



**MUMBAI METRO RAIL CORPORATION LTD**  
**(MMRCL)**

**E-TENDER FOR**

**SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF  
ELECTRICAL, AIR CONDITIONING, FIRE-ALARM WORKS AND OTHER  
ALLIED SERVICES FOR MUMBAI METRO RAIL CORPORATION LTD.  
PROJECT OFFICE AT E-BLOCK, BANDRA-KURLA COMPLEX, MUMBAI-  
400 051**

**BID DOCUMENT**

**DATE: 15-12-2016.**

**MUMBAI METRO RAIL CORPORATION LIMITED  
PLOT NO. C-14 & 15, 5<sup>th</sup> FLOOR A WING, OLD MMRDA BLDG.  
BKC, BANDRA (E), MUMBAI, 400 051  
Tel- 26597654, [Email - ramesh.sharma@mmrcl.com](mailto:ramesh.sharma@mmrcl.com)  
Website: [www.mmrcl.com](http://www.mmrcl.com)**



MUMBAI METRO RAIL CORPORATION LIMITED  
PLOT NO. C-14 & 15, 5<sup>th</sup> FLOOR A WING, OLD MMRDA BLDG.  
BKC, BANDRA (E), MUMBAI, 400 051  
Website: [www.mmrcl.com](http://www.mmrcl.com)

## **e-Tender Notice**

Mumbai Metro Rail Corporation (MMRC) hereby invites bids through e-tendering portal from qualified and experienced contractors in form "B-1" (Percentage Rate) for Supply, Installation, Testing and Commissioning of Electrical, Air Conditioning, Fire-alarm Works and Other Allied Services for Mumbai Metro Rail Corporation Ltd. Project Office at E-Block, Bandra-Kurla Complex, Mumbai – 400 051".

For any additional information & help for uploading & downloading the e-Tender, please contact MMRDA's e-tendering service desk at the following ID: [etendersupport@mailmmrda.maharashtra.gov.in](mailto:etendersupport@mailmmrda.maharashtra.gov.in) Phone No. 022-26597445/022-26594049.

**Date:15/12/2016**  
**Place: Mumbai**  
**(Elect.)**

**sd/-**  
**Executive Director**

**MMRCL**

## **COMPOSITION OF TENDER DOCUMENTS**

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<b>Part 2</b>	<b>Technical Specification</b>
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# **PART-1**

## **SECTION-I**

## **PART-A:**

### **DETAILED e-TENDER NOTICE & SCHEDULE**

1. Digitally Signed & unconditional online Tenders in form "B-1" (Percentage Rate) are invited by the Executive Director (Elect.) Mumbai Metro Rail Corporation Ltd (MMRCL), from bidders who have carried out work of similar type and magnitude and fulfilling conditions as under:

<b>Sr No</b>	<b>Name of Work</b>	<b>Estimated Cost of Construction Work (In Rs)</b>	<b>Tender Fee (In Rs)</b>	<b>Earnest Money Deposit (In Rs)</b>	<b>Performance Security (In Rs)</b>	<b>Construction Period (In months)</b>
1.	<b>SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF ELECTRICAL, AIR CONDITIONING, FIRE-ALARM WORK AND OTHER ALLIED SERVICES FOR MUMBAI METRO RAIL CORPORATION PROJECT OFFICE AT E-BLOCK, BANDRA-KURLA COMPLEX, MUMBAI-400 051.</b>	484 Lakhs	5000	4.84 Lakhs	24 Lakhs	5 Months

2. Online E-Tender Schedule is as under:

<b>Sr. No.</b>	<b>Tender Schedule</b>	<b>Bidder Schedule</b>	<b>Start Date &amp; Time</b>	<b>End Date &amp; Time</b>
1.	Tender Publishing	-----	30.12.2016 @ 10.00 hrs	30.12.2016 @ 11.00 hrs
2.	-----	Tender Document Download	30.12.2016 @ 12.31 hrs	30.01.2017 @ 15.00 hrs
3.	-----	Bid Preparation and Submission	30.12.2016 @ 11.01 hrs	30.01.2017 @ 15.00 hrs
4.	Tender Closing	-----	30.01.2017 @ 15.00 hrs	30.01.2017 @ 18.00 hrs
5.	-----	Online Control Transfer of Bid	30.01.2017 @ 18.01 hrs	31.01.2017 @ 18.00 hrs

