hardening neoprene, rubber or approved material. The gasket shall be sufficiently thick to withstand compression and shall be adhered to the metal with adhesives. Exact length should be used and cut pieces shall not be accepted.

All M.S. hanger rods and angle frame work shall be given 2 coats of zinc

chromate pains prior to installation. In case the paint is damaged, additional coats shall be applied.

All hangers and supports shall remain free and not enclosed in insulation work.

Duct Silencers

a) Material

The outer casing shall be out of min. 22G galvanized steel in accordance with ASHRAE recommendations for high-pressure rectangular ductwork. Seams shall be lock formed on Pittsburgh lock machine.

Interior elements of silencers shall be out of min. 22 G galvanized perforated steel. The inner side of the perforated sheet shall be backed by R P Tissue to prevent fibre fly over.

Acoustic fill shall be fibre glass (not mineral wool) of density not less than 40 Kg/m2 sufficient to obtain specified acoustic performance and shall be packed under 10% compression to eliminate voids due to vibration and settling. Material shall be inert, vermin and moisture proof.

All material of construction and acoustic fill shall be incombustible as per IS 3144.

Air tight construction shall be provided by use of non-hardening duct sealing compound at site by the air
conditioning contractor. b) Acoustic Performance

Silencer acoustic ratings shall include insertion loss and self-noise power levels and shall meet or exceed minimum performance specified by the Acoustical Consultant. Contractor shall provide computer selection for the silencer supplied at site which indicates db reduction at different octave Band frequency.

a. Aerodynamic Performance

i. Static pressure drop through silencers shall not exceed those listed in the silencer schedule at the indicated air flows.

b. Transitions

Insulation:

Duct work shall be insulted as specified in Section "Insulation".

Testing

a) After completion all duct systems shall be tested for air leakage.

b) The entire air distribution system shall be balanced to supply the air quantities as required in the various regions and rooms to maintain the specified Auditorium conditions. The final balance of air quantities and its temperatures through each grille, register or diffuser shall be tested and recorded as specified in Section – "Test Readings" and submitted to the Project Manager for approval.

c) Upon fabrication of duct, air-balancing shall be done by the contractor without any extra cost. Also leak test to be performed at various locations of duct.

C) SECTION -3

VOLUME CONTROL DAMPERS, AIR TERMINAL DEVICES, FIRE DAMPERS FLEXIBLE DUCTS

VOLUME CONTROL DAMPERS

Provide splitter damper in each supply take-off. Make turning vanes, dampers, deflectors, splitters of same material of ducts. Splitters shall be full depth of branch duct and 1 1/2 times branch width.

Dampers shall be placed in ducts and at every branch of supply or return air duct connection whether or not indicated on the drawings, but shall be provided for the proper volume control and balancing the system.

All duct dampers shall be made out of extruded aluminium channels with roboust construction and tightly fitted. They shall be provided with suitable links, levers and quadrant as required for their proper operation, control or setting to any desired position. Dampers and their operating devices shall be made robust, easily operable and accessible through suitable access doors in the ducts.

Every damper shall have clear indication showing the damper position at all the times. Dampers shall be placed in ducts and at every branch (whether or not indicated on the drawings) for the proper volume control and for balancing the system.

FIRE DAMPERS

Combined Motorized Smoke & Fire dampers with actuators carrying UL 555S Certificate shall be used for this project. The dampers shall be multi leaf Ruskin type. The damper shall consist of outer frame, damper blades, Electro-thermal trip, linkage, actuator & sleeves. The blades & outer frame shall be formed out of 1.6 mm thick GSS.

Under normal conditions, the damper blades shall be held in the open position against spring pressure by a solenoid valve operating on 220V. The damper louvers shall close on a signal from Smoke Detectors / Temperature Sensors.

Each damper shall have its own panel, which will incorporate the following :

- Necessary circuitry required to step down voltage available from UPS or Emergency power supply.
- Status of damper
- Indication in the event of damper closure as to whether closure is due to signal from Smoke sensor or Temperature sensor.

- Provision for transmitting signal to a remote location.

AIR TERMINAL DEVICES GENERAL

Provide Air Terminal Devices of sizes & type as shown in the drawings. All the accessories like adapter box with an extended round collar to connect the flexible duct as shown in the drawings shall be within in the scope of contractor.

All supply and return air grilles and diffusers shall be as per the approved list furnished in the document. Consultants / Project Managers reserves right to choose the best. The grille shall be provided with powder coated paint of approved color. Further, the contractor shall submit a sample of grilles & diffusers for the approval.

MATERIAL

All air terminal devices mentioned in the tender documents / drawings shall be made out of extruded aluminum sections with very high quality finish. Grilles & diffusers shall be of extruded aluminium from hard stock free from pits and spots joints shall be hairline. The colour of powder coated finish shall be as per Owner/Project Managers approval.

SIZING

Grilles / Diffusers shall be sized within limits of sound pressure level NC-32 curve as a typical room having average room attenuation of 8 dB.

CONSTRUCTION

All supply air diffusers shall be of Powder coated extruded aluminium sections and removable core type. Volume control dampers shall be provided for all diffusers.

Return air diffusers shall be identical to supply air diffusers except that they do not incorporate volume control dampers.

Supply air grilles shall be double deflection type & of Powder coated extruded aluminium construction. They shall be complete with Volume control dampers of aluminium mounted directly on grilles. The vanes at the front shall be horizontal while those at the rear shall be vertical. The width of the perimeter flanges shall be 32 mm. The vanes shall be 3 mm thick and 25 mm deep.

Return air grilles shall also be Powder coated extruded aluminium construction. They shall incorporate horizontal vanes, which shall be fixed. The perimeter flanges shall be 32-mm width. The vanes shall be 3 mm thick and 25 mm deep. The pitch of vanes shall be 20 mm.

D) SECTION -4

THERMAL INSULATION

MATERIAL

For Thermal Insulation for ducts, acoustic insulation (duct liner) & under slab ir

proposed to use Armaflex / Eurobatex (no alternative makes are acceptable) make closed cell
elastomeric foam structure flexible thermal & acoustic insulation.

QUALITY CONTROL

The Contractor shall ensure that samples of all forms of insulation material to be installed are submitted to the Owner/ Project Managers for the approval within 30 days from the date of issue of letter of intent. The Owner/ Project Managers shall have the right to reject all subsequent supplies that do not conform to the approved samples.

THICKNESS

Sheet Metal Ducting:-

Ø Refer Drawings/BOQ

REFER RELEVANT DRAWINGS FOR FURTHER DETAILS ON INSULATION.

INSTALLATION

The Contractor shall ensure that all insulation on piping and equipement is applied only after the system has been pressure tested satisfactorily. Care shall be taken to apply the insulation in such a manner as to allow the dismantling of pumps without damaging the insulation.

For elbow and bends, the semi-cylindrical sections of the insulation material shall be cut into tapered segments and applied.

INSTALLATION PROCEDURE

The Contractor shall ensure that the insulation shall be applied as follows:

Ø Refer Drawings.

ACOUSTIC LINING

Duct liner (Insulation) of specified thickness of Elastromeric rubber insulation of class "o type manufactured as per ASTM E 84 test & which should also meet Elastromeric rubber insulation of class "o" NFPA 90A supplementary materials for air distribution system which should not absorbs less 0.2% water by volume (ASTM c 209), should not support microbial growth (ASTM C1071, G21, G22) and should emit objectionable odors (ASTM C 665) and should have thermal conductivity of
0.27 (R - 2.78 in 3.4" thickness) and water vapor permeance of 0.10.

Incidental Services

On site Comprehensive Warranty:

- 1 Years (12 months) from Installation & Commissioning and date of acceptance
- Down-time call attendance should be within 48 hours.
- In case the Equipment / System remains non-operational for more than 7 days then warranty period will be extended for the equivalent period for which Equipment / System remained nonoperational. Warranty extension in such case shall be done without prejudice to any other Term & condition of the contract.

Commercial evaluation of bid.

The bidder is free to quote. However, any partial quotation of work will be treated as incomplete, which will be liable for rejection. The commercial bids price will be compared and awarded accordingly. The total price including 3 years CMC (comprehensive maintenance contract after expiry of success full completion of 1 Year warranty) will be considered for evaluation of the lowest price. The bidder should also quote for all incidental services. The bid will be commercially evaluated and identified as lowest, as per the scope of works specified in the work.

- The layout plan of area to be air-conditioned is enclosed.

- No other drawings shall be made available. The contractor / vendor shall visit the site and discuss with the Engineer-in-charge for any other details that he may need before submitting the offer.

- The enclosed drawings represent existing air distribution duct layout. This arrangement can be changed / rearranged as per site / architectural requirements in consultation with prior approval of Engineer-in-charge.

- These are not working drawings. The vendor shall prepare detailed working drawings & execute the work as per working drawings approved by the Engineer-in-charge.

- All the measurable quantities of items will be measured as per the final design and as per actuals at the time of execution as per the site requirement.

Inspection & Tests

- The Supplier shall at its own expense and at no cost to the Purchaser carry out all such tests and/or inspections of the Goods and Related Services as are specified here. The Supplier shall at its own expense and at no cost to the Bank carry out all such tests and/or inspections of the Goods and Related Services.
- The inspections and tests may be conducted on the premises of the Supplier or its subcontractor(s), at the point of delivery and/or at the Goods final destination. If conducted on the premises of the Supplier or its subcontractor(s), all reasonable facilities and assistance, including access to drawings and production data - shall be furnished to the inspectors at no charge to the Bank.
- Whenever the Supplier is ready to carry out any such test and inspection, it shall give a reasonable advance notice, including the place and time, to the Purchaser. The Supplier shall obtain from any relevant third party or manufacturer any necessary permission or consent to enable the Purchaser or its designated representative to attend the test and/or inspection.
- The Bank or its representative shall have the right to inspect and/or to test the Goods to confirm their conformity to the Contract specifications at no extra cost to the Bank and what inspections and tests the Bank requires and where they are to be conducted. The Bank shall notify the Supplier in writing in a timely manner of the identity of any representatives retained for these purposes.
- Should any inspected or tested Goods fail to conform to the specifications, the purchaser may reject the goods and the Supplier shall either replace the rejected Goods or make alterations necessary to meet specification requirements free of cost to the Purchaser.
- The Purchaser's right to inspect, test and, where necessary, reject the Goods after the Goods' arrival at final destination shall in no way be limited or waived by reason of the Goods having previously been inspected, tested and passed by the Purchaser or its representative prior to the Goods shipment.

Installation, Commissioning & Acceptance Tests

The acceptance test will be conducted by the Purchaser, their consultant or other such person nominated by the Purchaser at its option after the equipment is installed at Purchaser's site in the presence of supplier's representatives. The acceptance will involve trouble free operation. There shall not be any additional charges for carrying out acceptance test. No malfunction, partial or complete failure of any part of the equipment is expected to occur. The Supplier shall maintain necessary log in respect of the result of the test to establish to the entire satisfaction of the Purchaser, the successful completion of the test specified.

In the event of the ordered item failing to pass the acceptance test, a period not exceeding two weeks will be given to rectify the defects and clear the acceptance test, failing which, the Purchaser reserve the right to get the equipment replaced by the Supplier at no extra cost to the Purchaser.

Successful conduct and conclusion of the acceptance test for the installed goods and equipment shall also be the responsibility and at the cost of the Supplier.

Training

1)	Location	IMAGE Indian Bank Training Centre, MRC Nagar, Chennai
2)	Number of persons	4 person
3)	Period of Training	2 days
4)	Nature of Training	Operation, maintenance & trouble shooting

GENERAL SPECIFICATION REQUIREMENTS - ELECTRICAL

1. GENERAL:

Withstanding the definition of wiring in I.E.E. regulations, or elsewhere, wiring shall so far this contract is concerned, include all work items / accessories in the complete wiring circuit from tapping the point in the sub main or distribution board to the following:

The switch /ceiling rose or connector / socket outlet / bell push / bookplate / call bells, buzzers.

i) The following shall be deemed to be included in the point wiring:

1. Circuit wiring from the relevant distribution board.

2. Switch and ceiling rose / connector

3. Wire as required up to lamp holder in the case of wall brackets, bulk circles and all other fittings, fan regulators and looping inside switch boards.

4. Bushed FRLS conduit of suitable size where cables pass through walls and ceiling below ceiling level to 1.5M above upper floor level.

5. Earth wire from 3 pin socket to the respective distribution board.

6. Continuous run of earth wire on complete lighting, fan wiring, to respective distribution board.

7. All wood or metal boards and boxes, sunk or surface type including those required for mounting fan regulators and switches (excluding those under distribution boards and main control switches)

8. Round blocks for housing connectors / ceiling rose.

9. All fixing accessories such as clips, nails, screws, or rawl plugs, wooden plugs etc., as required.

ii). SIZES OF WIRES:

All wires shall be FRLS insulated single core copper stranded conductor as specified and shall be 690 / 1100 V grade. The smallest conductors for lighting and circuits shall be 1.5 Sq. mm. and 2.5 Sq. mm. of copper respectively using the following colour codes as per standard practices.

Phase - 1	Phase - 2	Phase - 3	Neutral	Earth
R	Y	B	N	
Red	Yellow	Blue	Black	Green.

iii). FITTINGS WIRES:

The use of fittings wires shall be restricted to the internal wiring of light fittings. The sub circuit leads shall terminate in ceiling roses or connectors from which they will be carried into the fittings.

iv). Connections to the switches, sockets etc., wherever possible shall be through crimped pin type plugs.

(v). FLEXIBLE CORDS:

For sort connections to appliances, fans and pendants shall be 250 / 440 V grade (3 or 4 core) with tinned copper wires, insulated, twisted and sheathed with strengthening cord The colour of sheath shall be to Architect's approval.

2. WIRING IN CONDUITS: [FOR EXTERNAL WORK UNDER SUSPENDED CONDITIONS ONLY]

2.1. CONDUITS

a) Rigid steel conduits shall be of heavy gauge welded black enamelled of 16 SWG sheet up to 40mm dia. and 16SWG sheet above 40mm dia. with threaded / screwed type accessories and when laid shall free from edges and burrs.

b) All rigid non-metallic conduits shall confirm to IS 2509 / 1973 & IS 9537 (part3) / 1983 either threaded or plain type and shall be used with corresponding accessories.

2.2. SIZES:

Shall be selected in accordance with IS codes depending upon the size and number sizes to be drawn, the minimum dia. being 19mm / 20mm.

2.3. JOINTS IN CONDUITS:

Conduit pipe shall be joined by means of screwed couplers and screwed accessories only. In long straight runs of conduit inspection type of couplers (for surface conduits) or running threads with couplers and jam nuts with bared threaded portion suitably protected by anti-corrosive paint shall be provided. Threading shall in all cases be sufficiently long enough [from 11mm to 27mm] long to accommodate pipes to full threaded portions of couplers or accessories. Cut ends of conduits pipes shall have no sharp edges nor any buffers left, to avoid damage to the insulations of conductors while pulling them

through such pipes and all such ends shall be neatly protected by approved bushes of proper size, of P.V.C. or of well seasoned TW, painted or of porcelain, bakelite or rubber.

2.4. PVC CONDUIT CONNECTIONS: [ALL OTHER CONCEALED WORKS ARE WITH PVC CONDUITS]

PVC conduits shall be joined by means of screwed or plain couplers depending on whether the conduits are screwed or plain. Where there are long runs of straight conduit, inspection boxes shall be provided at intervals as approved by the Architect. The threads of pipe and sockets shall be free from grease and oil and shall be thoroughly cleaned before making the screwed / plain joints. Proper jointing materials as recommended by manufacturers of these conduits shall be used for jointing of PVC pipes. Use PVC couplers and connectors for PVC pipe connections and terminations in boxes. All the joints shall be watertight.

Junction boxes and running joints shall be provided at suitable places to allow for subsequent extensions if any, without undue dismantling of conduit system. Diagonal run of conduits shall be avoided as far as possible. Junction between conduit and adaptable boxes, back outlet boxes, switch boxes and the like must be provided with entry spouts and smooth FRLS bushes. Joints between conduits and iron clad distribution boards and control gear shall be effected by means of conduit couplers into each of which will be coupled smooth FRLS bush from the inside of box or case. Conduit system shall be erect and straight as far as possible. Traps where water may accumulate from condensation are to be avoided, and where unavoidable suitable provision for draining the water shall be made. All jointing methods shall be subject to the approval of Architects.

Separate conduits shall be provided for the following system.

1. 16 Amps Power outlets for, heaters, refrigerators and such appliances and 25A metal clad 3 PIN Socket controlled by 25A DP MCB for Air-conditioners.
2. 6 Amps outlets and lighting system
3. Fire alarm system / Telephone system
4. Equipment wiring

2.5. BENDS IN CONDUIT:

Wherever necessary, bends or diversions may be achieved by means of bends / or circular inspection boxes with adequate and suitable inlet and outlet screwed joints. In case of recessed system, each junction box shall be properly secured and flush with the finished wall surface, so that the conductors inside the conduits are easily accessible. No bends shall have reading less than 2 1/2 times the outside diameter of the conduit. Heat may be used to soften the FRLS the conduit for bending. Caution should be exercised in using the PVC conduits in location where ambient temperature is 50 Celsius or above. Use of PVC conduit in places where ambient temperature is 60 Celsius or above is prohibited.

PVC conduits shall not be used in outdoor exposed system. G.I. pipe conduits shall be used for outdoor system.

2.6. FIXING OF CONDUITS:

Conduits and junction boxes shall be kept in position while the walls, slabs and floors are under construction/ renovation and proper hold-fasts shall be provided. Conduits shall be so arranged as to facilitate easy drawing of wires though them. Adequate junction boxes of approved shape and size shall be provided. Where conduits cross expansion joints in the building, adequate devices shall be used to take care of any relative movement. All conduits shall be installed in such a manner that no damage occurs due to other pipe net works. A conduit shall not come in contact with any wooden members unless otherwise specified. Conduit stubs in floors / slabs shall be kept as short as possible above the finished floor level in order to avoid any damage on them. After conduits, junction boxes, outlet boxes, and switch boxes are installed in position, their outlets shall be properly plugged or covered so that water, mortar, insects or any other foreign matter does not enter into the conduit system.

Exposed conduits shall be fixed by means of space bar saddle at intervals not more than 1000mm in normal and 500mm from both sides of fitting or accessories. The saddles shall be of 3 mm X 19 mm galvanized mild steel flat, properly treated with primer and painted, securely fixed to support by means of nuts and bolts and brass machined screws as required. Conduits shall be laid in a neat and organized manner as directed and approved by the Architect.

Conduit runs shall be planned so as not to conflict with any other service pipes lines / ducts.

Where exposed conduits are suspended from the structure they shall be clamped firmly and rigidly to the hangers of design to be approved by the Architect. Where hangers are to be anchored to reinforced concrete members, appropriate inserts and necessary devices for their fixing shall be left in position at the time of concreting. Making holes or openings in the concrete will generally not be allowed. In case of unavoidable situations prior permission of the Architect shall be obtained.

Conduits in chases shall be avoided. Where unavoidable, conduits shall be fixed in chases by means of staples not more than 600 mm apart and the chase filled with cement mortar 1:4. Cutting of horizontal chases in walls is prohibited.

2.7. PROTECTION:

To minimize condensation or sweating inside the conduit pipes, all outlets of conduits system shall be adequately ventilated as directed and approved by Architect. All screwed and socketed connections shall be adequately made fully water tight by the use of proper jointing materials i.e. 'Tropolin' for PVC conduit and white lead for metal conduit.

2.8. OUTLETS:

All outlets for fittings, switches etc., shall be boxes of suitable metal of 'surface or flush' mounting type. Wall thickness shall not be less than of 16g covered with a sheet 1/8" (3mm) thick perfect or 3mm thick decorative laminated hylam as may be specified, in front giving minimum clear depth of 75mm. All MS boxes, irrespective of sizes, shall have a fully threaded stud welded inside, for earth

termination.

2.9. CONDUCTORS:

All Conductors used in conduit wiring shall unless otherwise specified be stranded. No single core cable of nominal cross-sectional area greater than 16 sq. mm. shall be enclosed alone in a conduit and used for alternating current.

2.10. INSPECTION BOXES:

Suitable inspection boxes, with ventilating holes in the covers shall be provided in a conduit wiring, at spacing not more than 12 meters apart or two solid 90 degree bends or equal to permit periodical inspection and facilitating removal of wires if necessary.

2.11. ERECTION AND EARTHING OF CONDUIT:

The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested for mechanical and electrical continuity throughout and permanently connected to earth confirming to the requirements specified under section 12 (below). Earthing by means of special approved type earthing clamps efficiently fastened to conduit pipe in a workman like manner for perfect continuity between each wire. And conduits crossing gas or water pipes, and others, which are liable to mechanical damage, they shall be adequately protected.

2.12. GUIDE WIRE:

Suitable fish or pull wire shall be drawn in all conduit before they are embedded. Steel conduits, even if galvanized, run in under-floor screed shall be painted with a heavy coat of emulsified bitumen.

3.0. WIRING IN CONCEALED CONDUIT

3.1. Conduits buried in concrete in structure shall be put in position and securely fastened to the reinforcement and the system got approved by the Architect / Structural Project Management Consultant before the concrete is poured. Proper care shall be taken to ensure that the conduits are neither dislocated nor choked at the time of pouring concrete. Suitable fish or pull wire shall be drawn in all conduits before they are embedded.

3.2. MAKING OF CHASE:

The Chase in the wall is neatly made and be of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of building under renovation, chase shall be provided in the wall, ceiling, etc., at the time of renovation and shall be filled up neatly after erection of conduit and brought to the original finish of the wall, ceiling etc.

3.3. The conduit pipe shall be fixed by means of staples or saddles not more than 500mm apart. Fixing of standard bends or elbow shall be avoided as far practicable and all curves maintained by bending the conduit pipe itself with

radius long enough to permit easy drawing in of conductors. All threaded joints of conduit shall be treated with approved preservative compound to secure protection against rust.

3.4. INSPECTION BOXES:

Suitable inspection boxes shall be provided as at 9.2 (Flush mounted).

3.5. TYPES OF ACCESSORIES TO BE USED:

All outlets such as switches, wall sockets, etc. may be either flush or of surface mounting type.

3.6. The outlets box shall be same as in Clause 9.2 ante and shall be mounted with the wall. The metal box shall be efficiently earthed with conduit by the stud vide 9.2.

4.0. WIRING IN SURFACE CONDUITS:

4.1. Conduit pipes shall be fixed on the approved heavy gauge metal saddles, Properly secured to walls or ceilings through suitable teakwood plugs (or other approved varieties) with round or cheese circle screws for rust proof material, at intervals of not more than 500 mm on straight runs, with saddles not more than 300 mm on either side of couplers or bends or similar fittings, from such fittings. The conduits shall be run neatly parallel or at right angles to walls and painted in different colours to distinguish light, power and telephone lines. Inspection boxes shall be provided as at.