6.	Opening Envelope A – Tender Fees, EMD	-----	01.02.2017 @ 15.01 hrs	01.02.2017 @ 18.00 hrs
7.	Opening Envelope B – Technical Bid	-----	01.02.2017 @ 15.01 hrs	01.02.2017 @ 18.00 hrs
8.	Opening Envelope C – Financial Bid	-----	-----	Will be intimated later

3. A pre-bid meeting will be held on **10.01.2017** at **15.00\_Hrs** at the 6<sup>th</sup> Floor, old MMRDA Building 'A' wing, BKC, Bandra (E), Mumbai
4. The bidder shall upload his information in formats specified in Section III of the Bid document. (Form – 1 to 7).
5. The bidder should upload scanned copy of PAN Card, Income Tax Certificate as well as VAT certificate etc.
6. The bids will be received online on above mentioned MMRDA official e- Tendering portal and will be opened by the Executive Director (Elect.) or authorized representative on scheduled date and time.
7. Bidders should have valid class 2 or 3 Digital Signature Certificate (DSC) having both Signing and Encryption Certificates obtained from any Certifying Authorities Bidder Executive Engineer empanelled by Controller of Certifying Authorities India. In case of requirement of DSC, Bidders should go to <https://etendermmrda.maharashtra.gov.in/files/mmrda/misc/Digital%20Certificate.rar> and follow the procedure mentioned in the document procedure for Digital Certificate. Bidders who are participating in e-tendering for the first time shall have to obtain User ID & password from the above mentioned portal and follow the procedure mentioned in the document procedure for Digital Certificate. Bidders who are participating in e-tendering for the first time shall have to obtain User ID & password from the above mentioned portal.
8. Tender Document and Supporting can be downloaded for reference purpose from the e-Tendering Portal of MMRDA during the period mentioned in the tender notice. Interested Bidders have to make online payment of Rs. 5000/- (Rupees Five Thousand only) inclusive of MVAT (non-refundable) as Tender Processing Fee using online payment gateway during bid preparation using Debit Card/Credit Card/Net-Banking. Tender Fee receipt will be system generated during bid preparation.
9. Tender Fee receipt must be uploaded during bid preparation by the bidder.
10. The competent authority reserves the right to reject any or all of the tender offers, without assigning any reasons thereof.
11. The bids shall be received online on above mentioned MMRDA's official e-Tendering portal.
12. Validity financial bid of the e-tender.
13. The lowest bidder will have to submit the rate analysis of all major items, if called for. Period of the offer of the bidder will be 120 days from the date of opening of the financial bid.

14. While quoting the offer, the bidder should mention percentage **above, below** or **at par clearly. If nothing is mentioned, the offer will be treated "Below" at the percentage quoted by the bidder.**
15. Bidder should upload scanned attested photocopies of all documents on above mentioned MMRDA official e-Tendering portal & produce in original on request by MMRCL at any stage.
16. A statement showing names of partners, Directors, etc. of the firm with complete address of each should be uploaded to above mentioned MMRDA official e-Tendering portal and authorized person on the behalf of firm who will sign e-tender using Digital Signature Certificate.
17. The acceptance of bid will be intimated by email or otherwise by the authority competent to accept the tender to the contractor, which shall be deemed to be an intimation of the tender given by the Authority Competent to accept the tender.
18. Successful bidder shall have to submit signed copy of tender document manually to the department.
19. MMRC reserves the right to verify financial transaction of contractor in his Bank / Financial Institutions. Contractor should give authority to that effect along with his accounts number and Bank/ Financial institution name & address. Any changes / modification may be communicated to MMRC immediately.
20. If there is any amendment in the tender the same shall be published on following MMRCL's official e-Tender portals / website:

**MMRDA Portal: <https://etendermmrda.maharashtra.gov.in>**

**MMRCL Website: <https://www.mmrc.com>**

21. The bidder may like to visit the site prior to submission of tender and ascertain the local site condition, working restrictions, constraints, conditions in tender document regarding necessary approvals, NOC required for the work from the local Authorities and shall quote the offer inclusive of all such expenses likely to be incurred while execution of the work. No claim or compensation for any extra payments incurred by the bidders towards the approvals/ NOC's/ permissions will be entertained by MMRC, which shall be noted.
22. In case of any queries, Bidders may contact MMRDA's e-tendering service desk at [etendersupport@mailmmrda.maharashtra.gov.in](mailto:etendersupport@mailmmrda.maharashtra.gov.in) on any working day from 10.00 Hrs to 17.30 Hrs. (Phone No. 022-26595971).

**Date. 15/10/2016**

**Place: Mumbai**

**Executive Director (Elect.)**

**MMRCL**

## **Part-B: Guidelines for submission of Bid**

1.

### **1.1 Location of the work:**

The work is to be carried out at Proposed Temporary location of MMRCL Office Building in 'E' Block of Bandra-Kurla Complex, Bandra (East), Mumbai-400051.

### **1.2 A Pre-Bid meeting will take place at the following date, time and place:**

Date: 16.11.2016

Time: 15.00 Hrs

Place: 'A' wing, 6<sup>th</sup> floor, Conference Room, MMRDA old building, 'E' block. BKC, Mumbai

At the pre-Bid meeting prospective bidders may request clarification of the Project requirements and the criteria for Bid. Attendance at the Pre-bid meeting is not mandatory.

### **1.3 Time limit for completion of work:**

Time limit for completion of work is 5 months from the acceptance of Work Order.

### **1.4 Earnest Money and Security Deposit:**

Earnest money for this work will be 4.84 Lakhs/-. Security deposit will be 24 Lakhs/-.

### **1.5 Details of Earnest Money:**

Earnest Money as mentioned in conditions above against the work should be paid online. Tenderers need to upload scanned copy of EMD paid receipt during bid preparation. Tenders with no earnest money deposit shall be summarily rejected. The earnest money of unsuccessful tenderers will be refunded on application after intimation regarding rejection sent to him or on expiry of validity whichever is earlier. In case of successful tenderer, amount of the earnest money may be transferred towards part of the security deposit to be paid after the award of the work.

### **1.5 Details of Security Deposit:**

The successful tenderers shall have to pay **24 Lakhs/-** as security deposit by Demand Draft/Pay Order in favour of "MMRCL" payable at Mumbai or Bank Guarantees issued by any Nationalized bank or scheduled bank issued by a branch in Mumbai in format acceptable to MMRCL while accepting the tender that is before issuing work order and five percent of estimated cost put to tender or contract price of work, whichever is higher deducting from Running Account Bills at the discretion of the Engineer-in-charge (at 5% of each Running Account Bill till the full security deposit is recovered or alternatively from the first and second Running Account Bills) so that, the total deposit equivalent to **24 Lakh/-** of the estimated cost put to tender or contract price of work, whichever is higher made up and held by the MMRCL as Security Deposit. The Bank Guarantee towards initial security deposit (i.e. 5%.) shall be pledged & valid for 30 days beyond the end of Defect liability period. The contractor shall be responsible to pay stamp duty as payable under Bombay Stamp Duty Act, 158 for Deposits paid in Demand

Draft / Bank Guarantee, etc and shall furnish a copy of Challan having paid the same to Government. Failure to furnish within **1 week** from the date of work order the same will be recovered at the rates in prevalence as per Stamp Duty Act, from the bills and resubmitted to Government.

#### **1.6 Additional Security Deposit:**

Additional Security to be paid by the selected contractor shall be calculated as follows:

No additional performance security towards unbalanced tenderers will be due for the tender, if the quoted percentage is up to and inclusive of 10 % below the cost of tender. If the tendered offer is anything more than 10% below compared to the cost of tender, the unbalanced cost for performance security will be worked out by taking 100% difference between the 90% of cost of tender and that of offer of the tenderer. The payment of additional security towards unbalanced tenders shall be in the form of Bank Guarantee of any Nationalized bank or banks promoted by All India Financial Institutions issued by a branch in Mumbai in format acceptable to MMRCL. The Bank Guarantee towards additional security deposit shall be pledged & valid for 30 days beyond the completion of work as certified by the Engineer. The additional security deposit shall be released along the final bill on satisfactory completion of work.

#### **1.7 Revision or Amendment in Tender Document:**

The Competent Authority, may omit or suspend certain items of work, revise or amend the tender document before online submission of tender. Such revisions or amendments or extension, if any, shall be communicated to all concerned by email on above mentioned MMRCL official E-Tendering portal which will be issued at least 7 days before the due date of receipt of tender.