6.0. ARMOURED AND UN-ARMOURED PVC CABLE ON SURFACE:

a) This system of wiring is suitable for providing sub-mains for low / medium voltage installation. All such cables used shall confirm to the relevant I.S. Specification.

b) FIXING ON WALL / CEILING:

PVC insulated, steel tape or wire armoured and FRLS-sheathed cable on walls, ceiling etc., shall be run on proper wooden / MS cleats with GI saddles placed at such distance apart as to neatly and adequately support the cable all along the run. The wooden cleats shall be secured on the wall / ceiling by flat circle screws to rawl / Phil plugs.

c) PASSING THROUGH WALL:

A teakwood box or extending through the whole thickness of the wall shall be buried in the wall and the cable shall be carried so as to allow 12mm clear space on the three sides of the cable or the cable shall carried in an approved bush of well seasoned teakwood duly painted, or other approved material. The cable shall in no case be buried directly in masonry or plaster.

d) LAYING:

The cables shall be uncoiled from the drum and laid in straight length so as to

avoid sharp bends, turns or twists on the conductor. The cables should be laid along wall / ceiling in the best workman like manner, so as to give a neat appearance. Excessive sharp bends to the cable shall be avoided.

e) STRIPPING OF OUTER COVERING:

While cutting and stripping the outer covering of the cables, care shall be taken to see that the sharp edge of cutting instrument does not damage the FRLS insulation of the conductors. The insulation shall be stripped off near the connection terminals as far as possible taking care again to see that the conductor is not damaged.

f) END TERMINATION:

The connecting terminals of the armoured and Un-armoured cable shall be terminated on the iron clad main switch / distribution board etc., by using proper size brass / alloy supporting glands. In case of armoured cables, the armoured cables shall be supported into the gland and connected to the earth as per standard / conventional practice. Terminations at both ends shall be made with cable lugs.

7.0. EARTHING:

a) Except for equipment provided with double insulation, all non-current carrying metal parts of electrical installations are to be earthed properly. All metal conduits, cable sheaths, switchgear, distribution fuse boards, etc., shall be bonded together and connected to an efficient earth electrode.

Medium Voltage energy consuming plant and equipment shall have two separate and distinct connections to the earth.

In the case of MV /L T panels, 2 nos. of earth bus bars of copper or aluminium of suitable section shall be run on the back side of the panel and earth bus bars and the individual switches shall be interconnected by means of copper or 01 wire of suitable gauge as specified.

b) EARTHING CONDUCTOR:

Earthing conductor shall be of higher conductivity copper or Al or any other suitable approved material to give equivalent conductivity and shall not less than half the largest current carrying conductor or 14 SWO (7 / 00.029) but subject to an upper limit of 65 sq.mm. For equipment exceeding 750 KVA the size shall be as per IS.1886-1961.

c) INSTALLATION:

The buried earthing leads will be protected from mechanical injury by 12mm Al pipe recessed in wall and floor where considered necessary and 'carried up to the earth electrode. It shall be fixed over its entire length with clamps, saddles, staples, etc. The earthing lead shall be securely bolted and soldered to the electrode with bolts and washer of the base metal. The earthing lead shall be securely connected at the other end to the main board and all its mountings and looped to all other iron clad switches and distribution boards.

d) ELECTRODE:

The construction of earth electrode shall be in accordance with relevant IS code. The electrode shall be surrounded by alternate layers of charcoal or coke and salt. Watering arrangement with 40mm GI pipe and funnel shall be provided, the latter being housed in chamber of inner size 450 mm X 450 mm. The resistance of earth electrode shall not exceed 1 Ohms; that of each continuity path from any point with electrode shall not exceed 1 0hm and that of earthing connection 0.1 Ohm.

8.0. UNDERGROUND CABLES:

a) HIGH / MEDIUM / LOW TENSION:

Cables should be double tape / wire armoured over lead covering and XLPE as specified in the schedule of work. All joints of cables should be in joint boxes and filling in of the compound shall be done as per IS specifications using best quality of materials. In case of the FRLS insulted armoured cables, joining will be done with approved quick setting epoxy compound with suitable jointing kit. The jointing work should be carried out by a competent authorized cable jointer.

b) TRENCH:

All underground cables shall be laid in suitable trenches which shall not be less than 450mm wide and 750 mm below ground level in the case M.V. and L.T. And 1200 mm below ground level in the case of H.T. Wherever necessary suitable propping and shoring shall be done to avoid caving in of the adjoining walls. Where the cables cross other services lines such as water / sewer lines or drains through walls into buildings, adequate protection should be made to prevent accidental exposure and / or damage to the cables.

c) SPACING BETWEEN CABLES:

Where more than one cable is laid in the same trench the actual space between the cables should be normally be 250 mm apart leaving a clear distance of 150 mm from the cable and the trench walls.

d) LAYING OF CABLES:

Before the cables are laid, a 75mm layer of sand base is to be provided for cushioning. The cables after being uncoiled from the rollers, and before laid into a trench, should be drawn in straight length. After the cable is laid a 230mm wide duct is to be formed with two well burnt brick laid on the edge one on either side of the cable and bridged by a well burnt brick laid flat on the top supporting bricks on edge, with sand filled in and around the cable. The trench is then filled with excavated earth, laid in layers, watered and consolidated, the surplus earth being disposed off.

Cable markers with 3mm thick plates of suitable size, with 40mm X 40mm X 6mm supporting vertical MS angle iron welded to plate duly painted in two coats, for protection against corrosion, or with 50mm thick RCC slab of suitable size, making done with details of cables and depths at which cables are laid, duly painted on them, shall be provided at ground level after being suitably embedded in cement concrete (I :3:6) blocks of 200mm X 200mm X 200mm and spaced at distances of about 30 mts. Centre to centre and in every change in

direction.

When more than one cable is to be laid, the width of the trench will be suitably increased and cables laid side by side confirming to specifications as above. In such case there shall be a separate brick duct for every cable. In case the cables cannot be laid side by side at one level they may be laid in tier formation in same trench. In this case, after the first 75mm of sand cushioning, the first tier of cable is laid and sand filled in the trench for full width to form a bed of 230 mm above this tier. After this, second cable is laid and the process repeated the top most tier being at least 450 mm below the ground level. The top cable shall be suitable covered with bricks as detailed for the single tier above. When laying with cables, care should be taken to see that the paper insulated cables are bent, straightened slowly, sharp radius being avoided. The minimum safe bending radius for single core cable is 20 diameters, and for multi core cables 10 diameters. and for armoured cable 12 diameters, the diameter being the overall diameter of the cable. Where the cables are required to cross the roads water / sewer lines etc., they should normally be taken through pipe sleeves at least 100mm in diameter, which may either of stoneware, steel or spun reinforced concrete. For more than one cable the diameter should not be less than 150 mm. Steel pipe shall be used where it is not possible to obtain sufficient depth to withstand impact from traffic.

e) Rate for cables shall include costs for all operations described above unless otherwise separately provided for elsewhere.

f) CABLE INSIDE BUILDING:

Cable laid inside the building should be properly protected and be carried either in ducts with suitable covers of slabs or chequered plates or fixed to walls by clamps, brackets or cable trays.

g) TESTING OF CABLES:

High voltage tests should be undertaken to ensure that no damage has occurred during the laying operation and that the joints are in order. Cable of 1.1 K V suitable for low and medium voltage should withstand for 15 minutes, 3,000 volts Direct Current applied between the conductor and sheath. In the absence of high pressure testing equipment it is sufficient to test for 1 minute with 1000 volts. If the test results are to be found not satisfactory, the Contractor shall arrange for having this set right at his cost, including removal of rejected materials, relaying etc.

9.0. RECEPTION AND DISTRIBUTION OF MAIN SUPPLY:

9.1. SWITCH CONTROL AT POINT OF COMMENCEMENT OF SUPPLY:

9.1.1. There shall be a circuit breaker or a linked switch on each live conductor of the supply of mains at the point of entry. The wiring through the installation shall be such that there is no breakage in the neutral wire in the form of a switch or fuse unit. The neutral shall also be distinctly marked as provided in the Indian Electricity Rules 1956.

9.1.2. The main switch gears shall be easily accessible and shall be situated as near as practicable to the termination of service line.

9.1.3. On the main switch gear, where the conductors include an earthed conductor of two wire system or an earthed conductor of two wire system or an earthed neutral conductor of a multi-wire system or a conductor which is to be connected there to an indication of a permanent nature shall be provided to identify the earthed neutral conductor in accordance with the Indian Electricity Rules 1956.

9.2.1. LOCATION:

a) Open type switch boards shall placed only in dry situations and in well ventilated rooms and they shall not be placed in the vicinity of storage batteries and exposure to chemical fumes.

b) In a damp situation, or where inflammable or explosive, dust, vapour, or gas, is to likely to be present the switch boards shall be totally enclosed or made flame proof as may be necessary in the particular circumstances.

c) A switch board shall be installed so that its bottom is 1250mm above a floor, unless the front of the switch board is located in a position to which only authorized persons have access.

d) Switch boards shall not be erected above gas stoves or sinks or within 2500mm of any washing unit in the washing rooms of laundries, or in bathrooms, lavatories, or kitchen or toilets.

e) Switch boards if unavoidably fixed in places likely to be exposed to weather, water or abnormally moist atmosphere, outer casing shall be provided with glands or bushings or adapters to receive screwed conduits according to the manner in which cables are run.

9.2.2. MOUNTING:

Iron / metal clad switch gear shall be preferably be mounted on any of the following boards:

a) HINGED TYPE METAL BOARDS:

For small switchboards for mounting iron / metal clad switch / gear metal board shall be used. Metal board shall consist of a box made of metal sheet of less than of 16g. thickness and shall be provided with a hinged cover to enable the board to be swung open for the examination of the wiring at the back. The joints shall be welded. The boards shall be securely fixed to the wall by means of rag bolts and shall be provided with locking arrangements and earthing stud. Al wires passing through the metal board shall be properly bussed. Alternatively, metals boards may be made of suitable size or channel iron frame work suitably mounted on front with 3mm thick MS plates and on back with 1.588 mm MS sheet. In the case of PVC sheathed system of wiring, the top and bottom members may be replaced by 25.4mm teakwood batten. Except for the above change all other details shall be applicable for the alternative also. Besides, the front sheet shall be provided with suitable hinges.

There shall be a clear distance of 31.75 mm between the front sheet shall be provided with suitable hinges.
A teakwood board of thickness not less than 6 mm will be provided at the back, if so specified.

b) FIXED-TYPE METAL BOARDS:

These shall consist of angle or channel iron frame fixed on the wall or on the floor. There shall be clear distance of 1000mm in front of the switchboard. A working distance of 1000 mm behind the switchboard is preferable. If there is any attachment of bare connections at the back of the switchboard, Rule 51 (1) c of Indian Electricity Rules, 1956 shall apply. The detailed dimensions and design of metal boards and angle iron frame work for switch gears, including the position of the various mountings, which shall be symmetrically and neatly arranged for arriving at the overall dimensions shall be prepared and submitted before hand and shall have been prior approval of the Architects.

9.2.3. Where so specified in the schedule of quantities or elsewhere switch boards shall be recessed into the wall with front fitted with hinged panel of 16 guage M.S. Sheet or 3mm thick decorative laminated Hylam Sheet in M.S. angle iron frame with locking arrangement, the outer surface of the doors being flush with the walls. Ample room shall be provided at the back for connection and at the front between the switchgear mountings and the door. Steel work shall be painted one coat with synthetic enamel paint of approved make and colour over an anti-corrosive primer.

9.2.4. ARRANGEMENT OF APPARATUS / MOUNTINGS:

a) Equipment which is on the front of a switch Board shall be arranged that an inadvertent personal contact with live parts is unlikely during tier manipulation of switches, changing of fuses or like operations.

b) No apparatus shall be project beyond any edge of the panel. No fuse body shall be mounted within 25mm of any edge of the panel and no holes other than the holes by means of which the panel is fixed shall be drilled closer than 12mm from any edge of the panel.

c) Various live parts, unless they are effectively screened by substantial barrier of non-hygroscopic non-inflammable insulating materials shall so spaced that an arc cannot be developed and maintained between such parts and earth.

d) The arrangement of the apparatus shall be such that they shall be readily accessible and their connections to all instruments and apparatus shall be easily traceable.

e) In every case in which switches and fuses are fitted on the same pole, the fuses shall be so arranged that they cannot be live when their respective switches are in ' off ' position.

f) No fuses other than fuses in the instrument circuits shall be fixed on the back of or behind a switch board panel or frame.

9.2.5. MARKING OF APPARATUS

a) When a board is connected to voltage higher than 250v all the terminals or leads of the apparatus mounted on it shall be marked in the following colours to indicate the different poles or phases to which the apparatus or its different terminals may have been connected.

Three Phases	-	Red, Blue and Yellow
I Neutral	-	Black

b) Where four wire three phase wiring is done, the neutral shall preferably be in one colour and each of the other three wires in another colour.

c) Where a board has more than one switch, each switch shall be marked to indicate which section of the installation it controls. The main switch shall be marked as such and when there is more than one main switch in the building, each switch shall be marked to indicate which section of the installation it controls.

d) All marking required under this clause shall be clear and permanent.

9.3. MAIN AND BRANCH DISTRIBUTION BOARDS:

9.3.1. Unless otherwise specified main and distribution fuse boards shall be iron clad / metal clad type or any type so described in these specifications, subject to approval of the Architects.

9.3.2. Main distribution boards shall be provided with a switch or any circuit breaker on each pole of each circuit, a fuse or a phase or a live conductor and a link on neutral or earth conductor of each circuit. The switches shall always be linked.

9.3.3. Branch distribution boards shall be provided with a fuse or a circuit breaker on the live conductor of each circuit an earthed neutral conductor shall be connected to a common link and capable of being disconnected individually for testing purposes. A spare circuit of the same capacity shall be provided on each branch distribution board. Lights and fans may be wired on a common circuit. As regards power sub-circuits the outlets shall be provided according to the load design of these circuits, but in no case there shall be more than two outlets on each circuit. Where there are special requirements like air-conditioning such outlets should be wired on separate circuits with a control such IC switch / miniature circuit breaker.

9.4. CIRCUIT LIMITATIONS:

Sub-circuits shall not have more than a total of ten points of lights, fan and socket outlets or a load of 800 watts, whichever is less. If a separate fan circuit is adopted the number of fans in a circuit shall not be more than ten.

9.5. INSTALLATION OF DISTRIBUTION BOARDS:

a) The distribution boards shall be located as near as possible to the center of the load they are intended to control.

b) These switches (as per clause 9.2) shall be fixed on a suitable stanchion or wall and shall be accessible for replacement of fuses.

c) These shall be of either iron / metal-clad type or all insulated type. But if exposed to weather or damp situations, they shall be of the waterproof type and if installed where they are exposed to explosives, dust, vapour or gas, they

shall be of the flame proof type.

d) Where two or more distribution fuses, boards feeding low pressure circuits are fed from supply at medium voltage these distribution boards shall be:

1) Fixed not less than 2000 mm apart or

2) Arranged so that two cannot be opened at the same time viz. they are interlocked and the metal case is marked "Danger - 440 Volts" or

3) Installed in a room or enclosure accessible to only authorized persons.

e) All distribution boards shall be marked "Lighting" or "power" as the case maybe and also marked with pressure and number of phases of supply. Each shall be provided with circuit list, giving details of circuit which it controls, and the current rating of the circuit and size of the fuse element.

9.6. WIRING OF DISTRIBUTION BOARDS:

a) In wiring a branch distribution board, the total load or the consuming devices shall be divided as far as possible evenly between the number of ways in the board leaving the spare circuit for future extension.

b) All connections between pieces of apparatus or between apparatus and terminals on board shall be neatly arranged in a definite sequence following the arrangement on the apparatus mounted thereon, avoiding unnecessary crossing.

c) Cables shall be connected to terminals only by soldered lugs / crimped lugs unless the terminals are of such form that they can be securely clamped without cutting cable strands.

d) All bare conductors shall be rigidly fixed in a such manner that a clearance of at least 25 mm is maintained between the conductors and any terminal other than the insulating material.

e) In a hinged board, the incoming and outgoing cables shall be neatly bunched and shall be fixed in such a way that the door shall be capable of swinging through an angle of not less than 90 degrees.

f) If required [in the schedule of quantities], a pilot lamp shall be fixed and connected through an independent single pole switch and fuse to the bus bars of the board.

g) All main and branch distribution boards shall be provided with earth bus bars as described in clause 12 ante.

10. PASSING THOUGH WALLS / CEILINGS:

When the conductors pass though walls / ceilings, anyone of the following methods shall be employed. Care shall be taken to see that wires pass freely through protective pipe or box and that wire pass though in a straight line without any twist or cross in wires, on either end of such holes.

a) A teakwood box extending through the whole thickness of the wall shall be buried in the wall and casings or conductors shall be carried so as to allow

12mm air space on three sides of the casing or conductor.

b) The conductor shall be carried in an approved heavy gauge solid drawn or lap welded conduit or in 2m thick FRLS pipe of such size that it permits easy drawing in. The ends of conduits shall be neatly bushed with FRLS, wood, or other approved materials. Where a wall tube passes outside a building exposed to weather, the outer end shall be bell mouthed and turned downwards and properly bushed on open end.

c) Where conductors pass from floor to another through ceiling, they shall be protected in the manner specified in (b) above, from 25 mm below the ceiling level and up to a height of 1500 mm above floor level. (Without any extra charges).

11. FIXING TO WALLS AND CEILINGS:

a) Plugging of walls or ceiling shall be done efficiently and neatly, using approved types of fiber fixing plugs with the right sizes and types of tool in workman like manner. Where this cannot be done, wooden plugs as described below can be used with special permission of the Architects.

b) Plug for ordinary walls or ceilings shall be well seasoned teak or other approved hardwood not less than 50mm long by 25 mm square on the inner end and 20 mm square on outer end. They shall be cemented into walls within 6 mm of the surface with plaster or lime punning. Where wiring to irregular coursing or other reasons the plugging of walls or ceiling with wood plugs present difficulties, the wood encasing, wooden batten, metal conductor or cleat (as case may be) shall be attached to the wall or ceiling in a suitable manner to be approved by the Architects.

In the case of new buildings, teakwood plugs shall be fixed in the walls, before first coat of white washing is given.

12. BRANCH SWITCHES:

Where the supply is derived from a three wire or four wire source and the distribution is done on the two wire system all branch switches shall be placed in the outer or live conductor of the circuit and no single pole switch or fuse shall be inserted in the middle wire, earthed or earthed neutral conductor of the circuit. Single pole switches carrying not more then 15 amperes may be of the tumbler type or as specified.

13. FITTINGS AND ACCESSORIES:

All materials used in the construction of fittings shall be of such quality, design and construction that will provided adequate protection in normal use, against mechanical and electrical failure and exposure, to the risk of injury or electric shock and shall withstand the effects of exposure to atmosphere.

14. ATTACHMENT OF FITTINGS AND ACCESSORIES:

14.1. In other than conduit wiring, all ceiling roses, sockets, outlets, switches, regulators, brackets, pendants, and accessories attached to the wall or ceiling shall be mounted on substantial blocks of well seasoned teakwood, or hard wood of approved quality twice varnished both inside and outside including

backside after all fixing holes are made in them. Blocks shall be used for attaching fittings and accessories to their blocks.

14.2. Groups of accessories and regulators shall be mounted on well seasoned and properly secured teakwood boards of suitable sizes to a accommodate that required number of fittings. The board shall be well varnished with pure shellac on all sides, both inside and outside and the cover shall be 3mm thick decorative laminated Hylam of approved make as may be specified. The board shall be divided into sections, one for the switches which shall be flush mounted and other for the regulators, fixed with suitable washers and round circle iron screws. In the case of surface type wiring, switches may be surface mounted or flush mounted as specified on double teakwood boxes with hinge cover, or covered with 3mm thick laminates hylam sheet, as specified.

14.3. PROTECTION OF CONDUIT AGAINST RUST:

The outer surfaces of the conduit surfaces of the conduit pipes including all bends, unions, tees, junction boxes, etc., forming part of the conduit system shall be adequately protected against rust, particularly when such system is exposed to weather. In all cases no bare threaded portion of conduit pipe shall be allowed unless such bare threaded is treated with anti-corrosive preservative or covered with approved plastic compound.

14.4. PROTECTION AGAINST DAMPNESS:

In order to minimize the condensation or sweating inside the tube, all outlets of the conduit system shall be properly drained and ventilated, but in such manner as to prevent the entry of insects as far as possible.

All necessary bends in the system including diversion shall be done by bending pipes or by inserting suitable solid or inspection type normal bends or similar fittings, or fixing M.S. inspection boxes which ever more suitable. Inspection conduit fittings shall be avoided as far as possible on conduit system exposed to weather. Wherever necessary, solid type fittings shall be used. No length of conduit shall have more than two equivalent 90 degrees bends from outlets to outlets the bends at the outlets not being counted.

SCHEDULE OF RATES

1. The schedule of rates should be read in conjunction with all the other sections like drawings, specifications etc.
2. The quantities shown against the items of work are only approximate and may vary to any extent. No extra whatsoever shall be entertained.
3. The rates inserted in the bills of quantities are to be for the full inclusive of value of the work described under the several items, including all costs and expenses which may be required in and for the construction and full protection of the work described, together with all risks, liabilities and obligations set forth or implied in the documents on which the tender is based. The quoted rates shall be for all heights, lifts and leads unless otherwise mentioned specifically in the description of item.
4. General direction and description of work and materials given else where in the contractor documents are not necessarily repeated in the Bill(s) of

quantities. Reference to be made to the other documents for the full information / details.

5. The contractor shall be deemed to have visited the site before quoting for the tender and to have examined for himself the conditions under which the work will be carried out including local conditions under which the work will be carried out including local conditions affecting labour and to have studied the items of the bills of quantities, the drawings and specification, relating to them and to have satisfied himself that the rates quoted by him provide for all minor accessories and contingent works or services as necessary for the works described even though there are not specifically defined.

6. Tenderer is advised to read items of works carefully and quote the rates accordingly. However, if he quotes different rates for the same items of work under different schedules of items, the lowest rates quoted shall be made applicable to all the Bills of quantities and the contract sum corrected accordingly.

7. Where an item of work not mentioned in a particular bill of quantities, is required to be executed and where the rate for such an item of work is quoted under a different bill of quantities forming a part of this contract, then the contractor being called upon shall execute the work and shall be paid at the rate so quoted. Nothing extra over shall be payable on this account.

8. The drawing(s) attached with this tender document are for the purpose of tender only, giving the tenderer a general idea of the nature and the extent of works to be executed.

9. The rates quoted by the tenderer shall be deemed to be for the execution of the works in accordance with the "Electrical Drawings" (to be supplied to the contractor).

10. The rates quoted by the tenderer shall include all labour, tools and plants, materials inclusive of all, transport, loading, unloading charges, all levies, all taxes, excise duties, etc. at the time of quoting their rates. The quoted rates shall remain firm throughout the contract period. No escalation on prices of labour and materials shall be entertained.

PARTICULAR SPECIFICATION FOR ELECTRICAL WORKS

1. LABELS AND DIAGRAM PLATE

Every incoming or outgoing switch mounted on the Panel / DB shall be provided with individual label identifying its designation and feeder number. Also all the Panels / DBs shall be provided with a non-rusting label on the front, engraved with its designation as per the Electrical Schematic Diagram. Inside the Panel / DB a circuit diagram shall be pasted on the back of the door for quick reference.