#### **1.8 Tender Rates:**

The rates quoted in schedule B are for finished and completed items and no extra amount for carting or transporting material, labour etc. shall be paid unless specifically so mentioned or provided for in the tender. The rates are inclusive of all leads and lifts for all materials in the completed items and also include all taxes, duties, royalties etc. including VAT/Works Contract Tax. No payment on this account will be made. The Income Tax, Works Contract Tax, Labour cess, etc. shall be deducted at source at the rate that will be in force from time to time.

#### **1.9 BID LIABLE FOR REJECTION:**

The bid is likely to be rejected if on opening, it is found that.

- a. The bidder has not strictly followed the procedure laid down for submission of bid.
- b. The bidder has proposed conditions, which are inconsistent with or contrary to terms and conditions specified.
- c. Addition, corrections or alternations are made by the bidder on any page of the bid document, without affixing signature/initials.
- d. Any pages or pasted slips are missing.
- e. Bidder has not signed each page of Bid.
- f. Bidder has specified any additional condition.
- g. Bidder has not attached the addendum and documents to the main bid form.
- h. The available bid capacity of the bidder shall be assessed by the formula (as per bidding data volume 1). The available capacity shall be more than the cost of work

quoted by the bidder. In case the bidder does not satisfy the bidder capacity the bid shall be treated as non-responsive and rejected.

- i. The contractor shall submit detailed information about all completed and ongoing works (form of qualification information in Section IV). The employer reserves the right to inspect the site of the completed ongoing works to ascertain the correctness of the information submitted by the bidder. If false information is found to have been submitted, the bidders bid shall liable for rejection.
- 1.10** The successful tenderer will have to sign an agreement as required. The necessary stamp fees, etc. required for completing the agreement will have to be borne by the tenderer.
- 1.11** The tenderer is requested to preferably visit the site of the work and see for himself the site conditions regarding layout and all other matters, affecting the work before filling in the estimated rates. Submission of a tender by a tenderer implies that they had read these instructions and has made himself aware of the scope of the work, conditions of contract and the MMRCL will not, therefore, bear any extra charges on any account, in case he finds on to have misjudged the site conditions or specifications.
- 1.12** Conditional tender shall not be accepted.
- 1.13** The right to reject all or any of the tenders without assigning any reason, whatsoever, is reserved with the Competent Authority.
- 1.14** The tenderer will have to enter into regular agreement in form B-1 on the receipt of acceptance of the tender and shall abide by all the rules and regulations embodied therein and pay the initial security deposit as shown in the schedule, failing which the MMRCL shall be entitled to forfeit the full amount of earnest money deposited by the tenderer.
- 1.15**
- 1.15.1 The successful tenderer shall have to work in co-ordination and cooperation with any other contracting agencies appointed by the MMRCL to work simultaneously in the same or adjoining area. The decision of the MMRCL in case of any dispute between the different agencies appointed by the MMRCL shall be final and binding.
  - 1.15.2 Income tax, Works Contract Tax, VAT, Service tax, labour cess and any other central, state, local tax ordered by the competent authority at the rates in force during the progress of contract or the percentage that will be in force from time to time shall be recovered / deducted from the gross amount of the bill whether for measured work or advance payment or secured advance.
  - 1.15.3 The Contractor shall have to make his own arrangement at no extra cost to the MMRCL for temporary water supply, sanitation and Electric supply etc. at the site of work. If temporary / permanent water connection is taken for construction purpose through Municipal Corporation's water line, then water charges to be paid to Municipal Corporation are to be borne by the Contractor. Contractor has to submit no dues certificates from Municipal Corporation in this regard before preparation of final bill failing which such charges will be paid by MMRCL and shall be recovered from amount due to the contractor with MMRCL.

- 1.15.4 The contractor will keep the site office clean and hygienic throughout till work is completed in all respects.
- 1.15.5 The detailed E-tender notice along with the subsequent corrigendum, addendum, etc. shall form part of the tender document.
- 1.15.6 If the contractor wishes to furnish the initial security deposit in Government Securities, endorsed to the Engineer or Bank Guarantee Bond, the validity period of such Bond shall be at least twice the specified time provided in the tender or up to the defect liability period whichever is more.

**1.16**

- 1.16.1 The Contractor shall furnish all tools plants, instruments, supervisory staff, labour, materials, any temporary works, consumable and everything necessary whether or not such items are specifically stated herein, for completion of the job in accordance with the specification requirements.
- 1.16.2 The Contractor shall carry out the necessary surveys of the site required for above work before starting the work.

**1.17** The contractor shall familiarize himself with the site where he is expected to execute the work and quote his percentage above/below the estimated rates considering all the hurdles likely to face during execution.

**1.18** The contractor whose tender is accepted will be required to produce to satisfaction of the Concerned Authority valid and current license issued in his favour under the provision of the contract labour (Regulations and abolition) Act 1970 and in case of failure to do so the acceptance of the tender would be liable to be withdrawn and earnest money forfeited.

**1.19** Contractor shall take out necessary Insurance Policy/Policies so as to provide adequate insurance cover for execution of the awarded contract work from the "Directorate of Insurance, Maharashtra State, Mumbai - 400 051" only. Insurance Policy / Policies taken out from any other insurance Company will not be accepted. However, if the contractor desires to effect insurance with the local office of any insurance company, the same should be under the co-insurance-cum-servicing arrangements (with G.I.F.'s share at 60% and insurance Company's share at 40%) approved by the Directorate of Insurance. If the policy taken out by the contractor is not on co-insurance basis the same will not be accepted and the amount of premium calculated by the Directorate of Insurance will be recovered directly from the amount payable to the contractors for the executed contract work.

**1.20** Bids from Joint Ventures(JV's)/Consortiums are accepted.

**1.21 Validity of Tender:**

One Hundred Twenty days from the date of submission of financial bid of e-tender. During this period no tenderer shall be allowed to withdraw his tender.

**2. GUIDELINES FOR SUBMISSION OF E-TENDER**

Bidder shall follow the instructions on the portal for submission of e-tender.

**2.1** Bid shall be submitted online on the e-tendering portal in 'three electronic envelopes system' within prescribed schedule.

## 2.2 e-Envelope A

Bidder shall upload scanned copies of the following:

- i) Upload Receipt for e-tender fee.
- ii) Upload Receipt of Earnest Money Deposit.

## 2.3 e-Envelope B (Technical bid)

Bidder shall upload scanned copies of the following:

- a) The bidder shall have experience of successfully completing/executing at least one single similar work under single work order amounting not less than 80% or 2 works not less than 50%, 3 works not less than 40% of the estimated cost carried out in Govt./ Semi Govt. Organization during last Three financial years. Certificate of satisfactory completion/execution of similar works shall be issued by officer not below the rank of Executive Engineer.
- b) The bidder shall have valid registration & License issued by Govt. of Maharashtra to carry out the Electrical works.
- c) Turn Over Certificate issued by the CA.
- d) Details of similar works executed in last Three years (Form-I)
- e) Details of works in hand (Form-II).
- f) List of machinery owned / proposed to be hired for the work (Form-III).  
List of Technical Personnel (Form-IV)
- g) Work contract Tax/ VAT no. certificate, sales tax registration certificate.
- h) Copy of PAN card.

## 2.4 e-Envelope- C (Financial bid)

- i) Bidder shall quote his offer on percentage basis at the prescribed space in e Envelope C (Form B-1). The amount quoted by the Bidder shall be calculated and converted in rupees by the system.
- ii) Upload the digitally signed copy of Tender document and Price Bid Cover letter.

## 2.5 Procedure for Tender opening

Contents of e-Envelope A will be scrutinized and only those bidders who have fulfilled the requirements shall be eligible for opening of e-Envelope B. Similarly, contents of e-Envelope B will be scrutinized and only those bidders who have fulfilled the requirements shall be eligible for opening of e-Envelope C. Bidder may remain present in the office of the tender opening authority at the time of opening of financial bids. However, the results of the financial bids of all bidders shall be available on the e-Tendering portal immediately after completion of the opening process.

## 2.6 Eligibility criteria for bidders:

Sr. No.	Eligibility criteria	Documents to be submitted
1.	The Bidder shall have Electrical contractor license to work in state of Maharashtra.	Valid Registration Certificate.