2. LT Panels

The panels shall be made with pressed CRCA Sheet steel of 1.6mm. Thickness and should be of free standing design. - Degree of protection shall conform to IP 50 of IS 2147. - The minimum and maximum heights shall be 450 mm. and 1950 mm. respectively from floor level. - All fuse switches shall be of double break design and utilisation category shall be AC 23 duty except for Lighting Boards (AC 22). - HRC Fuse links of 80 KA minimum rupturing capacity shall be used. ALL MCCBs shall be 3 pole / 4 pole as specified in BOQ and breaking capacity of 36kA and should confirm to IS/IEC 6047-2

Proper door interlocks shall be provided such that unless the Fuse Switch/ MCCB is in OFF Position, the door cannot be opened and vice versa.

The Busbar compartment shall be separate and shall be accessible from the front.

The maximum current density of Aluminum busbars shall be 0.8 A per Sq.mm. - They shall be liberally sized for the specified current ratings (both short circuit and continuous currents) maximum temperature of the bus and bar connection shall be limited to 80^{o}C.

The metering equipments shall not be mounted on the busbar compartment cover.

All bus works shall be braced to withstand stresses due to short circuit current and without damage.

Appropriate colour code shall be used to identify the various phases busbars and the neutral as per relevant Indian Standard using heat shrinkable sleeves.

The boards shall be easily extendable on both sides.

The design shall be compartmentalized.

All cables shall be entering the boards only from the top or bottom.

All Aluminum bus bars should confirm to E 91 E grade as per IS 5082.

The distribution boards shall be fabricated in such way that it shall be totally enclosed, dust and vermin proof, dead front, with hinged door type of bolted / welded construction suitable for wall mounting.

Each DB shall have individual hinged / bolted gasketed doors with cam lock. Removable conduit entry plates shall be provided at top and bottom of the DB to facilitate drilling the conduit holes at site to suit individual requirements or knockout shall be provided.

Protective insulated cover plate shall be provided inside the panel to shroud all the live parts. Only the operating handle of the switch and the operating knobs of the miniature circuit breakers shall be projecting outside the cover plate. The unused outgoing gap of DB shall be suitably shrouded to avoid accidental contact. Each phase or way shall also be suitably shrouded with DMC / SMC. The boards shall be factory wired and assembled. Circuit identification cables shall be provided on the cover.

All lighting / power distribution boards shall be provided with double door arrangements with phase segregation type.

All components in the distribution boards shall be same make.

The busbars shall be air insulated and made of high conductivity high strength copper busbars liberally sized with high safety factor for the required rating (both short circuit and continuous currents). The neutral busbar shall have adequate number of terminals for all outgoing single phase circuits. A copper earth bus of suitable size shall be provided in each DB for earthing of the power, lighting circuits and earthing of DB.

3. PAINTING

All metal surfaces shall be thoroughly cleaned and degreased to remove all mill scale, rust, greased and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under surface shall be prepared by applying two coats of red oxide. The under surface shall be made free from all imperfections before undertaking the finishing coat.

After preparation of the under surface, the switchboard shall be of powder coated spray painted with two coats of final paint. Colour shade of final paint shall be as per SHADE RAL 7032 (SIEMENS GREY COLOR) .

All unpainted steel parts shall be cadmium painted or suitably treated to prevent rust formation. If these parts are moving elements, then they shall be greased.

4. SWITCHES

All switches shall be load break heavy duty air break type provided with quick make/ break manual operating mechanism. The operating handle shall be mounted in the door of the compartment having the switch.

Switches shall be designed to carry the rated current continuously without overheating.

Barriers shall be provided to prevent inter phase arcing and live terminals shall be shrouded to avoid accidental contact.

5. FUSES

Fuses shall be non deteriorating HRC Cartridge link type, Diazed Fuses are not acceptable.

The fuses shall be pressure fitted type and shall preferably have ribs on the contact blades to ensure good line contact.

It shall be possible to handle fuses during off load conditions with full voltage available on the terminals. Wherever required fuse pullers shall be provided. The fuse bases shall be so located in the modules to permit insertion of fuse pullers and removal of fuse links without any problems.

6. **MCCB**

MCCBs should comply with IS/IEC-60947-2.

The MCCB shall be suitable for universal mounting (i.e) the Load / Line must be interchangeable.

The MCCB shall be suitable for operating Voltage of 415 V minimum and an Insulation Voltage of 690 V. The type of protection shall be thermal overload & magnetic short circuit protection. The breaking capacity shall be 36kA/1Sec. MCC shall have front operated handle with door with lock.

7. **PROTECTION**

The Thermal setting shall be continuously adjustable from 63% to 100% of its normal current.

The magnet setting shall be continuously adjustable from 500% to 1000% of its normal current.

Trip reset should be available Manual / Automatic.

8. MCB/MCB DB's

All MCBs shall be as per IS/IEC-60898-1 & IS/IEC – 60947-2

MCCB DBs shall be manufacturer's factory build and confirm to IS – 8623-1&3

9. MINIATURE CIRCUIT BREAKERS

The MCB's shall be of current limiting type and shall comply to IS/IEC – 60898-1 & IEC – 60947-2. The MCBs shall have inverse – time tripping characteristics against over loads and instantaneous trip against short circuits. The MCBs shall be of fault current limiting type also. The MCBs shall be slip on type to the busbar. The ON and OFF machines of the switch handle shall be clearly marked. The MCBs shall be suitable for operating in ambient of 45°C without de-rating. The incoming and outgoing of the MCBs shall be accessible only after opening the front door of the DB. The MCBs shall be suitable for 415V, 3 phase, 4 wire, 50HZ system with the fault level of 10KA RMS symmetrical. The terminals of MCB knobs shall be suitable for use with eye lugs. The 4 pole, 3 pole and 2 pole MCB knobs shall be trunked with adequate strength tandem pin.

9.1. EARTH LEAKAGE CIRCUIT BREAKERS

Incomer of the DB shall be provided with current operated Earth leakage circuit breakers with a sensitivity of 30mA or higher. The ELCB shall have trip free mechanism and shall operate even on neutral failure.

The ELCB shall be provided with a test push button to stimulate leakage and test the ELCB. The ELCB shall operate and switch off the circuit within 30 milliseconds in case of a fault.

The enclosures of the ELCB shall be moulded from high quality insulating materials, which shall be fire retardant, anti-tracking, non-hygroscopic, impact resistant and shall withstand high temperatures.

All cable entries shall be from the bottom or top. The bus bar shall be of Tinned Copper having continuous current ratings equal to that of the incoming switch.

The busbars shall be designed to withstand a fault level of not less than 31 MVA for one second / as per the system requirement.

The MCB's shall have a lockable switching lever.

The minimum electrical endurance shall be 20,000 operations-.

The housing of the MCB shall be mounted self-extinguishing thermoset plastic material.

The short circuit current shall be brought to zero within 4 to 5 milli seconds from the time they are established.

All MCBs shall have a minimum short circuit capacity of 10 KA Rms.

Undrilled gland plates shall be provided both at the top and bottom. The degree of protection shall confirm to IP 50.

Phase separation barriers shall be provided

9.2. GROUNDING

The DBs shall be provided with two nos brass earthing stud terminals with suitable nuts, washers etc for connection to earth bus outside the DB.

9.3. PAINTING

Care shall be taken in workmanship and selection of materials to prevent the occurrence of any form of damage or corrosion due to damp or highly humid conditions.

The DB shall be prepared, primed, filled and painted to the highest standards.

All items shall be cleaned and deburred after fabrication and welding is complete. External surfaces shall be filled and rubbed down as necessary to obtain a perfectly flat smooth surface free from blemishes and imperfections and the whole shall be powder coated with epoxy paint and the shade shall be indicated later.

9.4. TESTS

All necessary routine shall be performed on the equipment to demonstrate satisfactory performance to owner / Project Management Consultant at works without any extra cost. Equipment shall not be dispatched without obtaining approval of test certificates for type, routine and acceptance tests (whichever applicable).

10. LT CABLES LAYING OF CABLES METHOD OF LAYING CABLES

In the Plant Buildings, Switch/Control rooms etc., power and control cables shall generally be taken exposed on brackets, cable racks/trays/hooks unless otherwise specified laid in concrete trenches or along building and technological structures.

Power and control cables installed along buildings and technological structures, ceiling, walls etc. which are required to be protected against mechanical damage.

Extra length of cables shall be provided wherever possible for any future contingency to the extent of 10% of the length of any section.

The cables laid fully burried in ground or partly in trench and partly in ground shall be armoured type. Cables are laid fully in rack/tray/hook or laid in G.I. pipes, shall be also armoured type.

The installation work shall be carried out in a neat workman like manner by skilled, experienced and competent workmen particularly with experience in jointing termination of aluminium / copper conductor cables.

Cables runs shall be uniformly spaced properly supported and protected in an approved manner. All bends in runs shall be well defined and made with due consideration to avoid sharp bending and linking of the cable. The minimum bending radius of cables shall not be less than twelve times the overall diameter.

Cable installation shall be property co-ordinated at site with the routing of other services, utilities and the cable routings with a view to avoid interference with any part of the building, structure, equipment, utilities and services.

Entry of cables directly burried in ground or from underground trenches, to the buildings shall be through GI pipe sleeves. Necessary precautions shall be taken to make entry point fully watertight by properly sealing the pipe sleeves with epoxy resin (rubberised compound).

All cables shall be provided with identification tags indicating the cable numbers in accordance with the cable/circuit schedule. Tags shall be fixed at both the ends of cable at joints and at 20 m. Spacing for straight runs. When a cable passes through a wall tags shall be of durable fibre of aluminum sheet with the numbers punched on them, and securely attached to the cables with non-corrosive wire. For single core cables wire shall be non-ferrous material.

All cables shall be tested for proper insulation prior to laying. The cable drums shall be transported on wheels to the place of work. The cables shall be laidout in proper direction as indicated on the drum using cable drunk stands. In case of higher size cables, the laid out cables shall run over rollers placed at close intervals and finally transferred carefully on to the trenches and racks. Care shall be taken so that links and twists or any mechanical damage does not occur in cables. Only approved cable pulling grips or other devices shall be used.

Adequate length of cables shall be pulled inside the switchboards, control panels, terminal boxes etc. so as to permit neat termination of each core/conduct. Control cables cores entering switchboard or control panels shall be neatly bunched and strapped with PVC perforated tapes and suitable supported to keep it in position at the terminal block. All spare crores shall be neatly dressed and suitably taped at both ends.

Power cable terminations shall be carried out in such a manner to avoid strain on the terminals by providing suitable clamp near the terminals.

All power cable terminations shall be by means of crimping type cable lugs. Control cables shall be terminated by crimping or directly clamped in the terminal blocks by screws.

No jointing shall normally be made at any intermediate point in through runs of cables unless the length of the run is more than the length of the standard drum supplied by cable manufacturers. In such cases when jointing is unavoidable, the same shall be made by means of standard cable jointing boxes/kits.

All cables entry openings in the equipment shall be sealed and made proof against entry of creeping reptiles.

11. LAYING OF CABLES ON RACKS/ TRAYS/ BRACKETS/ HOOKS

All power cables in trenches and on structures shall be laid on racks and shall be clamped by means of single or multiple galvanised MS saddles. The saddles shall be placed at an interval of 1000 mm. in both horizontal and vertical straight runs, at each bend and turnings from horizontal to vertical direction and vice versa.

Multi-core control cables shall be laid touching each other on trays and wherever required may be taken in two layers. Ladder type cable racks shall be selected from three sizes viz. 300 mm., 450mm. and 600 mm. Ladder. type trays shall be painted after fabrication.

Vertical spacing between cable racks/trays shall be 250 mm.

Power cables of different voltage grades shall be laid in separate racks / brackets / hooks. Control cables as well as signal and communication cables shall be laid in a separate trays. However, in cases where smaller size power cables (below 16 sq.mm) of fewer numbers cables provided suitable vertical barriers are installed between them.

Order of laying of various cables in racks/trays brackets/hooks shall be such that control cables are located at the bottom-most tier and 1100 V grade cables at top tier. In case of duplicate feeders of same consumer, these shall be laid in two separate racks/brackets.

Where there is possibility of mechanical damage cable rack / trays shall be adequate protected by sheet steel covers. For future installation of cables, provision shall be made to keep 20% space as spare on each tray/rack/bracket.

12. LAYING OF CABLES BURIED UNDERGROUND

Power and control cables laid directly buried in ground shall be laid generally conforming to the requirements of code of practice IS : 1255 in so far as it is applicable. Generally cables shall be taken at a depth of 750 mm. from finished ground level and shall be provided at least 150 mm. sand cushioning both at top and bottom and precast reinforced concrete protective covers or bricks.

For laying 1100V grade power cables in horizontal axial spacing shall be 75 mm. Control cables shall be laid touching each other without any horizontal spacing. However, the distance of the control cable from the nearest power cables shall be 150 mm. Power and control cables may be laid in a common trench, but power cables for each voltage grade cables may be laid in a common trench, but power cables for each voltage grade and the control cables shall be separately in groups. Generally, cables shall be laid in one layer. In general, communication shall not be taken in a common trench. In case the same is required to be taken along with power cables, the minimum axial spacing between two cables shall be 350 mm where a brick separator shall be provided between the two cables and without brick separation the spacing shall be 500 mm.

Precast concrete protective cover shall be placed centrally along the cables. The concrete slab shall be of RCC type as per appendix C of IS : 1225 of length having suitable provision for dove tailing with the adjacent slab. The length of the slab shall be 750 mm the width however shall vary depending on the number of cables in the trench as well as axial spacing. The minimum width of slab shall not be less than 200 mm.

After laying of cables the trench shall be back filled with good excavated soil and well rammed in successive layers not less than 300 mm. depth. The excavation of trenches shall be kept as straight as possible. The width of trench shall be in accordance with the number of cables to be laid out in no case shall be less than 400 mm. The minimum clearance between trench edge and cable shall not be less than 100 mm.

Where cables required to cross roads, railway tracks and surface drains they shall be taken through reinforced concrete spun pipes at a minimum depth for 1000mm.

For crossing water, oil, gas or sewage pipes etc. cables shall be taken above the pipes where minimum 500 mm. clearance is available from top of pipes. Where 500 mm. clearance is not available the cables shall cross pipes through RC pipes at a minimum depth of 750 mm. from finished ground level keeping the distance between the utility pipes and pipe carrying cables 250 mm. minimum.

In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made in case the cable develops fault at a later date. Also when group of cables are laid together the cable length shall be adjusted to stagger the straight through joints.

Direct burial underground cable shall be generally laid in the utility alley along the roads and cable routing shall follow the road layout. However, in special cases to keep the cable lengths minimum the cables may be laid by the shortest route and the same shall be taken through RC pipe.

While laying cables parallel to buildings, utility pipelines, drainage, sewerage etc., the minimum clearance shall not be less than 1000 mm.

13. CABLE TERMINATION AND JOINTING

Termination and jointing of aluminium conductor power cables shall be by means of compression method using compression type of aluminium lugs. Copper conductor control cables shall be terminated directly into screwed type terminals provided in the equipment. Wherever control cables are to be terminated by means of terminal lugs, the same shall be tinned copper compression type.

14. CONDUIT & WIRING

14.1. GENERAL REQUIRMENT OF WIRING SYSTEM

14.2.

14.3. 14.1.a. System of Wiring

The system of wiring shall consist of FRLS insulated copper conductor wires in Heavy gauge rigid MS conduits for concealed installation and metal conduits for surface installations as called for.

14.4.

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 size of conduits, locating of junction boxes, size and location of switch boxes and other relevant details. Any discrepancy found in the drawings shall be brought to the notice of the Project Management Consultant/employer. Any modifications suggested by the Contractor shall be got approved by the Project Management Consultants before the actual laying of conduits is commenced.

Generally concealed electrical wiring installation shall be in PVC conduits and surface wiring in MS conduits.

14.5. 14.1.b. Mains and Sub-Mains

Mains and sub-mains cable or wires where called for shall be of the rated capacity and approved make. Every main and sub-main wire shall be drawn into an independent adequate size conduit. An independent earth wire of the proper rating shall be provided for each sub main, two earth wires of proper rating shall be provided for every single phase sub main. For every 3-phase sub main, two earth wires of proper rating shall be provided along with the sub main. The earth wires shall be fixed to conduits by means of clips at not less than 1000

mm distance. For mains and sub-mains extra lengths of cable shall be provided to facilitate easy connections and maintenance.

14.6.

14.7. 14.1.c. Circuit main for light circuit

Circuit main/ sub circuit main is inclusive in the point wiring (ie. wiring from MCBs in DB to First Switch Box/Switch Box to Switch Box looping) and however wherever called for separately in the BOQ alone shall be measured in length from the Distribution Board/Panel Board up to the first switch box on that circuit only; from Switch Box to Light Point for single control Light point and for group control Light Point all the points connected to a single switch will be termed as group light point.

Point wiring and circuit wiring should be done in independent conduits and should not be taken through one conduit.

Fan regulator box, fans, light fittings, calling bells are to be properly earthed. In respect of 6 Amps conventional plug point, the third pin should be earthed with 2.5 Sq.mm green FRLS insulated copper wire.

Lights, fans and 6 A points shall be wired on a common circuit. Each circuit shall not have more than a total of ten points of lights, fans and 5 A socket outlets or a load of 800 watts whichever is less. The ceiling fan point shall be complete with special outlet box including fixing and connection of regulator. Supply and fixing of 6A switch for each ceiling fan is included in scope of Contractor.

14.8. 14.1.d. For 16A Power Plug Points

14.9.

In one circuit, there shall not be more than two 16A power plug points and 3R x 2.5 Sq.mm copper conductor wires shall connect circuit.

Type of plug socket outlet and switch shall be modular type . Plug socket can be standard type or 16/6 A universal type. The circuit main would commence from DB and end up to the switch box. Looping of circuit would be done to second 16A power point from first 16A power point and shall be counted as power point wiring.

Each circuit would have its own 2.5 Sq.mm green FRLS insulated copper wire from DB to switch box and would be connected to third pin of socket outlet.

Electrical load for each 16A power point would be considered as 1000 watts.

14.10.

14.11. 14.1.e. General Wiring

All wires shall have been manufactured in accordance with the latest IS Specification (IS 694 - Part II).

All wires shall be FRLSH insulated, copper conductors of 1100V grade. Cross section of the conductor shall be as per the specification mentioned in schedule of quantities.

Minimum cross section of conductor for electrical wiring shall be 1.5 mm square.

For single phase wiring, the colour of the insulation of phase conductors shall be Red/Yellow/Blue and black for neutral. The colour coding adopted should be uniform for the en tire Project.

Earthing is to be done by Green FRLSH insulated copper conductor. For three phase the insulation of phase conductors shall be Red/Yellow/Blue, as per relevant phase and Black for neutral.

Earth wire shall always be of copper conductor FRLH insulated and colour of insulation shall be Green.

Whenever wires are being terminated in a Distribution Board/Switch Box/Plug point/Outlet Box etc., a minimum of 200 mm long extra wire should be provided in the form of a loop for further maintenance use.

For each lot of wires, the Contractor shall submit all relevant test certificates issued by the Manufacturer stating its origin, date of manufacture, constitution and standards to which it complies. All wires and cables shall bear the manufacturer's label and shall be brought to site in original packing.

Only Authorized/certified wiremen and cable jointers shall be employed to do the cable jointing work.

Wires shall not be jointed inside the conduit or pull boxes. Where unavoidable, joints shall be made through approved mechanical connectors with prior permission of Architect / Employer.

Control switches shall be connected in the phase conductors only; and shall be 'ON' when knob is down. Switches shall be fixed in galvanized steel boxes. Plated screws shall be used.

Power wiring shall be distinctly separate from lighting wiring.

Each circuit phase wire from the distribution boards should be followed with a separate neutral wire of the same size as that of the circuit wire.

Wires originating from two different phases shall not run in the same conduit.

14.1.f. CIRCUIT WIRING / Group Wiring

The following specification is applicable only when three or more lights (or) more than 500 watts of lighting load is controlled by one MCB/ Switch.

Lights would be controlled by rated capacity MCB/switch and connected by wire size, as specified in schedule of quantities. However, it shall not be less than 5A and 2.5 sqmm respectively.

MCB/Switch for these lights should be installed in a suitable MS box with hylam/Front Plat / Modular type as per OEM.

Total electric load is to be controlled from each of the single Phase MCB DB shall not exceed 3000 watts or six groups of lights or as specified in the approved drawings. Circuits with earthing for this Group Lighting Board would always be from DB of size as specified in schedule of quantities.

"Group lights" points would commence from DB including circuits, surface/concealed conduit system, necessary wiring, MS switch box, M.C.B, hylam sheet cover and outlet box up to last light of the group.

Lights, 6A sockets, Ceiling fans and Ex-haust fans may be wired on a common circuit. Such circuit shall have 10 points of light, ceiling and ex-haust fan and socket outlets or a load of 800 watts, whichever is less. A switch board might have more than two circuits but should be of same phases.

All outlets connected on a lighting circuit shall be measured under point wiring. It shall Include wiring from switch point of the circuit up to light, fan, socket outlet via switches, regulators, controls etc., as called for. Generally, the following accessories shall be included.

The following shall be deemed to be included in the point wiring:-

a) Switches and Manufacturing mounting box.
b) Ceiling rose or terminal connector as required
c) Bushed conduit, G.I.Sleeves where cables or pipes passes through wall etc.
d) Earth wire from three pin socket outlet point/fan regulator to common earth including earth dolley except the earth wire from the first tapping point of live wire to the final distribution board.
e) All fixing accessories such as clips, rails screws, rawl plugs, wooden plugs etc. as required.
f) Connections to ceiling rose, connector socket outlet, lamp holder,switch and fan regulator etc.
g) Looping the same switch board interconnections between points on the same circuit.
h) Providing fish wire in conduits while recessed circuiting work undertaken.

i) The Chases in the wall shall be neatly made and in ample dimensions to permit the conduit to the fixed in the manner desired.

j) Any special or suitable round block for neatly housing the connector and covering the fan hook in case of fan point.
k) Bushed conduit, MS.Sleeves where cables or pipes passes through wall etc.
l) Earth wire from three pin socket outlet point/fan regulator to common earth including earth dolly.
m) All wood or metal blocks, boards and boxes sunk of surface type, including those required for mounting fan regulator but excluding those under the main distribution switchgear.
n) All fixing accessories such as clips, rails screws, rawl plugs, wooden plugs etc. as required.
o) Connections to ceiling rose, connector socket outlet, lamp holder, switch and fan regulator etc.
p) Looping the same switch board interconnections between points on the same circuit.
q) Providing fish wire in conduits while recessed circuiting work is undertaken.
r) In case of buildings under construction, conduits shall be burried in the wall before plastering. These shall be grouted and covered with cement and mortar, neatly finished at the plane of the un-plastered brick work and stretched for providing key to the plaster and cured. Under no circumstances, finished plastered surfaces shall be allowed to be chased for the conduit work. Before taking up chasing of the wall, the routes shall be marked and got approved by Architect / Project Management Consultant. In case of exposed brick / rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work.

14.12. 13.1.g. Drawing Conductors

The drawing and jointing of MS insulated copper/aluminium conductor wire and cables shall be executed with due regard to the following precautions. While drawing wires through conduits, care shall be taken to avoid scratches, etc., Care shall also be taken to ensure that the insulation is not peeled off either in portions or as a whole; and the conductor is not broken anywhere. There shall be no sharp bends that may lead to the breakage of the conductor.