2.	<p><u>Turnover:</u></p> <ul style="list-style-type: none"> <li>• The bidder (Prime Bidder in case of Consortium/JV) should have an average annual financial turnover of Rs.1.5Cr construction works during the immediate last three consecutive financial years.</li> <li>• For members other than the Prime Bidder, Each Member should have an average annual financial turn over (gross) of Rs. 1.25 Cr during the immediate last three consecutive financial years.</li> </ul>	<p>Certificate from the <b>Statutory Auditor or Chartered Accountant</b> clearly stating the Turnover.</p>
3.	<p>The Bidder (Individual or all members combined of JV/Consortium) should have satisfactorily completed during the last five years ending on 31<sup>st</sup> Aug 2016 following works at least:</p> <p>I) <b><u>Electrical works:</u></b></p> <ul style="list-style-type: none"> <li>• One similar work for Electrical Systems of aggregate cost not less than the amount equal to 174 Lakhs. OR</li> <li>• Two similar works for Electrical Systems costing not less than the amount equal to 109 Lakhs. OR</li> <li>• Three similar works for Electrical Systems costing not less than the amount equal to 87 Lakhs.</li> </ul> <p>Similar works is defined as "<u>Building Electrification Work, Lighting, Internal wiring, DG &amp; UPS Installation, Panelling and DBs, Firefighting, Fire Detection and Alarm System, Water Pumping system &amp; Piping Works</u>".</p> <p style="text-align: center;"><b><u>AND</u></b></p> <p>II) <b><u>HVAC works:</u></b></p> <ul style="list-style-type: none"> <li>• One similar work for HVAC Systems of aggregate cost not less than the amount equal to 126 Lakhs. OR</li> </ul>	<ul style="list-style-type: none"> <li>• Certificate of satisfactory completion of similar work should be certified by an officer not below the rank of Executive Engineer/Project Manager or equivalent.</li> <li>• In case the work is executed for private client, copy of work order, bill wise details of payment received certified by C.A., T.D.S certificates for all payments received and copy of final/last bill paid by client shall also be submitted.</li> <li>• For completed works, value of work done shall be updated to 30.09.2016 price level assuming 10% inflation for Indian Rupees every year.</li> <li>• In case of Joint Venture/Consortium, full value of the work, if done by the same JV/Consortium shall be considered. However, if the qualifying work(s) were done by them in JV/Consortium having different constituents, then the value of work as per their percentage participation in such JV/Consortium shall be considered.</li> </ul>

	<ul style="list-style-type: none"> <li>• Two similar works for HVAC Systems costing not less than the amount equal to 78 Lakhs. OR</li> <li>• Three similar works for HVAC Systems costing not less than the amount equal to 63 Lakhs.</li> </ul> <p>Similar works is defined as <u>“HVAC Works for Buildings, Installation of VRV Systems, VFD, Ducting work &amp; associated Electrical Panelling”.</u></p>	
4	<ul style="list-style-type: none"> <li>• The bidding capacity of the contractor should be equal to or more than the estimated cost of the work put to tender. The bidding capacity shall be worked out by the following formula:  <math display="block">\text{Bidding Capacity} = [A \times N \times 1.5] - B</math> <p>Where,</p> <p>A = Maximum value of construction works executed in any one year during the last five years (updated to the current year by considering inflation of 10% per year) taking into account the completed as well as works in progress.</p> <p>N = Number of years prescribed for completion of work for which bids has been invited.</p> <p>B = Value of existing commitments (as on 30.09.2016) and ongoing works to be completed during the period of completion of work for which bids have been invited.</p> </li> </ul>	<ul style="list-style-type: none"> <li>• In the case of a group, the formula will be applied to each member to the extent of his proposed participation in the execution of the work. If the proposed % participation is not mentioned, then equal participation will be assumed.</li> </ul> <p><b>Example for calculation of bid capacity in case of JV / Consortium:</b></p> <ul style="list-style-type: none"> <li>• Suppose there are “P” and “Q” members of the JV / Consortium with their participation in the JV / Consortium as 70% and 30% respectively and available bid capacity of these members as per above formula individually works out “X” and “Y” respectively, then Bid Capacity of JV / Consortium shall be as under:</li> </ul> $\left( \begin{array}{l} \text{Bid Capacity of the} \\ \text{JV / consortium} \end{array} \right) = \begin{array}{l} 0.7X \\ + \\ 0.3Y \end{array}$
5	<p>The bidder should have a solvency of Rs. 1 Cr certified by his Bankers. <b>(Not required if applicant is a registered Class(A) Electrical contractor of PWD)</b></p>	Bank Certificate

6	The bidder have to submit valid Work contract tax no./certificate, Sales tax registration no./certificate, as applicable.	Valid registration certificate.
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# **Section II**

## **Scope of Work**

## **SECTION II: SCOPE OF WORK**

The information and data contained herein is for guidance of the Bidders and is meant to explain the purpose behind invitation of the Bid. The Bidders have to ascertain / verify the data and incorporate in their bid.