FRLS Insulated copper conductor wire ends shall be soldered (at least 20 mm length) before inserting into the switch for termination and Conductors having nominal cross sectional areas exceeding 10 Sq.mm shall always be provided with cable sockets/lug of same material as that of conductor.

Strands of wires shall not be cut for connecting terminals. The terminals shall have sufficient cross sectional area to take all strands and shall be soldered. Connecting brass screws shall have flat ends. All looped joints shall be soldered and connected through block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less.

At all bolted terminals, brass flat washer of large area and approved steel spring shall be used. Brass nuts and bolts shall be used for all connections.

For all internal wiring, FRLS 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. If the use of joint connections are unavoidable due to any specific reason, prior permission, in writing, shall be obtained from the Architect / Employer. No wire shall be drawn into any conduit, until all work of any nature, that may cause injury to wire, is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of wire. Before the wires are drawn into the conduits, the conduits shall be thoroughly cleaned of moisture, dust, dirt or any other construction debris, by forcing compressed air through the conduits. All sub-circuit wiring for light points shall be with 2.5 Sq.mm FRLS insulated copper conductor.

All Light, Fan, Sockets, fittings must be earthed.

Point wiring rate should include circuit mains wiring cost also.

Separate neutral must be taken for each circuit.

The physical and electrical continuity shall be maintained throughout the conduit systems.

Only 14 SWG thick PVC conduits shall be used as required in Bill of Quantities or Schedule of works.

Only concealed type of fan hooks shall be used on all possible locations.

Wires of any two branch circuits connected to different phases must be drawn in separate conduits.

Receptacles, control switches, fan regulators, MCB DBs, junction boxes for concealed wiring system shall be flush mounted in wall / ceiling / partitions as required.

50 mm. dia and height MS inspection boxes of 14 SWG Thick having smooth external finish shall be provided to facilitate removal and replacement of wires wherever required.

Strands of wires shall not be cut for connecting terminals. The terminals shall have sufficient cross sectional area to take all strands. At all bolted terminals, flat washers of large area and approved steel shall be used.

13.1.h. **COLOUR CODING OF WIRES**

Colour coding of wire shall be carried out as detailed below:

PHASES	RED
	YELLOW

	BLUE
NEUTRAL	BLACK (OR) GREY
EARTH	GREEN

Colour code shall be maintained for the entire wiring installation as red, yellow, blue for three phases, black for neutral.

The minimum diameter of the conduits shall be 25 mm only.

The following sizes or higher of FRLSH multi strand copper conductor wires shall general be followed throughout:

From the final switch to individual outlets (Phase, Neutral and Earth)	:	1.5 sq.mm.
From Distribution Boards to First Switch Board and subsequent	:	1.5 sq.m.m
All 16A socket (Only Phase & Neutral)	:	2.5 Sq.mm.
Earth wire throughout for Lighting	:	1.5 Sq.mm.

Conduits for power and lighting shall be separate and shall not be mixed.

All Control switches (6 AMPS & 16 AMPS Capacity) used in point wiring, whether surface mounted or concealed type shall conform to IS 3854 and carry ISI Mark distinctly.

All switches and socket outlets shall be mounted in a suitable sized MS Box with ample space for connection and disconnection of wires.

All socket outlets shall invariably have their third earth pin connected to main grounding /earthing grid.

14.13. MS Conduits

Conduits and accessories shall conform to IS: 9537-Latest and the specifications given below. MS conduits shall be of black, round, heavy gauge Milled Steel (MS). The internal surface of the conduit shall be smooth. All flexible conduits shall be of steel. Only approved quality as recommended by the Project Management Consultant and factory made bends/accessories shall be used.

Conduits and Accessories shall conform to IS: 9537 (Latest) and tender specifications. The steel conduits shall be solid drawn, mild steel, 16 gauge, heavy duty electrical welded, thread type, having perfect circular tubing with tight fitting joints and shall be capable of being cleaned easily. The conduit shall

be protected from rust by one coat of paint applied inside and outside in its manufactured form.

Minimum Conduit Dia (OD) For Electrical Wiring Shall Be 25.0 mm.
Minimum Conduit Dia (OD) For Telephones and Audio/Video shall be 19.0 mm

Joints between conduits and accessories shall be securely made, to ensure earth continuity.

Where called for, buried wiring passing underground, shall run in galvanized steel conduit.

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. This shall be approved by respective Architect / Engineer-in-charge.

The number of 650/1100 volts grade insulated copper conductor wires that may be drawn in the conduits of various sizes are given below. The space occupied by the wires shall not exceed 60% of the conduit Internal Area and 40% of conduit space should be left free.

Maximum permissible number of 650/1100 volt grade insulated wires that may be drawn into rigid non-metallic or MS conduits are given below:

Sl. No.	Size of Wire (in Sq.mm)	Maximum Number of wires within conduit of size				
		19mm	25mm	32mm	38mm	51mm
1	1.5	-	6	10	14	-
2	2.5	-	5	10	14	-
3	4.0	3	5	10	14	-
4	6.0	2	5	8	11	-
5	10.0	-	4	7	9	-
6	16.0	-	2	4	5	12
7	25.0	-	-	2	2	6
8	35.0	-	-	2	5	-

14.14. 13.2.a. INSTALLATION OF CONDUITS

14.15. 13.2.a.i. Concealed Conduit System

Unless otherwise specified all wiring shall be in heavy gauge rigid PVC conduit embedded in wall, or ceiling and Surface type MS conduiting above false ceiling. The size of the conduit shall be selected in conformity with relevant IS code and as specified in the above table. Factory made conduit bends and accessories shall be used. MS conduit shall be jointed using solvent cement as recommended by the conduit supplier. The conduit in ceiling slab shall be straight as far as possible. Before the conduits are laid in the ceiling, the position

of the outlet points, controls, junction boxes shall be set out clearly as per the dimensions and to minimize off-sets and bends. Conduits in ceiling shall be bonded to the reinforcement rods with GI bonding wire to secure them in position. MS light outlet/pull boxes shall be provided as required. The conduit in ceiling slab shall be laid above the first layer of reinforcement rods to avoid cracks in the ceiling surface.

Conduits concealed in the wall shall be secured rigidly by means of steel hooks/staples at minimum 750 mm intervals. Before conduit is concealed in the walls, all chases, grooves shall be neatly made to proper required dimensions to accommodate number of conduits.

The chased portion of the walls for electrical works shall be plastered by electrical Contractor to bring it to the finished wall surface. The outlet boxes, control switches, and inspection and draw boxes shall be fixed as and when conduits are being fixed.

The recessing of conduits in walls shall be so arranged as to allow at least 12 mm plaster cover on the same. Where conduit passes through expansion joints in the building, adequate expansion fitting or other approved devices shall be used to take care of the relative movement of expansion joints.

All grooves, chases etc., shall be refilled with cement mortar and finished up to wall surface before plastering of walls is taken up by the general civil Contractor. Whenever the conduits terminate into Control Boxes, distribution boards etc., conduits shall be rigidly connected to the boxes/boards with check nuts on either side of the entry to ensure electrical continuity. All opening of conduits, junction boxes shall be properly plugged with MS stoppers or any other suitable materials, so that water, mortar, vermin or any other foreign materials do not enter into the conduit system. All conduit ends terminating into an outlet shall be provided with bushes of MS or rubber after the conduit ends are properly filed to remove burrs and sharp edges. Necessary GI pull wires shall be inserted into the conduit for drawing wires. The Insulated Earth wires shall be run in each conduit originating from the panel board up to the Light, Socket and Switch boxes. If the Electrical Contractor forgets to install any conduit/boxes etc., before the plastering/painting work is done by other agencies, he may be permitted to install the same with prior permission of Architect / Employer and the expenses towards redoing the wall, floor, ceiling etc., shall be borne by the Electrical Contractor.

14.16.

14.17. 13.2.a.ii. Open/Surface Conduit System

Conduits on surface of treated walls/RCC slabs shall be avoided as far possible. In case it is not avoidable, prior approval in writing shall be obtained from Employer/Project Management Consultant on the exact route. Heavy gauge GI saddles shall fix conduit. Distance between two consecutive saddles shall not exceed 900 mm. No wooden gutties for fixing saddles/clamps shall be used.

Use of Rawl plug/steel fastener with hard setting/scaling compound is recommended. Conduits shall be run in square and by metrical lines. Wherever couplers, bends, or similar fittings are used, saddles shall be provided at either side at a distance of 300 mm from the center of such fittings. Conduits shall be joined by means of screwed couplers and screwed accessories only. In long distance straight runs of conduit, inspection type couplers/junction boxes shall be provided.

Threading shall be long enough to accommodate pipe to the full threaded portion of the Couplers and accessories. Cut ends of conduits shall have neither sharp edges nor any burrs left, to avoid damage to insulation's of wires.

Using pipe-bending machine shall do bends in conduit runs. Sharp bends shall be accomplished by introducing solid bends, inspection bends or cast iron/ MS inspection boxes. Radius of solid bends shall not be less than 75mm. Not more than 90-degree bend shall be used in a conduit run from outlet to outlet.

All conduits opening shall be properly plugged with MS stoppers/bushes. Conduits shall be adequately protected against rust by applying two coats of approved synthetic enamel paint after the installation is completed and should be certified by the Architect / Employer.

Wherever conduits terminate into control boxes, outlet boxes, distribution boards etc., it shall be rigidly connected to the box with check nuts on either side of the entry.

In the floors, conduiting below the flooring should be avoided. Wherever it is unavoidable, GI pipe should be used with prior approval of Employer/Architect.

The entire conduit system shall be bonded to the earth.

15. ALL STRAIGHT JOINTS THROUGH INSULATED TUBE LUGS – CRIMPED

Only certified wiremen and cable jointers shall be employed to do jointing work. All wires and cables shall bear the manufacturer's label and shall be brought to site in original packing. For all internal wiring, PVC Insulated wires of 650 V grade shall be carried out in loop system and no joints shall be allowed in the length of the conductors. If the use of joints/connections are unavoidable due to any reason prior permission, in writing shall be obtained from the Project Management Consultants / Employer. No wire shall be drawn into any conduit, until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires into the conduits. The conduits shall be thoroughly cleaned of moisture, dust, dirt or any obstruction by forcing compressed air through the conduits. The minimum size of PVC Insulated copper conductor wires for all sub-circuit wiring for light points shall be 1.5 Sq.mm.

16. LOAD BALANCING

Balancing of circuits in three phases installation shall be planned before the commencement of wiring and shall be adhered to.

17. SWITCHES AND ACCESSORIES

All switches shall be placed in the live conductor of the circuit and no single pole of fuse shall be inserted in the earthed neutral conductor of the circuit.

Single pole switches (other than for multiple control) carrying not more than 15Amps may be of the piano key type/moulded plat type and the switch shall be `ON' when the knob is down.

The switch box shall be placed in the live conductor of the circuit and no single pole of fuse shall be inserted in the earthed neutral conductor of the circuit.

Single pole switches (other than for multiple control) carrying not more than 15 Amps may be of the piano key type/moulded plat type and the switch shall be `ON' when the knob is down.

The switch box shall be made of metal on all sides, except on the front. In the cases of cast iron boxes wall thickness shall be at least 3mm. and in case of welded mild steel sheet boxes the wall thickness shall not less than 18 gauge for boxes upto a size 20 cms x 30 cm. above this size 16 gauge MS boxes shall be used. Except where otherwise stated 3mm. thick phenolic laminated sheets shall be fixed on the front with aluminum alloy/ brass/cadmium plated iron screws as approved by Architect/Engineer - incharge.

To facilitate drawing of wires in the conduit, GI Fish wire of 16 SWG shall be provided while laying recessed conduit. Point wiring shall include all works necessary to complete wiring of a switch circuit of any length from the tapping point on the distribution circuit to the following (via the switch).

a) Ceiling rose or contractor (in the case of ceiling / exhaust fan points) b) Back plate (in case of fluorescent fitting with down rods etc).
b) Socket outlet (in the case of socket outlet points)
c) Lamp holder (in case of wall brackets, bulk head and similar fittings).
d) All civil works like chipping, making good the damages, drilling holes in walls etc., are to be done by the contractor only.

17.1. LENGTH PER POINT

The term "Length per point" in point wiring in the case of the fan and light points shall mean the distance between the switch and ceiling rose, connector or back plate, lamp holder depending upon the fitting, measured along the run of wiring irrespective of the number of wires in the run. In the case of socket outlet points, the length shall mean the distance between the socket outlet and the tapping point of live wire on the nearest switch board.

17.2. **MEASUREMENT OF POINT WIRING**

Points on the basis of length per point inclusive of circuit mains shall be classified as under:

a) Average point : Length per point not exceeding 10 M.
b) Special point for 5A socket outlet points : Length per point exceeding 10 M Light, Fan and

The rate for average point shall be on a per point basis.

For special points, the extra length of wiring over and above the length of Meters specified shall be measured and paid for.

In case of points with more than on light point controlled by the same switch, they shall be measured on a set basis (i.e.) Two lights controlled by one switch shall be considered a set and so on. The distance between the first point and subsequent point shall not be more than 5 mts. In case of more than two lights controlled by one switch only the average distance between light points shall be considered.

The minimum size of pipe shall be 25mm. dia only. The wall thickness shall 2mm only. The chases in the wall shall be neatly made and in ample dimensions to permit the conduit to be fixed in the manner desired. In case of buildings under construction, conduits shall be burried in the wall before plastering. These shall be grouted and covered with cement and mortar, neatly finished at the plane of the unplastered brick work and scratched for providing key to the plaster and cured. Under no circumstances finished plastered surfaces shall be allowed to be chased for the conduit work. Before taking up chasing of the wall the routes shall be marked and got approved by Architect / Engineer-incharge. In case of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work.

17.3. 16.3 Switch Outlet and Junction Boxes

All concealed outlet boxes for switches, sockets and other receptacles shall be rust proof and shall be of thick Galvanized steel (GI) boxes having smooth external and internal surfaces.

All outlet boxes for receiving plug sockets and switches shall be of standard factory make and of approved size, and shape. All boxes shall have adequate number of knock out holes of required diameter and earthing terminal screws. Outlet boxes shall have a minimum depth of 65 mm.

All 5/15 amps switches shall be enclosed type flush mounted for 240 volts AC. The box in which the switches are fixed shall have an adjustable plate cover. Ample space at the back and sides shall be provided for accommodating wires. Switch, controlling the light point shall be connected to the phase wire of

the circuit. The Switch plate shall be white plastic or any other approved type and it should match the interior design.

17.4. Light Outlet Boxes

17.5.

The Light Outlet Boxes for concealed installation shall be round in shape and shall be made of MS knock out holes/projections to connect MS pipes. Light outlet boxes for surface installation shall be of MS (painted).

17.6. Inspection Boxes

Rust proof inspection boxes of 2 mm thick mild steel having smooth external and internal finish shall be provided to facilitate removal and replacement of wires, where required.

17.7.

17.8. Fan Outlet

For fixing of ceiling fans, circular outlet boxes made of 16 SWG steel sheet, 100 mm diameter, complete with fan hook fabricated art of 12 mm dia mild steel rod.

17.9. Wall Socket Outlets

Following types of socket outlet shall generally be used for interiors:

All sockets shall be of shutter type. 5A 3 Pin Switched Socket outlet in guest rooms, Toilet, office area, lobby, restaurant etc., 5A 3 Pin un-switched socket outlet for TV supply with Independent 5A SP Control switch near the bedside.

15/5A 3 pin switched socket with Indicator for power points.

15A, 5 pin domestic plug point for using mixie, microwave oven etc., should be provided. Guest rooms kitchen, main kitchen and split AC units, etc., shall only be operated by metal clad industrial type socket and plug with suitable rating of MCBs of any one of the following combinations as per design and rating of the equipment's used. In pantry area, where the domestic appliances are used, flush type switches and sockets can be fixed.

16 Amps SP Industrial type socket controlled by 16 Amps SP MCB mounted on a fabricated MS box with cover plate.

20 Amps SP Industrial type socket controlled by 20 Amps SP MCB mounted on a fabricated MS box with cover plate.

32 Amps S.P/T.P 230V/415V, Industrial type socket controlled by 32 Amps S.P/T.P. MCB mounted in a fabricated MS box with cover plate.

No electrical cable/temporary cabling shall be allowed at floor level for connecting any equipment on any account.

16. EARTHING

The method adopted for system as well as equipment earthing shall be in accordance with the code of practice for earthing IS:3043-1966 /1987 (latest) and shall also comply with the relevant clauses of Indian Electricity Rules.

All non-current carrying metallic parts of various electrical equipment as well as cable armouring metallic conduit/GI pipe system, cable racks/ trays brackets, supporting structures etc. shall be effectively earthed. Earthing of medium and high voltage equipment shall be done by means of two separate earth conductors connected either directly to earth electrodes or to an earthing ring irrespective of use of armoured cable or metallic conduit/GI pipe.

The total earth resistance at any point of the earthing system for sub-station and main building shall not be more than 1 Mega ohms. However, for other areas, shall not exceed 5 Mega ohms.

Interconnections with electrodes shall be done with 16 mm^2 . PVC Insulated armoured copper cable with crimped sockets at a depth of 600mm. and shall be provided.

100 mm dia 3 Mt long cast iron pipe of standard quality shall be used as earth electrode

For earthing Installation, excavation of size shall be of 1 meter diameter and 3 meter length shall be excavated after depth of 3 meter the size of excavation shall be 900X300X900mm depth. Pipe Electrode shall be in vertical position. At bottom 150mm layer of Salt and charcoal power shall be installed than Plate shall be installed. Alternate layer of 150mm of Salt and charcoal power shall be used up to 2.5 meter. Min 120kg of charcoal power and 120kg of salt shall be used for each earthing pit. The pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case not less than 2.5 M below finished ground level.

17. CLEARANCE AND SAFETY

For all switch boards, control panels, power control centres, a clear front space of not less than 1000 mm. shall be provided in front of the equipment. In case, where the equipment is provided with drawout unit, a minimum clearance of 2,000 mm shall be provided.

For all electrical equipment a minimum clearance headroom of 500mm shall be provided.

All motors located away from the feeding and control panels and for which control desk of posts are not within visible location, shall be provided with readily accessible and easily operated, locally mounted lockable type `stop' pushbuttons in the control circuits.

All electrical equipment operating on 415 V or higher voltage shall be provided with caution notice boards of approved type and shall be affixed permanently in a conspicuous position.

Where a group of equipment is located within a switch / control room or within a fenced area, the notice board shall be fixed at the entrance. Where a group of equipment is located within a switch / control room or within a fenced area, the notice boards of approved type and shall be fixed at the entrance.

All moving parts of the equipment which are exposed and liable to cause hazard to the operating and maintenance personnel shall be suitably protected by metallic guards.

In front of the entire (all) switch boards rubber mats shall be provided for personnel safety.

Open type control panel or open type busbars shall not be installed inside the plant/ building.

18. TESTING AND COMMISSIONING

The inspection and testing shall be carried out in accordance with Indian Electricity Rules 1956 and IS 732 (PART – 3) Inspection and Testing of Installation by the Contractor in the presence of Architect / Engineer in charge / representative. In the event of defects being found, these shall be rectified as soon as practicable and the installation re-tested free of cost. Some of the Test and Inspections to be carried out are:-

a) General inspection of complete installation with respect to conformity with Indian Standards and Indian Electricity Rules.

b) General workmanship (Earthing, cables, bolt, connections etc).

c) Testing of Insulation Resistance of all cables and wires.

d) Testing of Earth continuity path

e) Testing of Polarity of Single Pole switches.

f) Lighting circuits to be tested for resistance to earth in the following ' manner:-

- All switches 'ON' with consuming devices in circuit
- All switches 'ON' with consuming devices removed the IR values between poles and E

- All switches 'ON' with consuming devices in position the IR between poles and E

g) Testing the earth resistance of earth pits and full earthing grid as a whole.

h) Test specified by manufacturer's for particular equipment.

i) Check for 'DANGER BOARD' sign wherever required and shall be supplied and erected at free of cost.

All Panels and DBs shall be subjected to High Voltage Test (2500 Volts for one minute) and Megger Test and Test Report shall be submitted by the Contractor before dispatch of the panel (wherever applicable if required).

19. Energy Meter:

The energy meter shall be of 3 Ø 4 wire 415V AC 3 x (20A-100A) whole current Electronic **Energy Meter (shall be approved by Architect)**. The Meter to be supplied must be tested from any of the NABL/ BIS Accredited Testing-Calibration Laboratories. The Energy meter shall be installed at the separate housing within an enclosure. The CTs shall be copper wound resin cast bus bar mounting type. The same will have communication port RS-232 or higher.

20. SAFETY

The Contractor shall maintain in a readily accessible place first aid appliances including adequate supply of sterilised dressings and cotton wool.

An injured person shall be taken to a public hospital without loss of time, in cases where the injury necessitates hospitalisation.

No portable single ladder shall be over 8 metres in length. The width between the side rails shall not be less than 30 cm. Clear and the distance between two adjacent rungs shall not be more than 30 cm. When a ladder is used an extra mazdoor shall be engaged for holding the ladder.

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 ending or railing whose minimum height shall be one metre.

Workers employed on mixing and handling material such as asphalt, cement, mortar shall be provided with protective footwear and rubber hand gloves.

Hoisting machine and tackle used in the works, including their attachments, anchorage and supports shall be in perfect condition.

The Architect / Employer reserves the right to instruct the Contractors to take additional safety precautions if found necessary. All workers shall be provided with helmet, Safety Shoes and Safety belts.

(i) These specifications are not meant to be exhaustive and prescribe the minimum acceptable standards. Where these do not cover certain items and aspects the best engineering practice shall be followed:

(ii) All codes and standards mean the latest. A list of I.S. Codes is attached to these specifications as an annexure. This list is also meant to be exhaustive and all relevant codes with divisions published on date shall be applicable.

21. ADDITIONAL CONDITIONS:

1. GENERAL

1.1 The entire electrical installation work shall be carried out in accordance with approved Drawings and in general conformity with the requirements of the Indian Electricity Act, 1910 ,the Indian Electricity rules, 1956, the relevant I.S.codes of practice, as amended to date, Wherever applicable and the regulations of the local licensing bodies/CEIG/CEA/ EB., and where such installations are subject to inspection and approval of fire insurance and Explosives Authorities the Installation shall be planned and executed also confirming to their Regulations/rules.

1.2 Rates for all items of work are deemed to include costs for all operations involved in adhering. To the specifications (including the IEE Rules/Regulations of the local licensing Authority/CEIG/CEA/EB of the Fire Insurance/Explosives Authorities, the I.S.S.) Unless there is a provision to the contrary in the schedule of quantities

1.2 .1 The specifications herein and the IEE Rules/Regulations of the local licensing authority. EB /CEIG / CEA and of the Fire Insurance/Explosives Authorities, the latter shall prevail

1.2.2 The specifications herein and the I.S.S. the former shall prevail

2. DRAWINGS AND SCHEDULES

The tender documents include only the general plan, the main and sub main circuit diagrams. These show the general scheme of distribution The tenderer should feel that the design, the specifications or the drawings/layouts require modifications either due to manufacturing practice or special requirements under regulations/rules or for the other substantial reasons he is required to set out in his covering letter the modifications needed, stating reasons there for, with complete information to enable the Employer to properly appreciate the modified proposals. The tenderer shall quote for the tender proposal but state separately the rates/sums necessary for such modifications, as alternatives.