### **Supply, Installation, Testing and Commissioning of Electrical, Air Conditioning, Fire Alarm Works and Other Allied Services for Mumbai Metro Rail Corporation Project office at E-Block, BKC Mumbai.**

For details of General arrangement bidder can refer the architectural & layout drawings given in Part 3. This is only for reference purpose however actual drawing may be issued later on with required changes.

#### **1.1 Scope of work**

##### **A. Design Supply, Installation, Testing and Commissioning of Electrical Work**

- Supply, Installation, Testing and Commissioning of Internal Wiring and Earthing for Lighting and Power.
- Supply, Installation, Testing and Commissioning of Cabling Work.
- Supply, Installation, Testing and Commissioning of Lighting fixtures.
- Supply, Installation, Testing and Commissioning of Lightning Protection System.
- Supply, Installation, Testing and Commissioning of Street Lighting System.
- Supply, Installation, Testing and Commissioning UPS system.
- Supply, Installation, Testing and Commissioning of DG Set with AMF panel.
- Supply, Installation, Testing and Commissioning Main LT panel.
- Supply, Installation, Testing and Commissioning Panels and DB's.
- Supply, installation, testing & commissioning and erection of 75KW Solar Power Plant under Net Metering Policy along with Performance monitoring system, Liaisoning with concerned Electricity department, Electrical Inspector and MEDA is the responsibility of Contractor as required.

##### **B. Design, Supply, Installation, Testing and Commissioning of Mechanical Work:**

- Supply installation testing and commissioning of AC system with required Ducting and piping.
- Supply installation testing and commissioning Ventilation (Fresh Air)
- Supply installation testing and commissioning Mechanical exhaust
- Supply installation testing and commissioning of Fire Safety System including Public Address System.
- Supply Installation, Testing and Commissioning of Fire Hydrant System

**C. Design Supply, Installation, Testing and Commissioning of Other Allied Services**

- Supply, Installation testing and Commissioning of Audio-Visual systems along with required accessories.
- Supply installation testing and commissioning of CCTV Camera along with required items.
- Supply, installation testing and commissioning of Structured Data Networking equipment including Cables, Patch Panel, Racks etc. Cables to be laid for Voice along with Data Networking.
- Supply Installation testing and Commissioning of EPABX system

**Details of items to be executed is given in schedule -B and the specifications are given in Part-II (These specifications shall be read with the relevant Part-2 items).**

## **Section III**

### **Details to be Submitted by Bidder**

**SECTION III : DETAILS TO BE SUBMITTED BY BIDDER**

**FORM-1**

**Details of similar type of works executed during last 5 financial years**

1.1 Constitution or legal status of Bidder

***[Attach copy]***

Class, Category and Place of registration:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Principal place of business: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Power of attorney of signatory of Tender

***[Attach]***

1.2 Total value of similar type of work.

Work executed and payment

s received in the last five years (Financial Year)

2011-2012 \_\_\_\_\_  
2012-2013 \_\_\_\_\_  
2013-2014 \_\_\_\_\_  
2014-2015 \_\_\_\_\_  
2015-2016 \_\_\_\_\_

*Attach certificate from Chartered Accountant.*

1.3 Work performed on works of a similar nature over the last five years (2011-12 to 2015- 16)\*:

Sr. No.	Name of the Work Executed/In Hand	Department	Value of contract (In Rs)	Actual date of completion /stipulated date of completion	Performance of work: Very Good /Good/Fair/Poor)
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*\*Attach certificate(s) from the Executive Engineer(s)*

**FORM-2**

**DETAILS OF WORKS TENDERED FOR AND IN HAND AS ON  
THE DATE OF SUBMISSION OF THIS BID**

**NAME OF THE BIDDER:**

**NAME OF THE WORK:**

<u>Sr. No</u>	<u>Name of Work</u>	<u>Place</u>	<u>Works in Hand</u>			<u>Works Completed</u>			<u>Remarks</u>
			Tender Cost	Cost of Remaining Work	Anticipated Date of completion	Tender Cost	Cost of Remaining Work	Anticipated Date of completion	
<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>

**FORM-3**

**DETAILS OF MACHINERY**

**NOTE:** INFORMATION ABOUT MACHINERY OWNED BY CONTRACTOR AND OTHER MACHINERY SHALL BE SHOWN SEPARATELY. PLANNED MOBILIZATION OF MACHINERY ON AWARD OF CONTRACT SHALL BE GIVEN IN REMARKS.