The contractor shall prepare detailed drawings are which are necessary complying with the requirements under the para-1 `General' above, proper execution of the work and under the approval of the architect .

3. SUPERVISION

From the contractor's side work shall be carried out by person/persons holding certificates of competency of appropriate class issued by the respective State Government bodies authorized to issue such certificates under statutory rules and regulations in force. The name/names of such supervising personnel shall be approved by the Project Management Consultant.

4. TESTING, MANUFACTURER'S TESTS, PRE-COMMISSIONING TESTS AND COMPLETE COMMISSIONING

The General intent of this specification is to mention the relevant tests to be done and finished to the employer by the contractor. These are guide lines. However the contractor shall carry out such tests and complete all formalities as per relevant **Indian standard specification**s, Tariff Advisory Committee's rules and Fire insurance requirements and/or Electricity rules and Regulations as per Government Gazette and publications.

4.1 Testing of equipment:

All the LT panels shall be subjected to factory tests as per BIS (Routine tests). These tests shall be witnessed by representative of the client and architects. The book let published by BS or IS (as the case may be) on these tests shall be made available in advance before the tests are carried out to the owner and architect. The contractor shall produce Type Tests reports on the type tests conducted by equipment vendors on similar equipments for our verification and approval.

All equipment before installing at the site shall be tested and all such results produced to the employer). Nothing shall absolve the contractor from re-performing any tests that contractor may be called upon specifically by architect/ employer/supply company or Electrical inspector. All equipments shall be tested jointly with the architect/ employer as required by various sections of specifications and test data shall be furnished as required.

The travel expenses, Boarding and lodging expenses for the client's representatives and Project Management Consultant has to be borne by the contractor only.

4.2 Pre- commissioning tests:

All rules, regulations and requirements of Electrical inspector/ government or local authorities and of Indian standard specifications and/ or rules and

regulations stated in the Indian Electricity acts shall be strictly complied.

On completion of erection, the contractor shall clean all the equipments thoroughly and inspect the entire installation for correctness and shall furnish a report of completion to the Project Management Consultant/ Employer. Pre commissioning tests shall commence only on approval of this report by the architect/Employer.

All tests and certification there of shall only be carried out by those authorized, skilled, experienced and certified permit holders of the supervisor category of State/ central electrical licensing authority.

4.3 Commissioning:

Contractor shall furnish all the necessary tests and test reports to Electrical supply Authorities and complete formalities required to comply as per Rules and Regulations laid down by them. If called on, the contractor shall carry out all such tests and prove the results to the entire satisfaction of the Electric Supply Authorities.

All such documents forwarded and / or letters and/ or correspondence exchanged in this regard shall be made available for inspection and the contractor shall furnish 3 sets of such documents and drawings for the employer's records.

5. Documents, certificates, Drawings and spare requirements:

The intent of this specification is to give a guideline to the contractor to furnish in reproducible all sets of relevant papers and lists of spares for the continuous performance of the electrical installation. Nothing shall absolve the contractor from finishing any information document/ or papers that have not been specifically stated herein.

Documents:

All relevant maintenance and operation manuals and dated of all electrical equipment supplied and erected by the contractor on the site shall be bound and finished to the Employer.

All relevant test certificates etc and as more specifically stated in clause, shall be furnished. Contractor shall also furnish all such certificates issued by the original manufacture towards guarantee of performance of all equipments supplied.

Drawings:

All working and erection drawings of the final erected plan of all electrical installation work in reproducible of equipment such as 11 KV RMG, 11 KV switch

board,LT metering panel, 11 KV and LT cable routing, sizing, connection diagrams, circuits, wiring diagrams etc shall be furnished to the employer. The employer reserves the right to the mode of submission of such details being furnished by the contractor.

Spare requirements:

The contractor shall not with standing anything stated otherwise, furnish lists of recommended maintenance tools, spares, fuses, sets, codes, catalogues, appropriate pricing, original equipment manufacturer's address etc to the Employer. Prior to such furnishing contractor shall make a proper assessment of all such requirements and then proceed to make lists. The contractor shall also be deemed to have understood the requirements, in such a way that it ensures a continuous operation and functioning of the Electrical Equipment under the stated ratings conditions and specifications.

6.WORKMANSHIP:

First class workmanship and neat appearance are essential requisites for compliance with these specifications.

7. CODES AND STANDARDS

All equipments including cables, wires and components thereof should be manufactured and installed as per the standards specified by Bureau of Indian Standards (BIS). Where such standards do not exist, then the covered item should got approved from the Project Management Consultants/ Employer prior to purchase and delivery at site.

IEC 62 271-100/IEC 60 056/IS 13118:1991 - Specification for alternating
IEC 62 271-200 current circuit breakers.

IEC 60044-1/IEC 60185/IS 2705:1992 - Current Transformer.
IEC 60529/IS 13947(Part-1) - Degree of protection provided by Enclosures for low voltage switchgear and Control gear.

LT panels	As per IE and EB standards / IEC -61439
MCB	IS/IEC-60898-1
RCCB	IS-12640 (Part-2), IEC-61009
1.1 KV cables	IS-1554-Part-1.
Earthing	IS-3043-1987.
MCCB	IEC/ IS 60497

Indian Electricity Act and Rules:		1951 and subsequent amendments
National electric code	:	With amendments
National building code	:	2016
Indian Electricity act	:	2013

Description of Scope of Works - Electricals

The following are the scope of works to be carried out by the contractor.

1) Wiring of light fittings in the main auditorium, balcony and stage with 3R 1.5 Sqmm FRLSH multi strand copper wire drawn in FR PVC conduit to be laid in perforated cable trays across the main auditorium and connecting them with light fittings (2 lights in one circuit/3 lights in one circuit/4 lights in one circuit etc as per BOQ and controlled directly from LDB.
2) Supply and fixing of LED down lighters in the main auditorium and stage on the false ceiling as per the layout drawing and handing over the existing fittings to the client.
3) Supply and fixing of LED strip lighting on the cove provided in the periphery of the false ceiling in the auditorium.
4) Replacement of single phase MCB DBs existing with 7-sement DB on both sides of the stage in first floor and second floor levels for both LDB and PDB and handing over the old DBs to the client.
5) Supply and replacement of 450mm dia heavy duty exhaust fans to be fixed above the false ceiling at existing location and handing over the old fans to the client.
6) Wiring for the exhaust fans with 3R 1.5 Sqmm FRLSH multi strand copper wire to be terminated in the PDB (2 nos exhaust fans in one circuit) .
7) Supply and fixing of 1 KVA sine wave inverter along with tubular lead acid batteries suitable for a back up of 1 Hr to be wired to the cove lighting for emergency purpose
8) Replacing the existing 16A switched sockets fixed on the stage, green rooms, press rooms etc with modular 6/16A switched sockets and handing over the old ones to the client. The existing wiring to be terminated in the newly fixed sockets.
9) Supply and fixing of 32A 5-pin socket and plug of polycarbonate material to be fixed on both sides of the stage and terminating 3.5x25 Sqmm aluminum armoured cable drawn from Auditorium main panel
10) Supply and installation of A/C panel-1 and 2 for auditorium to be installed in the left side and right side AHU rooms on the third floor level. The panels shall confirm to the SLD provided in the tender.
11) Laying and terminating of copper armoured XLPE cables along with 2R 10 SWG copper wire from A/C Panel 1&2 to the various A/C indoor and outdoor units as per the SLD. The cables to be routed in GI perforated cable trays.
12) Supply and laying of 3.5x240 Sqmm aluminium armoured XLPE cable from existing A/C panel in the basement floor (2 nos 400A TPN outgoing feeders) and terminating the same at both ends.
13) Supply and installation of 2 nos 100mm dia 3 Mt long castn iron pipe electrode in the ground as per the instructions of architect and conforming to IS-3043,interconnecting the same to A/C panel-1&2 with 25x3mm copper tape.
14) Supply and installation of 4 nos of 100 MM Dia cast iron pipe 3mts long including all the accessories as per standard earth drawing, filling the same with alternate layers of charcoal, salt & river sand and making of brick masonry chamber 600 x 600 x150 MM with cement plastering both inside and outside. The chamber shall have the cast iron cover of 10 mm thick with cast iron frame.

15) Supply and installation of 25x3mm copper tape as down conductor from both the lightning arrestors and connecting them to 2 nos earth electrodes.
16) Supply and fixing of GI perforated cable trays to be fixed on steel truss above false ceiling and also fixed in wall for routing of light wiring conduits, armoured cables, fire alarm cables etc.
17) Supply and fixing of beam detectors below the false ceiling for detection of any smoke in the auditorium.
18) Supply and fixing of photo electric smoke detectors above false ceiling.
19) Supply and fixing of response indicator below false ceiling.
20) Supply and fixing of 4-zone conventional fire alarm panel.
21) Wiring of light fixtures in the ground floor dining hall.
22) Removal of existing 300x300mm CFL fitting and supply and fixing of LED fixture in the corridors for ground, first and second floors. The existing wiring shall be re terminated to the new lighting fixtures
23) Supply and fixing of 90W LED floor lights above false ceiling for maintenance purposes.
24) Scaffolding will be provided by Bank through other agencies.

SAFETY CODE

FIRST AID

1. At every work place, there shall be maintained in readily accessible place first aid appliance including supply of sterilized dressings and sterilized cotton wool. The appliance shall be kept in good condition, and in large work place, they shall be placed in charge of a reasonable person who shall be readily available during working hours.

2. At large work places, where hospital facilities are not available within easy distance of the works, first aid posts shall be established and be run by a trained compounder.

3. In every work place, there shall be provided and maintained at suitable places, easily accessible to labour sufficient cold water fit for drinking.

SCAFFOLDS

1. Suitable scaffolds shall be provided for workmen for all works that cannot safely be done from the ground, or from solid construction except in the case of short duration work which can be done safely from ladders. When a ladder is used, it shall be of rigid construction made either of good quality wood or steel. The steps shall have a minimum width of 450 mm and a maximum rise of 300 mm. Suitable hand holds of good quality wood or steel shall be provided and the ladder shall be given an inclination not steeper than ¼ to 1 (1/4 horizontal and 1 vertical).

2. Scaffolding or staging more than 4 m. above the ground floor, swung or suspended from an overhead support or erected with stationary support shall have a guard rail properly bolded, braced or otherwise secured, at least 1 m. 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.

3. Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally and if the height of the platform, gangway or stairway is more than 4 m. above ground level or floor lever, they shall be closely boarded and shall have adequate width and be suitably fenced as described in (2) above.

4. Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 1 m.

5. Wherever there are open excavations in ground, they shall be fenced off by suitable railing and danger signals to be installed at night so as to prevent persons slipping into the excavations.

6. Safe means of access shall be provided to all working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 m. in length while the width between side rails in rung ladder shall in no case, be less than 290 mm. for ladder up to and including 3 m. in length. For longer ladders this width shall be increased at least 20 mm for each additional meter of length.

7. A sketch of the ladders and scaffolds proposed to be used shall be prepared and approval of the Engineer obtained prior to construction.

OTHER SAFETY MEASURES

8. All personnel of the contractor working within the plant site shall be provided with safety helmets. All welders shall wear welding goggles while doing welding work and all metal workers shall be provided with safety gloves. Persons employed on metal cutting and grinding shall wear safety glasses.

9. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public.

EXCAVATION & TRENCHING

10. All trenches, 1.25 m. or more in depth shall at all times be supplied with at least one ladder for each 30 m. in length or fraction thereof. The ladder shall be extended from bottoms of the trench to at least 1 m. above the surface of the ground. Sides of trenches which are 1.5 m. 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 m. of the edges of the trench or half of the depth of the trench whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done.

11. The contractor shall take all measures on the site of the work to protect the public from accidents and shall be solely bound to bear the expenses of defence of every suit, action or other proceedings at law that may be brought by any persons for injury sustained owing to neglect of the above precautions and to pay any such persons or which may with the consent of the contractor, be paid to compromise any claim by any such person. No future claim shall be entertained / made against the bank in this regard.

DEMOLITION

12. 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 electric 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 pre-cautions steps shall be taken to prevent danger to persons employed from the risk 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.

PERSONAL SAFETY / PROTECTIVE EQUIPMENTS

13. All necessary personal safety equipment as considered adequate by the Engineer should be kept available for the use of the person 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.

a. Workers employed on mixing asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective goggles.

b. Those engaged in white washing and mixing or stacking of cement bags or any material which is injurious to the eyes shall be provided with protective goggles.

c. Those engaged in welding works shall be provided with welder's protective eyesight lids.

d. Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

e. 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 manholes and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident to the public.

f. The contractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead or any toxic material in any form. Wherever men above the age of 18 are employed on the work of such painting, the following precautions should be taken:

i. No paint containing lead or lead products shall be used except in the form of paste or readymade paint. Paints like vinyl and epoxies having toxic fumes should be applied after following all precautions laid down by manufacturers.

ii. Suitable face masks should be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

iii. Overalls shall be supplied by the contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.

14. When the work is done near any public place where there is risk of drowning all necessary equipments should be provided and kept ready for use and all necessary steps taken for prompts rescue of any person in danger and adequate provision should be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

HOISTING MACHINES

15. Use of hoisting machines and tackle including their attachments anchorage and supports shall confirm to the following standards or conditions:

a. These shall be of good mechanical constructions sound material and adequate strength and free from patent defect and shall be kept in good repair and in good working condition.

b. Every rope used in hoisting or lowering materials of as 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 shall be in charge of any hoisting machine including any scaffolding winch or give signals to operator.

d. In case of every hoisting machine and of every chain ring hook, shackle shovel and pulley block used in hoisting or as means of suspension the safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with the safe working load. In case of a hoisting machine having a variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose or testing.

e. In case of departmental machines, the safe working load shall be notified by the Engineer. As regards contractor's machines, the contractors shall

notify the safe working load of the machine to the Engineer whenever he brings any machinery to site of work and get it verified by the Engineer concerned.

16. Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with such means as will reduce to the minimum of the risk or any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations which are already energised, 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.

17. 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.

18. Adequate washing facilities should be provided at or near places of work.

19. These safety provisions should be brought to the notice of all concerned by display on a notice board at a prominent place at work spot. The person responsible for compliance of the safety code shall be named therein by the contractor.

20. To ensure effective enforcement of the rules and regulations relating to safety precautions the arrangements made by the contractor shall be open to inspection by the Labour Officer, Engineers of the Department or their representatives.

21. The contractor is solely responsible for the safety and security of the workmen engaged by him or his subcontractors in this project.

22. Notwithstanding the above clause from (1) to (21), there is nothing in these to exempt the contractor from the operations of any other Act or Rule in force in the Republic of India.

TECHNICAL SPECIFICATION FOR ROOF TOP SOLAR PV SYSTEM

BRIEF SCOPE OF WORK

1) The contractor shall **Design, Engineering, Supply Installation, Testing and Commissioning and Operation & Maintenance of 55kWp Grid interactive Solar Photo Voltaic system at Indian Bank's IMAGE Auditorium at MRC Nagar, Raja Annamalaipuram, Chennai - 600 028**

2) The contractor shall also obtain necessary clearances/approvals for installation of 55kWp grid interactive solar power plant from the competent authorities. The copy of the approvals, certificates has to be submitted to the Employer. The contractor is responsible to obtain the necessary clearances/approvals for installation/operation of 55kWp KW grid interactive solar power plant and also for power purchase/sale from the competent authorities, if required. Liaisoning for getting all mandatory approval pertaining to subsidy / Net metering etc. ***The contractor shall also obtain necessary clearances /approvals for installation of 55kWp grid interactive solar power plant from the competent authorities of HO:Main Building.*** Payment to the prospective contractor for this liasoning work (as per the BOQ) in getting project approval from TEDA/MNRE will be released only on submission of approval for the subject project to the Bank and payment to the prospective contractor for liasoning work (as per BOQ) in getting net-metering will be processed only after installation of net-metering in the IMAGE by TANGEDCO / respective agency for the subject project.

3) The solar panel shall be installed at a suitable height and the entire arrangement shall withstand wind speed of 180 KmpH

4) The structure and solar panel drawings with weight shall be vetted by Architect /Employer before installation of solar power plant. The contractor shall not damage the existing water proofing done on the roof while installation of support structures of solar power plant. They have to get prior approval for the civil works that has to be carried out for support structures at terrace of building from Architect / Bank. In case of any damage done to the water proofing and detect leakage due to the same, the contractor will be responsible to rectify the same at their cost to the full satisfaction of the bank.

5) Solar Power plant Single line diagram/ General Arrangement / technical documents / civil drawings / Support structures / Cable race way layout including installation details shall be approved by the Architect / Employer before installation of solar power plant.

5) The contractor shall visit the site, understand the site logistics and access the *actual requirement before submitting tender.*

7) The complete electrical system arrangement, installation, including laying of cables / wiring, installation of support structures, civil works shall be done in consultation with Architect / Bank's Engineer in charge.

8) A copy of SLD, GA, Circuit diagrams, drawings of civil works shall be submitted to the Architect / Bank at the time of installation.

9) The complete setup from design, engineering, supply, erection and commissioning including grid connectivity and Operation & Maintenance of Solar PV System is under contractor's scope.

10) Suitable Energy meter with time totalizer shall be supplied and installed as directed by Architect / Employer as per specification given in the tender to monitor the daily generation.

11) The operation & maintenance of Solar Photovoltaic Power Plant for a period of **05** years (in addition to DLP period of one year) would include wear, tear, overhauling, machine breakdown, insurance, and replacement of defective modules, invertors / Power Conditioning Unit (PCU), spares, consumables & other parts as per warranties & guarantees given in the tender.

12) During O&M period of 5 years (in addition to DLP period of one year) contractor shall carryout the works as per the schedule give the tender document.

13) The contractor shall make necessary arrangements to safe gurad and maintain the solar power plant from seasonal changes, thefts, etc. for the entire AMC (O&M) period.

14) Contractor will comply with all the IE Rules. 1956, Indian Electricity Act. 2003 and regarding the work of repairs and maintenance

16) The SLD & Available terrace area given in the tender is indicative only. The bidder is completely responsible for preparation of drawings etc, site survey before submitting the bid and after award of contract (successful bidder).

****

Outline scheme of the project

i. The array capacity of the proposed grid connected PV power plant shall be 55 KWp.
ii. PV array should be installed as indicated in the layout drawing and supported by concrete blocks to be prepared at site. The installation is on the roof top of the Indian Bank, IMAGE building.
iii. The power plant shall be connected to the existing (Bank) LT system through 2 nos grid tie string inverters of 25 KW capacity each and with output voltage of 415V 3-phase, 50 HZ AC.
iv. The inverters shall be located in the electrical room at the terrace as per the layout drawing
v. The output of the 3 nos grid tie inverters are to be terminated to a inverter combined panel which is also located in the inverter room.
vi. The output of the inverter combiner panel shall be terminated to the Main LT panel located in the basement floor.
vii. The energy meter will be fixed in the combiner panel.
viii. The interface ports provided in the grid tie string inverters will measure the amount of energy generated and same will be wired to the monitor.
ix. The SPV power plant to be installed should be robust, economic. Efficient and time tested.

2.0 Solar PV Modules

The cell of the modules shall be polycrystalline. The capacity shall be considered as 330Wp per module. The approx number of modules shall be 168 nos. The PV modules shall qualify IEC-61215 or IS-14286 and IEC-61730. The proposed PV modules have test certificates issued from accredited test laboratories of MNRE (Ministry of new and renewable energy). Test certificates issued by IEC accredited laboratories are also acceptable. The proposed PV modules shall be manufactured in India.

Each PV module used in this project must use an RF (Radio frequency) identification tag. The information must be mentioned in the RFID tag used in

each module as per guide lines of MNRE which must be inside the laminate and able to withstand harsh environment condition.

Technical specification of the PV Module shall include but not limited to the following:

Sl. No	Item	Description
1.0	Certification	i) IEC 61215 or IS 14286 ii) IEC 61730
1.1	Test certificate issuing authority.	NABL/ IEC Accredited Testing Laboratories or MNRE accredited test centers (preferably the latest).
2.0	PV Cell	
2.1	Type	poly crystalline
2.2	Size	156mm x 156mm
3.0	PV Module	
3.1	Rating at STC	330Wp, 72 cells (without any negative tolerance)
3.2	Efficiency	Minimum 14%
3.3	Fill factor	Minimum 70%
3.4	Withstanding voltage	1000V DC
3.5	Glass	Toughened
3.5.1	Thickness	3.2 mm (minimum)
3.5.2	Type	High transmission, low iron, tampered & textured
3.6	PV Module Junction Box	
3.6.1	Protection level	IP 65 or above
3.7	Bypass Diode	
3.7.1	System Voltage (Vsys)	1000 V dc
3.7.2	Number	3 numbers
3.8	Module Frame	
3.8.1	Type	Anodized aluminum frame

3.0 PV Array

Specification of the PV Array shall include but not limited to the following:

Sl. No	Item	Description
1.0	Nominal Capacity	55kWp
2.0	PV Module interconnection connector	MC-4
3.0	PV Module interconnection cable and array cable	PV 1-F standard / NEC standard "USE-2 or RHW-2" type (double insulated)
4.0	PV array String Voltage	Compatible with the MPPT Channel of the inverter
5.0	Number of Parallel String against	02 Nos (Maximum) / AS Specified by manufacturer

4.0 Array Structure

i) PV Array shall be installed at the Roof top of the Corporate office Building of Indian bank.

ii) PV Array structures shall be of GI with combination of either of I, C, L or T sections MS flat as per structure design requirement. The structure should be capable of withstanding **a wind load of 180 km/hr after installation (Structural design document to be submitted by the contractor)**

iii) Weight of the Metallic part of PV Array structure excluding nuts and bolt must be minimum same as the Weight of the total PV Module**.**

iv) Structural shall be corrosion resistant and electrolytically compatible with the materials used in the module frame, its fasteners, nuts and bolts.

v) The array structure shall be made of hot dip galvanized MS structure of minimum galvanizing thickness **120 micron (Test certificate to be submitted by the contractor from standard testing laboratory to prove the thickness of galvanization)**

vi) Structures shall be supplied complete with all members to be compatible for allowing easy installation.

vii) The module mounting structure shall have to be designed and fabricated with optimum tilting angle considering the site conditions.

viii) The structure shall be designed for simple mechanical and electrical installation. It shall support Solar Photo Voltaic modules at a given orientation, absorb and transfer the mechanical loads to the ground.

ix) All fasteners for supporting conduits, nut & bolts shall be made with stainless steel of grade SS314 except foundation bolts and the nuts and bolts to be used for connection of earth strip with module mounting structure which will be of MS (GI Coated).

x) Supporting structures including module Mounting structure shall have to be adequately protected against all climatic condition. The array structure shall support SPV modules at a given orientation and absorb and transfer the mechanical loads to the columns properly.

xi) The structures shall be designed for simple mechanical and electrical installation.

There shall be no requirement of welding or complex machinery at the installation site. Required civil work or support platform is absolutely essential to install the structures, detailed engineering drawings and instructions for civil and other works shall got approved from the competent authority before carried out at the site.

xii) The Specification of the GI sections, flats must be as per **IS 808**

xiii) The supplier shall specify installation details of the PV modules and the support structures with appropriate diagrams and drawings.

5.0 PV Array Junction Box (AJB)

Array Junction Box (AJB) shall have to be used for termination of string prior connecting array with each inverter. There shall be two Arrays Junction Box incase, the inverter is located elsewhere away from PV Array. The desired specification of the PV Array Junction Box and accessories shall include but not limited to the following:

Sl No	Item Description	Desired Data
1.0	Enclosure	
1.1	Degree of Protection	IP65 with UV Protected
1.2	Material	Polycarbonate.
1.3	Withstanding voltage	1000V DC
1.4	Withstanding Temperature	100 ^{O}C
1.5	Accessories mounting	DIN Rail
1.6	Number of Strings entry	As may be required
2.0	Cable Entry and Exit	
2.1	Position	Bottom at cable entry and exit
2.2	Cable Entry and Exit connector type	MC 4 Connector (PV Array String cable)
2.3	Cable gland	Earthing cable entry
3.0	Surge Protecting Device (SPD)	
3.1	Type	DC
3.2	Approved Make	OBO Betterman / ABB/ Legrand
3.3	Protection class	Type B+C
3.4	Number of set	As may be required as per string
3.5	System Voltage	Matched with System Voltage 1000
4.0	Fuse with fuse holder	
4.1	Position	Positive and negative terminal for each series string
4.2	Type	Glass fuse, for PV Use only
4.3	Rating	Current: Minimum **1.25** times the rated short circuit current of the string

6.0 Grid Connected Inverter

The inverters shall be of string inverter. The proposed 55kWp grid connected solar PV power plant shall be connected with grid. As such, the inverters shall be compatible to operate with existing utility supply. The PV system shall comprise of **two (02) numbers** of grid tie inverters each of nominal capacity 25 KW.

Specification of each 25 KW inverter shall include but not limited to the following:

Sl. No.	Operating Parameter	Desired specification

1.0	Type	Grid connected String Inverter
2.0	Usage	Specially used for PV system
3.0	Standards	
3.1	Efficiency Measurement	IEC 61683/ Equivalent BIS Std.
3.2	Environmental testing	IEC 60068-2 (1,2,14,30) / Equivalent BIS Std.
3.3	Interfacing with utility grid	IEC 61727
3.4	Islanding Prevention	IEC 62116
3.5	Type Test certificate issuing authority	NABL/ IEC Accredited Testing Laboratories
4.0	**Input (DC)**	
4.1	PV array connectivity capacity	12 kWp (minimum)
4.2	MPPT Voltage range	Compatible with the array voltage
4.3	Number of MPPT Channel	2 nos (Minimum)
5.0	**Output (AC)**	
5.1	Nominal AC Power output	25 KW
5.2	Number of Grid Ph	3Ø
5.3	Adjustable AC voltage range	Programmable as per grid condition 360V-
5.4	Frequency range	47-53 Hz
5.5	AC wave form	Sine wave
5.6	THD	Less than 3%
5.7	Switching	High frequency transformer / transformer
6.0	General Electrical data	
6.1	Efficiency (Maximum)	95 %
6.2	Sleep mode consumption	Less than 5 W
7.0	**Protection**	
7.1	DC Side	1. Reverse-polarity protection Reverse current to PV array protection, over voltage, Under voltage protection
7.2	AC side	1. DC inject protection to grid less than1% 2. Over voltage and Under voltage 3. Over current Over and under grid frequency protection,
7.3	Isolation Switch	1. PV array Isolation switch (DC)
7.4	Ground fault detection device (RCD) which can detect changes in ground current. Rating shall be	To be provided for transformer less inverter.
8.0	Display	
8.1	Display type	LCD Display
8.2	Display parameter	
8.2.1	DC	Voltage Current Power
8.2.2	On grid connected mode	Line status Grid voltage Grid frequency Export Power Cumulative Export Energy

9.0	Interface (Communication protocol)	Suitable port must be provided in the inverter for i) On site upgrade of Software, On site dumping data from the memory, Web based remote monitoring
10.0	Web monitoring	Matched with the monitoring and data
11.0	Mechanical Data	
11.1	Protection Class	IP 65 or higher
11.2	Operating ambient	0^{0} C to 60^{0}C
11.3	Cooling	Natural / forced cooling

7.0 Web enable on line data logger and Remote Monitoring Unit:

Web enable data logging system may be an integrated part of the inverter or a separate unit. The data logging system includes **MPPT wise PV array monitoring** system also. The data Logger should have the provision of recording **the data of solar insolation (the amount of solar radiation reaching in a given area), PV cell temperature and ambient temperature and associated electrical parameters** at different stages to study performance of system as well as to study status of the system at a particular instant. The data logger should have required transducer to monitor and record the required system data. **The data logger should be provided with an insolation sensor and a module temperature sensor, ambient temperature sensor matched with the system**.

The data logger shall have reliable battery backup and data storage capacity (minimum two days data) to record all sorts of data simultaneously round the clock. Web based Remote Monitoring system must be compatible with data logger.

The Web based monitoring system should have the provision of graphical representation of the data shall include but not limited to the following:

7.a – Web based monitoring system:

Sl. No.	Operating Parameter	Desired specification
1.0	Input data	PV Power PV Energy
2.0	Meteorological data	Insolation Module Temperature Ambient Temperature
3.0	Output data	
3.1	Inverter	Export Power Export energy

All data shall be recorded chronologically date wise. The data file should be MS Excel/XML/or any readable form compatible and should have the facility of

easy download. The system should be connected to the standalone PC trough Cat-6 cabling kept at the building management control room at ground floor.

7.b – Stand alone PC (01) nos with the following configuration:

Sl. No.	Operating Parameter	Desired specification
1.0	Software operating system	Windows 8
2.0	Hardware optical drive	CD ROM/DVD
3.0	Hardware memory	4GB RAM
4.0	Hardware drive	500GB
5.0	Monitor	18.5" LED
6.0	Mouse	Wireless
7.0	Keypad	Standard Microsoft

7.c- Ethernet Switch

Sl. No.	Operating Parameter	Desired specification
1.0	No of ports	8
2.0	Standard	IEEE 802.3u 100 base TX IEEE 802.3u 10 base-T
3.0	Network media	UTP cat 6
4.0	Power Adapter	7.5 V 1A (EXT)
5.0	Back plain bandwidth	3.2 Gbps

7.d- Ethernet Cable

Operating Parameter	Specification
Material of conductor	: Annealed copper 24 SWG
Insulation	: Solid polyethylene 0.94mm dia
Pair colour code	: Blue/white- blue, orange/ white- orange Green, white- Green, brown/ white- brown
Input impedance (0.722-100 Mhz)	: 100 + 15Ω
Mutual capacitance	: 5.0 nF/ 100 m
Capacitance unbalance	: 330pF/100 m (Max)
Velocity of propagation	: 0.7 c (Solid)
ACR (Solid)	: Min. 10 db at 125 Mhz
Test frequency	: 100 Mhz
Band width	: 100 Mhz
Wave length	: Not applicable for copper cables
Data Rate	: 100 Mbs
Distance support	: 100 mt
Standards followed	: ISO/ IEC-11801, CENELEC EN 50173, ANSI/ TIA/

EIA 568-A/B	
Category	: 5/ 5e
Certifications UL	: NEMA WC63.1, CM, CMR, IEC 332-1, ETL verified

8.0 Inverter Combiner Panel

Each of the output of the two (02) Nos Inverters shall be terminated in a Combiner Panel (indoor wall mounting type) through 63A 415V 4 pole MCB at the in incoming side (Inverter side). The outgoing side (Grid side) shall be connected through a 125A 415V 50 kA TPN MCCB. The set of AC surge suppressor (Surge protection Device) shall be connected at the outgoing bus.

9.0 Energy Meter :

Two number 3 Ø 4 wire 415V AC 3 x (20A-100A) whole current Electronic **Energy Meter (Main metering & Check metering)**. The Meter to be supplied must be tested from any of the NABL/ BIS Accredited Testing-Calibration Laboratories. The Energy meter shall be installed at the separate housing within an enclosure. The Energy meter shall be installed at the combiner panel. The CTs shall be copper wound resin cast bus bar mounting type. The same will have communication port

RS-482 for data logging.

10.0 Cables & Wirings:

The Specification of wiring material of PV Power plant shall include but not limited to the following:

Sl No	Item	Description
A	DC Cable	
1.1	Conductor	Tinned annealed stranded flexible copper according to IEC 60228
1.2	Standard	PV-1F / 2 PfG 1169/08.2007 / VDE Standard
1.3	Make	LAPP/Top Solar/Nexans/ Schneider
B	AC Cable	
2.1	Rated Voltage	1.1kV
2.2	Construction	
2.2.1	Type	Armored or unarmored as per
2.2.2	Conductor	Stranded flexible copper
2.2.3	Insulation	PVC
2.2.5	Standard	IS : 1554 -1
2.3	Make	RR Cable/ Polycab/LAPP/ Havell's
C	PVC Conduit tees, bends etc	
3.0	Standard	ASTM D 1785 u PVC

3.1	Ambient Temperature	0 ^{O}C to 50 ^{O}C
3.2	Type	UV stabilized , temperatures, Shock proof
3.3	Make	Oriplast /Supreme
D	GI Pipe	
2.0	Make	TATA- B class

Notes:

(i) All the Array Junction Boxes shall be located at the rear side of the solar array.

(ii) The equipment / structure of the equipment fixed on the array structure then suitable insulation must be provided between Array structure and the equipment and equipment structure.

(iii) The minimum clearance of the lower edge of the equipments from the developed ground level shall be maintained as standard practice.

11.0 System, Equipment, Array structure

i. Array Structure must be earthed with GI Strip

ii. The complete earthing system shall be electrically connected to provide return to earth from all equipment independent of mechanical connection.

iii. The equipment grounding wire shall be connected to one grounding electrode per PV power plant.

iv. Test point shall be provided for each earth pit.

v. An earth bus and a test point shall be provided inside the room / location where we are installing the inverter and combiner panel.

vi. Earthing system design should be as per the standard practices and conforming IS-3043.

vii. The earth electrode shall be maintenance free chemical type

viii. The Code of Practice Earthing shall be IS 3043:1987

ix. Necessary provision shall be made for bolted isolating joints of each earthing pit for periodic checking of earth resistance.

x. Minimum six (06) numbers of earth pit. Earthing Pit Cover Needs to be provided (3 nos for neutral earthing of 3 nos inverters and 3 nos for general earthing of all other equipments)

xi. Earth Grid must be made by inter connection of earth pit through GI Strip. The size of the GI earth strip must be minimum **25 x 3 mm**. The thickness of the galvanization should not be less than 610gr/M2.

12.0 Lightning Protection

The building is already provided with lightning protection which will cover the solar module areas also.

13.0 Signage:

Safety Signage: Safety Signage must be provided mentioning the level and type of voltage and symbols as per IE Rule at different position as may be required.

The Solar PV System Caution Stickers shall be fixed in the following locations.

(a) On the Main LT Panel were the solar power is terminated.
(b) Near PV Modules / Junction Box / Combiner panel / Inverter / Soar Generation Meter.
(c) And signage at locations as per the requirement of CEA/TANGEDCO

The above stickers shall be non-corrosive caution label with the following text:

WARNING – DUAL POWER SOURCE

The size of the caution label shall be 105mm (width) x 20mm (height) with white letters on a red background.

14.0 Provision for Module Cleaning

Module Cleaning: Necessary arrangement and equipment is to be provided to facilitate easy cleaning of the PV Modules

15.0 Fire Buckets and Fire Bucket holding stand

Fire Bucket of minimum quantity eight (08) numbers and Fire Bucket Stand of minimum quantity two (02) shall be provided at Array field. Each fire Bucket holding stand (Triangular type) shall have the arrangement to hold four (04) numbers of fire buckets. The Fire Bucket stand must be as per IS 2546. The stand shall be installed at the rare side of the PV Array. The minimum technical specification is a follows:

Bis Specification	IS 2546
Fire Bucket Capacity	10 Litres
Fire Bucket Body Material	Galvanized Mild Steel Sheet
Body Thickness	1 mm

16.0 Spares,Tools and Measuring Instruments:

The minimum number and different type of spares, tools and measuring instruments must be supplied under this project within the contract value. Also any special tools, spares, measuring instruments if required as may be shall be provided by the contractor within the contract value.

17.0 Operation and Maintenance (O&M)

i. Cleaning of solar modules with soft water, wet and dry mops : Monthly
ii. DC String / Array and AC Inverter monitoring: Continuous and computerized.
iii. AC Energy monitoring: Continuous and computerized.
iv. Visual Inspection of the plant : Monthly
v. Functional Checks of Protection Components and Switchgear : Monthly
vi. String Clean PV Array and Installation Area: Quarterly.
vii. Inverter, transformer, data acquisition, energy meters and power evacuation checks: Quarterly.
viii. Support structure and terrace water-proofing checks: Yearly.
ix. O & M log sheet shall be provided and maintained: Monthly
x. The repair/replacement work shall be completed within 72 hours from the time of identification / reporting of the fault.
xi. A Monthly performance report of the plant inclusive of energy generation data shall be provided.
xii. All recorded data (monthly & yearly) shall be preserved in both manual and computer format and submitted.

18.0 Warranties and Guarantees

Warranties and Guarantees		
1	Solar Modules	10 years free replacement guarantee against material defect or craftsmanship
2	Solar Modules	90% power output for 10 years and 80% power output for 25 years
3	Inverter	Workmanship/product replacement - 5 years, service - 25 years
4	PV Array Installation	Structural -25 years
5	Balance of System / Plant – Parts and workmanship	Parts and Workmanship – 10years, service – 25 years
6	Power Evacuation and Metering Equipment	Workmanship / product replacement – 10 years, service- 25 years

19.0 Standards

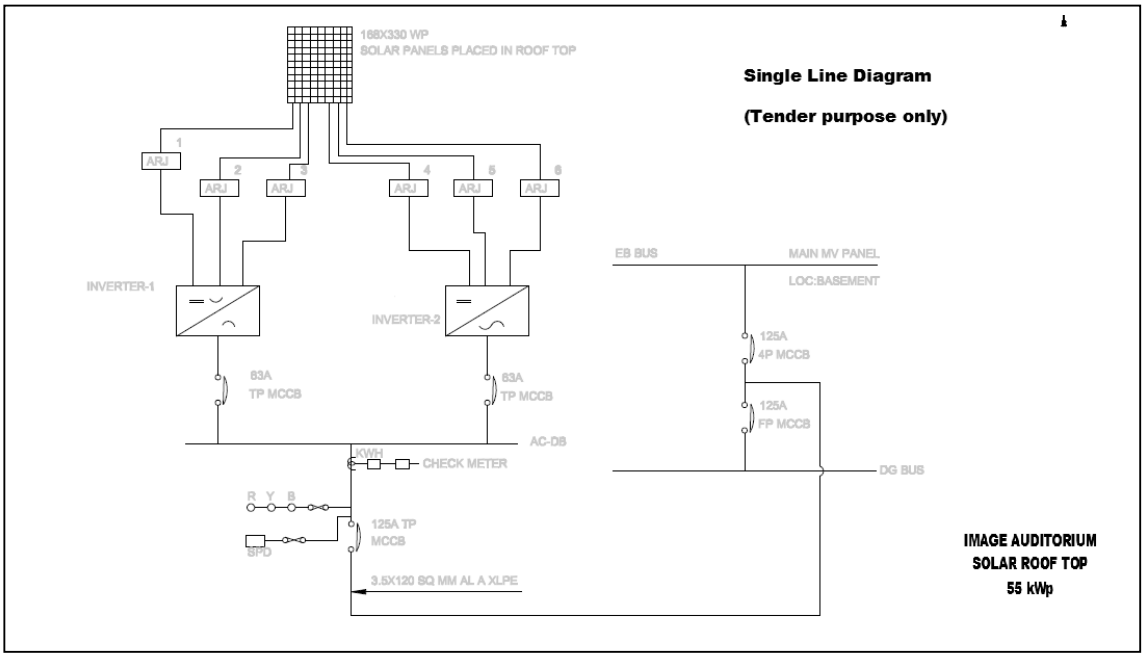
Standards	
IEC 60364-7-712 - Electrical Installations of Buildings	Requirements for Solar PV power supply systems
IEC 61727 or similar	Utility Interface Standard for PV power plants > 10 kW
IEC 62103, 62109 and 62040 (UL 1741)	Safety of Static Inverters - Mechanical and Electrical safety aspects
IEC 62116	Testing procedure of Islanding Prevention Methods for Utility-Interactive PV Inverters
PV Modules	IEC 61730 - Safety qualification testing, IEC 61701 - Operation in corrosive atmosphere
IEC 61215	Crystalline Silicon PV Modules qualification
String/Array junction boxes	IP65, Protection Class II, IEC 60439-1, 3
DC/AC distribution boxes	Rated for IP54
Static Watt Hour Meter (AC)	IS 13779-1999
Central Inverter	Rated for IP54
Surge Protection Devices	Type 2, DC 1000V rated
PV Module/string/string combiner box interconnects	MC4 compatible. DC 1000V rated
All DC and AC cables, conduits, cable trays, hardware	Relevant IS
Earthing System	Relevant IS
PV Array support structure	Relevant IS

APPROVED MAKES

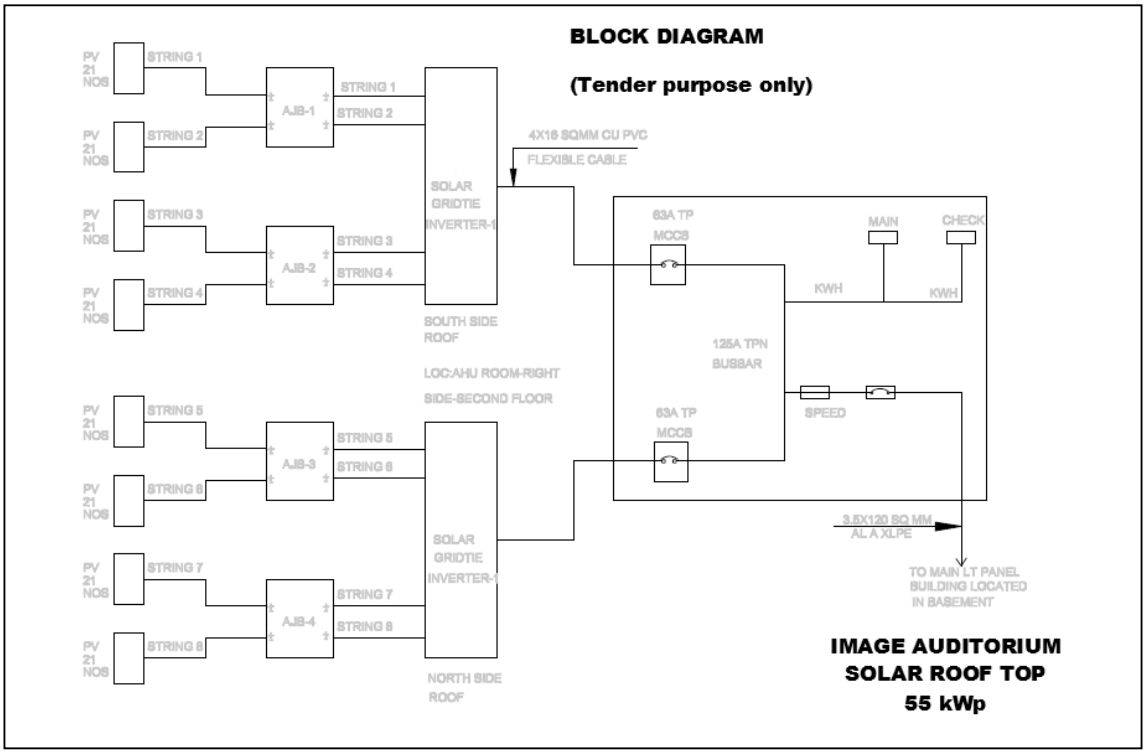
1. Solar PV panels : Vikram Solar/HHV/Warre/ Emmvee
2. Solar inverter : Kaco/ Delta/Schneider
3. Junction box : Hensel/Spelsberg/ABB/Cooper busman
4. Combiner panel : Local fabrication approved by Architect
5. MCB / MCCB : Legrand/ Schneider/Siemens/ L&T
6. Armoured cables 1.1 KV : Polycab/KEI/Ravin/Havells/ RR Kabel
7. Energy Meter : L&T/Siemens/Schenieder/Secure
8. Surge protection : OBO Betterman/ ABB/ Legrand

9. PV module interconnecting
   Connector : Tyco/ Cooper busman/Nordid
10. PVC Conduit tees, bends etc
    (Hard & flexible) : Oriplast /Supreme
11. Cables and
    Wires for AC : RR Cable/ Polycab/LAPP/ Havell's
12. Cables and
    Wires for DC : LAPP/Top Solar/Nexans/ Schneider
13. Surge Protecting Device (SPD) : OBO Betterman / ABB/ Legrand
14. GI Pipe : TATA-B class
15. Personal computer : HP, Dell/Lenovo
16. Ethernet switch : Amp/ Dax/Sisco/ Logitec
17 Cat-5/5E cable : Amp/Dax/Sisco

SINGLE LINE DIAGRAM (FOR TENDER PURPOSE ONLY)



BLOCK DIAGRAM (FOR TENDER PURPOSE ONLY)



GUARANTEED TECHNICAL PARTICULARS (GTP)

(to be completely filled and submitted along with technical bid)

PV MODULE (GTP)

Sl. No	Item	Specification (AS PER	AS OFFERED
1	Certification	i) IEC 61215 or IS	
		ii) IEC 61730	
1.1	Test certificate issuing authority.	NABL/ IEC Accredited Testing Laboratories or MNRE accredited test centers	
2	PV Cell		
2.1	Type	poly crystalline	
2.2	Size	156mm x 156mm	
3	PV Module		
3.1	Rating at STC	330Wp, 72 cells (without any negative tolerance)	
3.2	Efficiency	Minimum14%	
3.3	Fill factor	Minimum 70%	
3.4	Withstanding	1000V DC	
3.5	Glass	Toughened	
3.5.1	Thickness	3.2 mm (minimum)	
3.5.2	Type	High transmission, low iron, tampered & textured glass with anti reflective coating	
3.6	PV Module Junction		
3.6.1	Protection level	IP 65 or above	
3.7	Bypass Diode		
3.7.1	System Voltage	1000 V dc	
3.7.2	Number	3 numbers	
3.8	Module Frame		
3.8.1	Type	Anodized aluminum frame	
4	**PV Module : MAKE offered**		

PV ARRAY (GTP)

Sl. No	Item	Specification (AS PER TENDER)	AS OFFERED
1	Nominal Capacity	25 kWp	
2	PV Module interconnection	MC-4	
3	PV Module interconnection cable and array cable	PV 1-F standard /NEC standard "USE-2 or RHW-2" type (double insulated)	
4	PV array String Voltage	Compatible with the MPPT Channel of the	
5	Number of Parallel String against each MPPT Channel	02 Nos (Maximum)	

PV ARRAY JUNCTION BOX (GTP)

Sl No	Item Description	Specification (AS PER TENDER)	AS OFFERED
1	Enclosure		
1.1	Degree of Protection	IP65 with UV Protected	
1.2	Material	Polycarbonate.	
1.3	Withstanding voltage	1000V DC	
1.4	Withstanding	100 0C	
1.5	Accessories mounting	DIN Rail	
1.6	Number of Strings	As may be required	
1.7	Approved Make	Hensel/Spelsberg/ABB/Cooper	
2	Cable Entry and Exit		
2.1	Position	Bottom at cable entry and exit	
2.2	Cable Entry and Exit connector type	MC 4 Connector (PV Array String cable)	
2.3	Cable gland	Earthing cable entry	
3	Surge Protecting		
3.1	Type	DC	
3.2	Approved Make	OBO Betterman / ABB/	
3.3	Protection class	Type B+C	
3.4	Number of set	As may be required as per string Design	
3.5	System Voltage	Matched with System Voltage 1000 V DC	
4	Fuse with fuse holder		
4.1	Position	Positive and negative terminal for each series string	
4.2	Type	Glass fuse, for PV Use only	
4.3	Rating	Current: Minimum **1.25** times the rated short circuit current of the string Voltage: Minimum 1000 V DC	

GRID CONNECTED INVERTER (GTP)

Sl. No	Operating Parameter	Specification (AS PER TENDER)	AS OFFERED
1	Type	Grid connected String	
2	Usage	Specially used for PV	
3	Standards		
3.1	Efficiency	IEC 61683/ Equivalent	
3.2	Environmental testing	IEC 60068-2 (1,2,14,30)	
		/ Equivalent BIS Std.	
3.3	Interfacing with utility	IEC 61727	
3.4	Islanding Prevention	IEC 62116	
3.5	Type Test certificate issuing authority (for item no 3.1 , 3.2 & 3	NABL/ IEC Accredited Testing Laboratories or MNRE approved test	
4	**Input (DC)**		
4.1	PV array connectivity	12 kWp (minimum)	
4.2	MPPT Voltage range	Compatible with the	
4.3	Number of MPPT	2 nos (Minimum)	
5	**Output (AC)**		
5.1	Nominal AC Power	25 kW (minimum)	
5.2	Number of Grid Ph	3Ø	
5.3	Adjustable AC voltage range	Programmable as per grid condition 360V	
5.4	Frequency range	47-53 Hz	
5.5	AC wave form	Sine wave	
5.6	THD	Less than 3%	
5.7	Switching	High frequency transformer /	
6	General Electrical		
6.1	Efficiency (Maximum	95%	
6.2	Sleep mode	Less than 5 W	
7	**Protection**		
7.1	DC Side	1. Reverse-polarity	
		2. Reverse current to PV array protection, over voltage, Under voltage protection	
		3. Over current	
7.2	AC side	1. DC inject protection to grid less	
		2. Over voltage and Under voltage	
		3. Over current	
		4. Over and under grid frequency protection,	
		5. Anti Islanding protection	

7.3	Isolation Switch	1. PV array Isolation	
7.4	Ground fault detection device (RCD) which can	To be provided for transformer less inverter.	
8	Display		
8.1	Display type	LCD Display	
8.2	Display parameter		
8.2.1	DC	Voltage Current Power	
8.2.2	On grid connected mode	Line status	
		Grid voltage	
		Grid frequency	
		Export Power	
		Cumulative Export Energy	
9	Interface (Communication protocol)	Suitable port must be provided in the inverter	
		for	
		i) On site upgrade of Software,	
		ii) On site dumping data from the memory,	
		iii) Web based remote monitoring system	
10	Web monitoring	Matched with the monitoring and data	
11	Mechanical Data		
11.1	Protection Class	IP 65 or higher	
11.2	Operating ambient	0 0 C to 600C	
11.3	Cooling	Natural / forced	
12	**MAKE offered**		

WEB BASED REMOTE MONITORING SYSTEM (GTP)

Sl. No	Operating Parameter	Specification (AS PER TENDER)	AS OFFERED
1	Input data	PV Power	
		PV Energy	
2	Meteorological data	Insolation	
		Module Temperature	
		Ambient Temperature	
3	Output data		
3.1	Inverter	Export Power	
		Export energy	

7.A PERSONAL COMPUTER (GTP)

Sl. No	Description	Specification (AS PER	AS OFFERED
1.0	Software operating system	Windows 7 or suitable operating system for the Data logging system	
2.0	Hardware optical drive	CD ROM/DVD	
3.0	Hardware memory	4GB RAM	
4.0	Hardware drive	500GB	
5.0	Monitor	18.5" LED	
6.0	Mouse	Wireless	
7.0	Keypad	Standard Microsoft	
1.0	Software operating system	Windows 8	

7.B ETHERNET SWITCH (GTP)

Sl. No	Description	Specification (AS PER	AS OFFERED
1.0	No of ports	8	
2.0	Standard	IEEE 802.3u 100 base TX IEEE 802.3u 10 base-T	
3.0	Network media	UTP cat 6	
4.0	Power Adapter	7.5 V 1A (EXT)	
5.0	Back plain bandwidth	3.2 Gbps	

7.C ETHERNET CABLE (GTP)

Sl. No	Description	Specification (AS PER	AS OFFERED

A	Material of conductor	Annealed copper 24 SWG	
1.0	Insulation	Solid polyethylene	
2.0	Pair colour code	Blue/white- blue, orange/ white- orange Green, white- Green , brown/ white- brown	
3.0	Input impedance (0.722-100 Mhz	100 + 15Ω	
4.0	Mutual capacitance	5.0 nF/ 100 m	
5.0	Capacitance unbalance	330pF/100 m (Max)	
6.0	Velocity of Propagation	0.7 c (solid)	
7.0	ACR (Solid)	Min. 10 db at 125 Mhz	
8.0	Test frequency	100 Mhz	
9.0	Bank width	100 Mhz	
10.0	Wave length	Not applicable for copper cables	
11.0	Data Rate	100 Mbs	
12.0	Distance support	100 mt	
13.0	Category	CAT-6	
14.0	Standards followed	ISO/ IEC-11801, CENELEC EN 50173,ANSI/TIA/EIA/568A/B	
15.0	Clarifications	NEMA WC63.1, CM, CMR, IEC 332-1, ETL verified UL	

CABLES & WIRINGS (GTP)

Sl. No	Description	Specification (AS PER	AS OFFERED
A	DC Cable		
1.1	Conductor	Tinned annealed stranded flexible copper according to IEC 60228 class 5	
1.2	Standard	PV-1F / 2 PfG 1169/08.2007 / VDE Standard E PV 01:2008-02 /Equivalent	
1.3	Make	LAPP/Top Solar/Nexans/ Schneider	
B	AC Cable		
2.1	Rated Voltage	1.1kV	
2.2	Construction		
2.2.1	Type	Armored or unarmored as per requirement	
2.2.2	Conductor	Stranded flexible copper	
2.2.3	Insulation	PVC	
2.2.5	Standard	IS : 1554 -1	
2.3	Make	RR Cable/ Polycab/LAPP/ Havell's or equivalent	
C	PVC Conduit tees, bends etc (Hard & flexible)		
3	Standard	ASTM D 1785 u PVC	
3.1	Ambient Temperature	0 0C to 50 0C	
3.2	Type	UV stabilized , temperatures, Shock proof chemical resistant	
3.3	Make	Oriplast /Supreme or equivalent	
D	GI Pipe		
2	Make	TATA- B class	

ADDITIONAL SPECIAL TERMS AND CONDITION

1.0 Field Proven Inverter

The proposed string inverter must be field proven in Indian atmosphere. The string inverter of the proposed manufacturer must be used in any project in India and in operation on or before 31st December 2018. Also there must be a good maintenance setup of the proposed inverter manufacturer with having sufficient numbers of qualified service engineers (Degree / Diploma engineers) and well equipped set up with instruments, tools and tackles at Tamil Nadu or Chennai city. The maintenance setup of the proposed inverter manufacturer may be inspected by authority, if required.

2.0 Equipment and Material

Equipment and material shall comply with description, rating, type and size as detailed in this specification. Equipment and materials furnished shall be complete and operative in all respect. All accessories, which are necessary for safe and satisfactory installation and operation of the equipment, shall be furnished. All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable. Contractor shall carefully check the available space and the environmental conditions for installation of all equipments available at site and shall design the system accordingly.

3.0 Mode of Execution

The PV power plant shall be procured as a complete package. The entire work shall have to be executed on **turnkey basis.**

4.0 Materials and Workmanship

Qualified, experienced people should be deployed to install the **PV Power Plant**. All materials shall be of the best quality and workmanship capable of satisfactory operation under the operating and prevailing climatic conditions of respective. Unless otherwise specified, they shall conform in all respect to the latest edition of the relevant code and standards.. The project must be supervised by a qualified Civil Structural Engineer/ Engineering firm and Electrical /Electronics Engineer so that the work shall be as per drawing and related IS/IEC Code. The work shall be performed confirming safety precaution of all level of worker execute the project. The name and the qualification of the project engineers must be submitted to authority after placement of order. **The qualification of the supervising engineers must be minimum diploma or degreed in respective stream.**

5.0 Testing and Inspection

- Material Inspection will be carried out after submission of all test reports /certificates and after completion of the manufacturing work, against formal intimation from the contractor. The contractor shall, give notice of any material being ready for testing and the authority Bank / Engineer-In-charge/ bank, if desired, shall attend at the contractor's premises and may proceed with the

routine tests. The material shall have to be dispatched at site after inspection and clearance from the purchaser. The inspection setup and instruments must be provided by the contractor within the contract value. The necessary charges for Site Testing, Transportation, accommodation and any other expenses shall be borne by the Contractor only.

Factory Testing:

- **A Factory Test Report (FTR) shall be supplied with the unit after all tests. The FTR shall include detailed description of all parameters tested qualified and warranted. The report must contain measurement of phase currents, efficiencies, harmonic content and power factor, also should include all other necessary tests/simulation required. Tests may be performed at 25, 30, 75 and 100 percent of the rated nominal power.**

Site Testing:

a. The PCU shall be tested to demonstrate operation of its control system and the ability to be automatically synchronized and connected in parallel with a utility service.

b. Operation of all controls, protective and instrumentation circuits shall be demonstrated by direct test if feasible or by simulation operation conditions for all parameters that cannot be directly tested.

c. Special attention shall be given to demonstration of utility service interface protection circuits and functions, including calibration and functional trip tests of faults and isolation protection equipment.

d. Operation of start up, disconnect and shutdown controls shall also be tested and demonstrate. Stable operation of the PCU and response to control signals shall also be tested and demonstrated.

6.0 Commissioning

After the erection and testing of the equipment/works as per above, commissioning of the plant and works shall be carried out and here the term "Commissioning" shall mean the activities of functional testing of the complete system after erection and testing, including tuning or adjustment of the equipment for optimum performance and demonstrating to the Purchaser that the equipment performance meets the requirements of the specifications.

7.0 Comprehensive Warrantee and Maintenance

The contractor must ensure that the goods supplied under the contract are new, unused and of most recent or current models and incorporate all

recent improvements in design and materials unless provided otherwise in the contract.

The warranty period **the complete PV Systems** will be **60 (sixty)** calendar months from the date of completion of Defects liability period of **one year** from date of commissioning of plant**.** The contractor shall remain liable to replace any defective parts that may develop in the plant of his own manufacture or that of his sub-contractors under the conditions provided **for** by the contract under proper use, and arising solely from faulty design, materials or workmanship, provided always that such defective parts as are not, repairable at site and are not essential in the meantime to the maintenance in commercial use of the plant are promptly returned to the contractor's works at the expense of the contractor unless otherwise arranged.

The maintenance includes Routine, Preventive, Breakdown & Capital Maintenance the details are as follows but not limited:

Routine, Preventive, Breakdown & Capital Maintenance:

8.0 Routine and preventive maintenance:

Routine and preventive maintenance shall include cleaning of PV Module on regular
basis , checks and maintenance activities such as tightening of all electrical connections ,daily, weekly, fortnightly, monthly, quarterly, half yearly, and yearly basis which are required to be carried out on all the components of the power plant to minimize breakdowns and to ensure smooth and trouble free running of the power plant. The supplier shall be responsible to carry out routine and preventive maintenance and replacement of each and every component / equipment of the power plant and he shall provide all labour, material, consumables etc. for routine and preventive maintenance at his own cost.

9.0 Breakdown maintenance:

Breakdown maintenance shall mean the maintenance activity including repairs and replacement of any component or equipment of the power plant which is not covered by routine and preventive maintenance and which is required to be carried out as a result of sudden failure/breakdown of that particular component or equipment while the plant is running. The supplier shall be responsible to carry out breakdown maintenance of each and every component of the power plant and he shall provide the required manpower, materials, consumables, components or equipment etc. for breakdown maintenance at his own cost irrespective of the reasons of the breakdown/failure

10.Capital maintenance:

Capital Maintenance shall mean the major overhaul of any component or equipment of the power plant which is not covered by routine, preventive and breakdown maintenance which may become necessary on account of excessive wear & tear, aging, which needs repair/replacement. The capital

maintenance of power plant and all civil structures shall normally be planned to be carried out on an annual basis. For this purpose a joint inspection by the supplier and purchaser shall be carried out of all the major components of the power plant, about two months in advance of the annual maintenance period, in order to ascertain as to which components of the power plant require capital maintenance. In this regard the decision of the purchaser will be final and binding. However, if the condition of any plant and component warrants its capital maintenance at any other time, a joint inspection of the purchaser and supplier shall be carried out immediately on occurrence of such situation and capital maintenance shall be carried out by arranging the shutdown of the plant/part of the plant, if required, in consultation with concerned authorities. The decision of the purchaser shall be final and binding. Capital maintenance also includes replacement of defective lights fans under the project supplied by the contractor. The capital maintenance includes painting, of mechanical structure, civil structure.

The contractor shall under take necessary maintenance/troubleshooting work of the Solar PV Power Systems. Down time shall not be more than 72 working hours from time of occurrence. Adequate measures should be taken for prevention of wear and tear of the machines. Solar PV Power System is to be designed to operate with a minimum of maintenance.

The scope of Support Service provides preventive maintenance as & when necessary within the contract period and break down maintenance in the event of malfunctions, which prevent the operation of the power system or part of it within the stipulated time period & free replacement of spares required for maintenance. Party will provide the A list of Spare parts & measuring instruments are The contractor will submit warrantee certificates of the work & spare parts and materials at the time of submission of completion report. *If any defect is found within the warrantee period, contractor will be liable to repair or replace the same at his own cost and risk, within three (72 hours) days from the date of complaint lodged by the authority or by the user themselves.*

11.0 End Users Training

The Contractor shall arrange for training at site for the end users / employer. The duration of training shall be minimum **five days**. The contractor shall provide training materials at least seven days before commencement of training programme. **The training shall be the part of contract and no extra cost shall be provided for organizing the training programme**.

12.0 Handing Over

The work shall be taken over by authority upon successful completion of all tasks to be performed at site(s) on equipment supplied, installed, erected, commissioned AND RUN SUCCESSFULLY FOR CONSECUTIVE **30 DAYS** AT A STRETCH by the contractor in accordance with provision of this order. During

handing over complete project work, the contractor shall submit the followings for considering final payment.

i. All As-Built Drawings & Design

ii. Detailed Engineering Document with detailed specification, schematic drawing, and test results, manuals for all deliverable major items, Operation, Maintenance & Safety Instruction Manual and other information about the project

iii. Certificate issued by the structural & civil engineer/firm having engineer with minimum LBS/ESE/EBA License for structural design of PV Array.

iv. Bill of Materials

v. Inventory of spares at projects site

vi. Completion certificate as per prescribed format provided by authority

13.0 CEA Inspection

The contractor shall submit all the necessary drawings, SLD etc to CEA / Govt Authorities and arrange for inspection of the installation and obtain their certification. **Rectifications if any pointed out by CEA/CEIG/TEDA/Govt. Authorities in the installed equipments / details shall be carried out by the contractor without any extra claim.**

14.0 Operation & Maintenance (O&M)

The bidder shall be responsible for operation and maintenance of the Roof top Solar PV system for a period of 05 years (in addition to DLP of 1 year) **for which one technician shall visit the site Monthly once on account of the same and submit the report to Bank.**

During this period, the bidder shall be responsible for time to time preventive maintenance and maintaining log sheets for operation details etc (as per clause 17 of technical specification for equipments)

15. Metering and Grid Connectivity

Metering and grid connectivity of the roof top solar PV system under this scheme would be the responsibility of the bidder in accordance with the prevailing guidelines of the concerned Distribution Company / TANGEDCO / TNERC / CEA (if available by the time of implementation). Bank could facilitate connectivity; however the entire responsibility lies with bidder only i.e obtaining clearance / liasoning etc.

16. Technical Specifications for mounting frames, safety ladder, walkway and Life line rope

The velocity of wind in the area will go upto 200 KMPH and hence solar modules are to be firmly bolted to the roof structure. Suitable GI channels to be used for mounting the solar modules. These GI channels shall be securely fastened to the existing roof rafters/purlins using SS bolts and nuts of self threading steel screws. With proper leak proof arrangements on the roof. The GI structure grid shall be suitably designed and rested on the rafters and pulins and in any case when

loading these should not sag. The loading will be approximately 200 Kg/ m2 by weight.

The solar panels shall be suitable fixed with stell brackets and with proper rubber gaskets to prevent the breaking of glass on the module. Wherever necessary, silicone sealant shall be applied to make the roof fully weather proof. The structure drawings shall be got approved by the architect before proceeding with the fabrication of the same.

Staircase:

To have easy and safe access to the roof top, a staircase to be fabricated with GI steel sections . The staircase will be 3 Mt high with 45 degree inclination from the third floor terrace to the slanted roof top supported by ISMB. The steps shall be fabricated with 6mm thick 0.28/1 Mt GI chequred plates with angle supports, cleats etc. The staircase will have safety hand rails made of GI tubular balustrades and GI tube railing connected by bolting. There will be staircases in the southern and northern sides of the building for easy access to the roof and easy escape route in case of any emergencies.

Catwalk:

There shall be a catwalk of size 0.5 mt wide fabricated out of GI plate 10mm thick with proper supporting members fixed to the building roof purling and rafters. The UDL of the catwalk shall be designed to 400N/mm2. The catwalk top shall be 5mm thick aluminium composite chequred plates to carry heavy load and shall have anticorrosive property and to withstand open weather condition. The catwalk should have safety hand rail all over the edge periphery of the roof structure. Apart from this a safety hand rail of 1 M length in every 3 Mt throughout the catwalk to be provided. The periphery hand rail shall be GI tubular structure , well supported to carry an impact load of 300 Kg latterly. The hand rail shall be of welded rings well supported at every 3 Mt to catch hold at times of emergency and also for hooking of safety belt.

Waterline:

The nearest water line in the building to be extended to the roof using 25mm dia GI pipe well clamped on structures with nozzle valves at least 2 nos on the south side roof and 2 nos on north side roof for water washing of solar modules

Life line rope:

A life line rope made of polyprolene and polyethylene blend, twisted rope with dia of 16mm and maximum length of 30 Mt to be anchored from one end of the to the other in east west direction on the peak of the roof. Anchor clamps are to be used for hooking the rope on both ends to anchor posts. These anchor posts are to be fixed to the truss member by steel screws. At one of the anchorage, a tension clamp to be provided along with a energy absorber to absorb the shocks . The rope is hooked to the anchorage posts using anchorage connectors which will support at least 500 lbs.

The life line rope is used for hooking the safety belts of the personnel who will be working on the roof and also to hook the tool bag etc. The tension on the rope to be checked at times and keep it to the required levels.

17.0 DRAWINGS AND DOCUMENTS:
17.1 DRAWINGS TO BE FURNISHED BY BIDDER AFTER AWARD OF CONTRACT

The Contractor shall furnish the following drawings and obtain approval.

a) General arrangement and dimensioned layout
b) Schematic Drawing showing the requirement of SV panel, Power conditioning Unit(s),Junction Boxes, AC and DC Distribution Boards, meters etc.
c) Structural drawing along with foundation details for the structure
d) Itemized bill of material for complete SPV plant covering all the components and associated accessories.
e) Overall layout showing SPV Plant.
f) Format for reports and charts for analysis of various parameters
g) SLD showing all the equipments till the final connection to the grid.

17.2 TECHNICAL BID DELIVERABLES

For PV plant of 55kWp, following details are to be provided as part of technical bid:

1. Systems Diagram
2. Electrical Line Diagram
3. Structure design drawings and material specifications
4. Structure design calculations.
5. PV panels and structure installation drawings, indicate row spacing
6. Specifications SPV power plant.
7. PV module and inverter data sheets
8. PV array and inverter design calculations
09. DC and AC electrical Balance of System design calculations
10. DC and wiring diagrams
11. DC and AC cable sizes
12. Earthing system diagram
13 Detailed Bill of Quantity, Bill of Materials, and specifications inclusive of Vendor names, model nos. and Contact details
14. Plant power performance ratio calculations and guarantee.
15. Plant energy performance ratio calculations and guarantee
16. Plant performance simulation using PV system.
17. Estimated yearly degradation of PV module power output.
18. Estimated plant energy generation in the first year till 25th year
19. Total foot print area required for the plant.
20. Completely filled Guaranteed Technical Particulars (GTP)

Annexure-1

e-REVERSE AUCTION GUIDELINES

These Guidelines are intended to guide about e-Reverse Auction processes, awarding criteria, and confidentiality requirements, and to the binding nature of bids made at e-Reverse Auction.

The aim of e-Reverse Auction is to enable negotiations to be engaged in using technology that allows a faster pricing process, a more objective way of selecting bidders and greater transparency of market prices. Indian Bank and bidders are expected to follow the standards set forth in these Guidelines.

1. Reverse Auction are carried out under the framework of rules as defined by Indian Bank and all bidders participating in Reverse Auction shall understand/ accept and give an undertaking for compliance with the same to Indian Bank in the prescribed format (**Annexure – 2**).

2. Any bidder not willing to submit such an undertaking shall be disqualified for further participation with respect to the said repir & renovation works.

3. Reverse Auction shall be carried out amongst all the bidders who have qualified for opening their price bid.

4. The overall lowest price quoted by the bidder will be considered as Reserve Base Price during reverse auction, further the item wise price of all items shall be arrived from the overall lowest quoted price in the same ratio as quoted by the bidders earlier in the financial bid and all the technically qualified bidders will be considered at same platform.

5. Decrement value to be kept for conducting Reverse Auction shall range from 0.50% to 5% of the Reserve Base Price converted to the nearest round figure, depending upon the value of the bid.

6. Reverse Action (no ties) shall be for a period of 30 minutes. If a bidder places a Bid in the last 5 minutes of Closing of the Auction, the auction shall get extended automatically for another 5 minutes. In case, there is no Bid in the last 5 minutes of closing of Auction, the Auction shall get closed automatically without any extension. Such extension will be allowed to continue till no quote is placed within 5 minutes of the last quote or 30 minutes whichever is lower. In any event the auction process deems to have concluded by 60 minutes from the start of the auction. Please note that if there are more than one item in a single auction, the auto-extension will be applicable to the entire event i.e. whenever a bidder places an acceptable bid in the last 5 minutes of the closing of the auction, the auction shall get extended automatically for another 5 minutes from the time of this bid for all the items in the auction. There will be total 6 (Each of 5 Min) extensions available during the Online Reverse Auction.

7. The eligible bidders can participate in the online Reverse Auction from any place of their choice and need not to visit Banks' Corporate Office for this purpose.

8. The User ID and password for online reverse auction is same as used in online bidding process/ provided at the time of bidder registration.

9. The Reserve Base Price for Reverse Auction will be informed after the Opening of Price Bid. This shall be the lowest rate received against the initial price bids submitted by participating bidders.

10. Bank shall make all out efforts to rectify the problem(s) leading to system failure during the online reverse auction. However in case the system could not be restored within the reasonable time period as deemed fit by Bank, the reverse auction event shall be suitably extended/ shall be restarted again after rectification by giving a new schedule for the same, which shall cover the left over time period as per the original schedule. On restart of reverse auction the last R1 price received during reverse auction at which the reverse auction event got terminated, shall be the starting price.

11. Where necessary, Bank will facilitate training for participation in Reverse Auction either on its own or through the service provider for the Reverse Auction to familiarize the vendors/ bidders with Reverse Auction process.

12. Any vendor/ bidder not participating in training shall do so at his own risk and it shall not be open for him to make any complaint/grievance later.

13. No request for postponement/ fixing of Training Date/ Time shall be entertained.

14. The Date and Time of commencement of Reverse Auction shall be communicated to the shortlisted bidders at least One day in advance.

15. Any force majeure or other condition leading to postponement of auction shall entitle Bank to postpone the auction.

16. The Reverse Auction may be conducted by Bank through a service provider specifically identified/ appointed/ empanelled by Bank.

17. In case Reverse Auctions conducted by Bank through a Service Provider, the Bank shall enter into a separate agreement clearly detailing the role and responsibilities of the service provider hosting the web portal for the Reverse Auction. The Service Level Agreement (SLA) by Bank with the service provider is an arrangement for smooth and fair conduct of the Reverse Auction.

18. All the bids made from the log-in ID given to bidder shall ipso facto be considered. Bids are to be made by the vendor / bidder using log-in ID and password assigned by the service provider /auctioneer.

19. Any bid once made through registered log-in ID / password by the vendor / bidder cannot be cancelled. The bidder, in other words, is bound to execute the "repair & renovation works" as per the RFP at the bid price in the reverse auction.

20. Every successive bid by the bidder / vendor being decremented bid shall replace the earlier bid automatically and the final bid as per the time and log-in ID shall prevail over the earlier bids.

21. No two bids can have identical price from two different vendors. In other words, there shall never be a "Tie" in bids.

22. All bidders will be able to view during the auction time the current lowest price in portal. Bidder shall be able to view not only the lowest bid but also the last bid made by him at any point of time during the auction time.

23. Names of bidders/ vendors shall be anonymously masked in the Reverse Auction process and vendors will be given suitable dummy names. After completion of Reverse Auction, the service provider / auctioneer shall submit a report to Bank with all details of bid and the original names of the bidders and the L-1 bidder.

24. Bank shall however, be entitled to cancel the procurement of Reverse Auction process, if in its view procurement or reverse auction process cannot be conducted in a fair manner and / or in the interest of Bank.

25. The successful vendor/ bidder shall be obliged to provide a itemwise Bill of Material at the last bid price at the close of auction.

26. No vendor shall involve himself / itself or any of his / its representatives in any price manipulation directly or indirectly with other bidders. If any such practice comes to the notice, Bank shall disqualify the vendor / bidders concerned from the reverse auction process.

27. Bidder shall not disclose details of its bids or any other details concerning Reverse Auction process of Bank to any other third party without specific permission in writing from Bank.
28. Neither Bank nor service provider / auctioneer can be held responsible for consequential damages such as no power supply, system problem, inability to use the system, loss of electronic information, power interruptions, UPS failure, etc. (Bank shall, however, entertain any such issues of interruptions, problems with open mind and fair degree of transparency in the process before deciding to stop or extend the auction.)

29. Any aggrieved vendor / bidder through Reverse Auction process can represent in writing within 24 hours of the Reverse Auction to Bank, failing which no representation/ complaint etc. shall be entertained.

30. Bank decision on award of Contract shall be final and binding on all the Bidders.

Annexure-2

ACCEPTANCE FORM FOR PARTICIPATION IN REVERSE AUCTION EVENT (To be signed and stamped by the bidder)

In a bid to make our entire procurement process more fair and transparent, Bank intends to use the reverse auctions as an integral part of the entire tendering process.

The following terms and conditions are accepted by the bidder on participation in the bid event:

1. Bank shall provide the user id and password to the authorized representative of the bidder. (Authorization Letter in lieu of the same shall be submitted along with the signed and stamped Acceptance Form).

2. Banks' decision to award the work would be final and binding on the suppliers/ bidders.

3. The bidder agrees to non-disclosure of trade information regarding the purchase, identity of Bank, bid process, bid technology, bid documentation and bid details to any other party.

4. The bidder is advised to fully make aware them selves of auto bid process and ensure their participation in the event of reverse auction, failing which Bank will not be liable in any way.

5. In case of bidding through Internet medium, bidders are further advised to ensure availability of the infrastructure as required at their end to participate in the auction event. Inability to bid due to telephone line glitch, internet response issues, software or hardware hangs, power failure or any other reason shall not be the responsibility of Bank.
6. In case of intranet medium, Bank shall provide the infrastructure to bidders. Further, Bank has sole discretion to extend or restart the auction event in case of any glitches in infrastructure observed which has restricted the bidders to submit the bids to ensure fair & transparent competitive bidding. In case an auction event is restarted, the best bid as already available in the system shall become the basis for determining start price of the new auction.

7. In case the bidder fails to participate in the auction event due any reason whatsoever, it shall be presumed that the bidder has no further discounts to offer and the initial bid as submitted by the bidder as a part of the tender shall be considered as the bidder's final no regret offer. Any offline price bids received from a bidder in lieu of non-participation in the auction event shall be out rightly rejected by Bank.

8. The bidder shall be prepared with competitive price quotes on the day of the bidding event.

9. The prices as quoted by the bidder during the auction event shall be inclusive of all the applicable taxes, duties and levies and shall be FOR at site but exclusive of GST.

10. The prices submitted by a bidder during the auction event shall be binding on the bidder.

11. No requests for time extension of the auction event shall be considered by Bank.

12. The original price bids of the bidders shall be reduced on pro-rata basis against each line item based on the final all inclusive prices offered during conclusion of the auction event for arriving at Contract amount.

Signature & Seal of the Bidder

APPENDIX – I

PROFORMA 'A'

(See Clause 22(h) of General Conditions)

CONTRACTOR'S LIABILITY AND INSURANCE SUMMARY

Name & Number of Insurance Policy with description	Value of Insurance	Validity Period	Loss or damage to work (covered under Policy) or any part thereof and all materials at site from any cause whatsoever
1.	2.	3.	4.
a) b) c)			

Damage, loss or injury to any property of the Employer's or Project Management Consultant's or his agent's and servant's	Claims under the Workman compensation Act 1923, the Minimum Wages Act 1948 & Contract labour (Regulation and Abolition) Act 1970	Remarks
5.	6.	7.
a) b) c)		

NB: Details of further policies taken if any and the loss or damage if any under that policy may please be indicated separately at appropriate places.

Signature of Contractor

Address:

Witness:

APPENDIX - II

PROFORMA 'B1'

MEASUREMENT SHEET

Running Bill No. _____
Name of the Work _____
Name of the Contractor _____

Sr. No.	Item	Qty. as per contract	Unit	No. / Length	Qty. of Present Bill

NOTE: Quantity of Present Bill shall be carried forward to Interim Bill.

PROFORMA 'B2'
INTERIM BILL

Interim Bill No. _____

Name of the Work _____

Name of the Contractor _____

S. No.	Item	Unit	Qty. as per Contract	Qty. upto previous bill	Qty. of present bill	Total Qty.	Unit Rate	Gross Amount

Total cumulative Gross Amount of Bill Rs. _____.

Gross Amt. of the present Bill = Gross Amt. of bill – Gross Amt. upto previous bill

APPENDIX - III

PROFORMA 'C'

REPORT OF VIRTUAL COMPLETION
(See Clause 36 of General Conditions)

Draft of letter to be written by the Contractor to the Project Management Consultant in connection with the Virtual Completion Certificate as per Clause No. 29 of General Conditions of Contract.

Having executed the work in terms of the Contract, we hereby certify and affirm that we have virtually completed the contracted works.

We hereby certify that the work has been executed wholly to our satisfaction and with the materials and workmanship in accordance with the contract.

We do certify further that we have executed the work in accordance with the applicable laws and without any transgression of such laws.

List of Materials of Approved Brand And/ Or Manufacture

Civil & Carpentry:

Details of Materials	**Manufacturers Name**
Reinforcement Steel (TMT – Fe500)	SAIL, Tata Steel, SRMB Steel, Rashtriya Ispat Nigam Ltd. (RINL), Jindal Steel & Power Ltd. And JSW Steel Ltd.
White Cement	Birla White, J.K. White
43 Grade Ordinary Portland Cement /Portland Pozzolona Cement.	ACC, Ultratech, Vikram, Ambuja, Jaypee Cement, J.K. Cement
Tubular truss /Structural Steel	SAIL, Tata Steel, Rashtriya Ispat Nigam Ltd. (RINL), SRMB Steel, Jindal Steel & Power Ltd. And JSW Steel Ltd.
Polycarbonate sheet	GE Platic, LEXAM
Decking steel sheet	Ezydec of TATA /Lloyed Superdeck / Multi Color
Vitrified tiles	RAK / Sunheart / Kajaria / Mobito/ OrientBell
Ceramic/Glazed tiles	Somany / Mobito / Sunheart / Kajaria / OrientBell
Heat resistant tiles	Thermatek / Orient
Chemical emulsion for anti-termite treatment (Chloropyriphos emulsifiable concentrate)	Dursban 50 TC / Terrrashield 50 TC or equivalent
Distemper/Paints	
Plastic Emulsion	SKK/Asian/ICI Asian/Berger/Nerolac
Synthetic Enamel	---do--
Oil Bound Distemper	ICI, Nerolac, Berger, Asian Paints, Fibrex
Steel Primer	ICI, Nerolac, Berger, Asian Paints
Wood Primer	Fibrex / Polydeck / SKK
Exterior waterproofing paint	

Details of Materials	Manufacturers Name
Wood finish (Melamine & PU Polish)	Jivanjor / Jivanjor (PU) / Asian
Curing compound	Fosroc, Sika, Cico
Anti-Corrosive epoxy paint (For Concrete surface)	Fibrex / BASF
Anti-Corrosive epoxy paint (For steel surface)	Fibrex / BASF
Wood Work	
Ply board/ Plywood	Merino / Green / Century / Prima Kanchan
Laminate	Merino / Green Lam / Century
Laminated Particle Board	Merino / Green / Prima Kanchan
Veneer Ply	Merino / Green / Century
Flush Door (Pine Filled)	Merino/ Green/ Kutty/ Century/ Prima Kanchan
Locks	Godrej / Golden/ Indo brass/Harrison or equivalent
Anodised Aluminium fittings for door & windows	Nu-lite/Argent/ Classic(heavy duty) or equivalent
Door closer	Everite / Prabhat / Door King / Hardwin
Floor springs	Sandhu / Prabhat / Door King / Hardwin
Factory pressed Laminated doors	Merino / Green / Century
Inherent Fire Retardant Fabric	Trevira CS fabric of RSWM Ltd. or equivalent
Fire retardant paint	Nullifier / Signum / Godrej
Steel Fire rated doors	Navair / Godrej / Promat
Wooden Fire rated Doors	Navair / Signum / Abacus
Fire rated vision Panels	Pilkington, Schott, Ferilite, Saint Gobain
Fire rated hardware	Dorma / Becker F S / Assaabloy
Skylight – Thermoform	Mccoy Architectural System, Vergola, Abucob
G.I. Steel door frame	Kutty Doors, Shakti Metdoor, Navair, Romat, Synergy Thrislington.
Friction Stay Hinges	Earl-Bihari, Ebco, Rotto, Cotswold, GU, Dorset.

Details of Materials	Manufacturers Name
Steel Windows/ Pressed Steel frames	San Harvic, Steelman Industries, PD Industries, Metal Windows, Bhawani / Ganpati Udyog (Rajpura) / JMD Steel
Paver block & Kerb Stone	Nitco, Unitile, NTC, Ultra
Glass Mosaic Tiles	Italia / Opio / Mridul
Wood Adhesive	Jivanjor / Fevicol / 3M
Tile Adhesive	ARDEX Endura / Fibrex / Pidilite / BASF
Grouting Compound	ARDEX Endura / Pidilite / Laticrete / BASF / Fibrex
Mosaic tiles	NITCO / Modern / NTC / GICO
Dash/Anchoring FASTENERS	HILTI / Fischer / Excel
High performance Epoxy based resin anchor system	BASF / Fosroc / Fibrex
Nuts/Bolts & Screws	GKW / Atul
Dholpur / red sand stone	Gang saw cut from Bansi Paharpur Quarry
Aluminium sections for doors & windows etc.	Jindal / Hindalco
Hardware fittings for Aluminium windows & doors	Powder coated fittings of Pulse make (LGF SYSMAC INDIA) / ALUTEC
Polyster Powder Coating Shades	Nerolac, Berger, J & N
Metal ceiling	Hunter Douglas / Aura (ASIPL) / CKM /
Mineral Fiber Ceiling	Armstrong / OWA / CKM
Extruded Polystyrene sheet (XPS)	Dow Corning / Supreme
Aluminium Composite Panel	ALUCOBOND / REYNOBOND / ALPOLIC

Specialised agencies for Aluminium glazing / Structural glazing / Aluminium door & windows / ACP work.	Bharat Archimetal / Green Façade Solution / AGV Alfab

Details of Materials	**Manufacturers Name**
Silicon sealant	GE / Dow corning
solvent based silicone repellent coating	PIDILITE / Fibrex / BASF
PVC Continuous fillet for periphery packing of Glazing	Roop / Anand / Forex
Backer Rod	Supreme Industries Ltd. Or Equivalent
Anti – static vinyl flooring	ARMSTRONG / TARKETT / FORBO
Anti – static homogeneous PU flooring	BASF / Fibrex
PU flooring	BASF / Fibrex
Float Glass	Modi Glass / Saint Gobain Glass
Reflective Glass	Saint Gobain / Asahi (India)
Hermitically sealed performance glass & Toughened Glass	Saint Gobain, Asahi
Glass processor for making DGU/ Toughening (with Uniglass European	AIS (Roorkee) / Sheesh Mahal Tuff Glasses Pvt. Ltd. (Rohtak) / Bala ji safety glass (Bangalore) / Fishwa
Looking glass / mirror	Saint Gobain / HNG / Modi Guard
Textured paint	Unitile products / Heritage (Bakelite Hylam Ltd) /Spectrum / SKK
Vertical / Venetian Blinds	Mac Décor / Vista Levealor / Neha's Touch / Cape Decor
Approved agency for Stainless steel railing	Jindal Stainless Ltd. / Kich / Khurana Fab / Kenz
Stainless Steel Railing, Accessories etc.	Jindal / Dorma / Geze

Gypsum Board	India Gypsum / Lafarge Boral
Precoated Galvanised sheets	Multicolor / Interarch
Wall Putty	JK / Birla
Floor hardener	PIDILITE / Fosroc / Sika / BASF / Fibrex
Polysulphide Sealant	PIDILITE / Fosroc / Sika / BASF / Fibrex
Specialised agencyfor expansion joint treatment	M/s Technocrats / M/s Tuff waterproofing Co. / BASF / Fibrex
Admixtures	Fosroc / Fibrex / BASF
HCI pipes	RIF (Raj Iron Foundary)
Centrifugally Cast (spun) Iron Pipes (Class LA)	Electro Steel / Kesoram
Centrifugally Cast (spun) Iron Pipes & Fittings	NECO / HEPCO (BINAY UDYOG) / Electro Steel
CPVC Pipes	SPERRY / ASTRAL / PRINCE / AJAY
G. I. Pipes	TATA / Jindal Hisar (as per class specified in the BOQ)
G. I. Fittings	Unik, AVR, Zoloto
HDPE Pipes	Reliance, jain Pipes, Oriplast
DI Pipes	Electro steel, Jindal, TATA Ductura
DI Fittings	Kartar, Electro steel
CI Fittings	Neel, Lartar, Sarkar
UPVC Pipe and Fitting	Astral, Supereme, Finolex
C.I. Manhole Covers, Frames & GI Gratings	NECO, Raj Iron Foundary Agra, BIC, SKF
Composite Pipe	Kitec
Stone ware pipes	Perfect Potteries / Anand / Hind or ISI marked S.W. Pipes, Parryware, Priyaclay
Hot water insulation (Rubberised sleeve)	Vidoflex / Armaflex / CareFlex
Insulation for external / exposed hot water pipes	KAIFLEX, ARMAFLEX, CAREFLEX
External Pipe coating 4 mm thick – 7 layered	Makpolycote / Pypcote

SFRC Manhole covers & Gratings	Kk, jain, Pargati
Brass Stop & Bib Cock	Zoloto, sant, L&K, Leader
Gratings & Rain water outlet fittings	Neer / Camry
Vibration eliminators	Resistoflex
Float Valve	IVC / Leader / Prayag
Cockroach trap	Chilly / Camry
Hot water insulation (Mineral wool insulation)	Rocklloyd / UP Twiga
Pressure gauge	Fiebig / H Guru
Manhole covers & G.T. covers	BIC
Chinaware	Hindustan / Cera / Kohler / Parryware / Hind Ware / Kohler
PVC Flushing cistern	Commander / Coral / Hindware (Simline) / Hindustan
Bakelite seat & Lid	Commander / Hindware / Parryware
R.C.C. Pipes	Pragati
C. P. Brass fittings	Jaquar / Kohler / Marc / Parryware
Brass Ferrules	Dhawan Sanitary Udyog (Prima), Kalsi, Annapurna
Copper pipes & PVC connections	Camry
C.P. bottle traps	Camry
Extension nipples	Camry
C.P. bathroom accessories like robe hook, towel ring, towel rail, soap dish, tumbler holder, toilet paper holder, towel rack etc.	Camry / Parko / Sieko / ESS ESS
Spreader, Waste Coupling	Gem / Ess Ess / Camry
Stainless steel kitchen sinks	Nirali / Kingston / Neelkanth
Glazed Fire Clay Kitchen Sink	PAMINI, SANFIRE, RKCP
Non – return valves & fully-way valves	Heavy quality Leader / Zolotto

Details of Materials	Manufacturers Name
Gun Metal Peet Valve	Heavy quality Sant / Zolotto
Butterfly valves	Audco
PVC water storage tanks	Sintex / Target
Water meters	Capstan Meters India Ltd. / Kranti
For Structural Glazing	
Aluminium	Hindalco/ Indal /Jindal
Masking Tapes	Sun Control/ Wonder Polymer
S. S. Screws/ Bolts	Kundan /Puja / Atul
Dash Fasteners	Hilti /Fischer
S.S. Friction Stay	Alu Alpha/ Securistyle
E.P.D.M. Gaskets	Hanu Industries / Roop
Standards for Tempering	DIN – 1249 – Part – 12 (1990)
Weather Silicon	GE / Dow Corning
Structural Sealant	GE / Dow Corning

Electrical Works:

Sl.No	Description	MAKES
1	Cable Glands single / Double compression with earthing	COMET / Dowell /Cosmos
2	LUGS & THIMBLES	Dowells / Jainsaon / Praca (single comp. type Glands)
3	1.1 kV LT Power & Control Cables	Finolex / Polycab / KEI
4	Insulating Mats	ISI Marked (As recommended by Architect)
5	Pre Fabricated Cable Tray	OBO Bettermann / Slotco or equivalent
6	Protection & Other Relays	AREVA/L&T / SIEMENS
7	Earthing pipes	Jindal / Tata / Sail
8	Air Circuit Breaker	L&T(Upower) / Siemens(Sentron) / C&S (equivalent of U Power)
9	Moulded Case Circuit Breakers	L&T(D-Sign) / Siemens (sentron) / Legrend / C&S
10	Fuse Disconnector Switch / Switch Fuse Units / HRC Fuses	L&T / Siemens / GE Power
11	Ammeter, Voltmeter, KWH,PF, Frequency meter / Digital Meters, Multifunction Meter	L&T / AE / Conserve
12	Selector Switch, Push Button / Indication lamps	Kay CEE/L&T/GE Power Control
13	LED Indication Lamps	AE/EASUN/Kay cee
14	Ct'S	AE/ Kappa/ Kaycee / L&T/ kaycee / Universal / MECO /Gilbert & Maxwell
15	Starters / Contactors / Timers	L&T / GE Power / Siemens
16	MCB / MCCB	Legrand / Schneider / L&T / C&S
17	PLC	ABB / ROCKWELL
18	UPS	Emerson/APC/NUMERIC/EATON
19	Ant vibration mounts	Dunlop-S Class
20	Battery	Exide/ HBL / Luminous
21	Electrical Light Fittings	Philips / Bajaj/ Wipro/Panasonic
22	Fans-Ceiling / Wall mount	Orient / Crompton Greaves/ Usha / Polar (Model to be appd. By the architect)
23	Smoke detectors	System sensor, Ravel, GST
24	Response indicator	Any standard makes
24	Fire alarm panel	System sensor, Ravel, GST

24	Exhaust Fan	Almonard/ Crompton
25	Geysers	Racold/Jaguar-aero smith/Venus / Bajaj
26	Prefabricated Panels / MCB DBs	L&T, Hager, Legrand
27	Cable Management System	MK/Legrand / Schenieder
28	CAT Cable / Wires& Fiber Optic Cable	Amp/D-Link / Molex/ Krone /Sisco
29	Telephone cables	Polycab / KEI / Finolex
30	Speaker wires	Polycab / KEI / Finolex
31	ACDB	Local fabrication approved by Engineer-In-charge
32	Energy Meter	L&T / HPL / Secure / Schneider
33	Surge Protection	OBO Betterman/ Legrand / ABB
34	Switches & Sockets	MK, Anchor (Roma) - Model approved by Architect
35	GI Sheets	TATA / JIDAL/ SAIL
36	Insulation acoustic	ARMAFLEX/BIRSAL/SUPREME
37	C-PVC/U-PVC Pipes	Astral /supreme / Avonplast
38	Controllers, controls & Sensors	Honeywell / Schneider/ Siemens
39	MS Structure/Beam/Gurdar/Channel	SAIL/TATA/JINDAL/ESSAR
40	FIRE Sealant	Promat, Hilti, Brila-3M
41	MS Conduit(ISI marked)	AKG(ISI marked), BEC(ISI marked), Gupta
42	Heavy Duty Accessories for MS Conduit	Sharma Sales Corporation / super Sales Corporation
43	Selector Switch, Toggle Switch	Salzer(L&T), Kaycee / Siemens
44	LT Jointing kit/Termination	Raychem / Safe kit/ Mahindra M-Seal / Denson
45	Main & Change over switch	L & T/ HPL / SIEMENS
46	Pre Fabricated Distribution Boards	MDS Legrand/ L & T / Hager
47	Metal clad sockets	Legrand/ L & T / Hager
48	LAN switches/ jacks	D-Link / MK
49	Beam detector	System Sensor, Ravel, GST
50	FR PVC	AVON PLAST / PRESSFIT/ANCHOR
51	FRLSH	RR Kabel / Anchor / Orbit