**NAME OF THE BIDDER:**

**NAME OF THE WORK:**

Sr. No.	Name of Equipment	No. of Units	Kind of make	Capacity	Age and condition	Present location	Remarks
1	2	3	4	5	6	7	8

**FORM 4:**

**LIST OF KEY PERSONNEL OF THE BIDDER TO BE APPOINTED FOR THIS WORK.**

**NAME OF THE BIDDER:**

**NAME OF THE WORK:**

Sr. No.	Name of Person	Designation/Post Held/Status	Academic Qualifications and Experience	Experience in similar nature of work	Remarks (any other points)

**FORM 5:**

**Information on litigation history in which the Bidder is involved.**

**NAME OF THE BIDDER:**

**NAME OF THE WORK:**

Other party	Employer	Cause of dispute	Amount involved	Remarks showing present status
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**FORM:6**

**DETAILS OF STRUCTURE OF ORGANIZATION**

**NAME OF THE BIDDER:**

**NAME OF THE WORK:**

1.	Name of bidder	
2.	Nationality of bidder	
3.	Office Address Telegraphic/Email Address Telephone Number	
4.	Year of Establishment	

5.	Location of Establishment	
6.	<p>Bid is submitted as</p> <ul style="list-style-type: none"> <li>a) An individual</li> <li>b) A proprietary firm</li> <li>c) A firm in partnership</li> <li>d) A limited Company or Corporation</li> </ul>	
7.	Attach the Organization chart showing the structure of the organization including the names of the Directors and Position of officers.	
8.	<p>Number of year of experience</p> <p>As a prime bidder (Bidder shouldering major responsibility)</p> <ul style="list-style-type: none"> <li>i) in own country</li> <li>ii) in other countries</li> </ul> <p><b>(Specify country)</b></p>	
9.	For how many years has your organization been in business of similar work under its present name? What were your fields when your organization was established? Whether any new fields have been added in your organization? and if so, when?	
10	Whether you ever required suspend construction for a period of more than six months continuously after the work is started? if so, give the name of project and reasons thereof.	
11	Have you ever left the work awarded to you incomplete? (If so, give name of project and reasons for not completing work)	
12	In how many of your projects were penalties imposed for delays? (Please give details)	
13	Give details of experience in similar Projects.	

**FORM:7**

**SAMPLE FORMAT FOR EVIDENCE OF ACCESS TO OR  
AVAILABILITY OF CREDIT FACILITIES**

**BANK CERTIFICATE**

This is to certify that M/s. .... is a reputed company with a good financial standing.

If the contract for the work, namely ..... is awarded to the above firm, we shall be able to provide overdraft/credit facilities to the extent of

Rs. \_\_\_\_\_ to meet their working capital requirements for executing the above contract.

_____	_____ Sd.
Bank	Name of
Manager	Senior Bank
Bank	Address of the

**FORM:8**

**Form of Subcontractors**

Item	Element of Work	Approximate Value	Name and Address of Subcontractor	Statement of similar works executed	Year of Execution

**\*\* The bidder shall enter in this schedule a list of the specialized works and approximate value of the work for which he proposed to use specialist subcontractors, with the names and addresses of the proposed subcontractors**

# **Section IV**

## **General Conditions**

#### **Section IV: GENERAL CONDITIONS**

1. The system of recording, measurements and payments will be based on the P.W.D. / Railway / MMRDA in vogue.
2. It is presumed that the contractor has gone carefully the standard and special specification of the individual items and studied the site condition before arriving at the percentage above / below the estimated rates quoted by him.
3. Special provisions in the detailed specifications or wording of any item shall give precedence over the corresponding contract provisions, if any. In case of any contradictions in the specifications, the interpretation and decision of the Engineer-in-charge shall be final and binding.
4. In all cases of errors, omissions or doubts or discrepancies in dimensions or description in drawings or in specification etc., a reference shall be made by the bidder to the Engineer-in-charge, whose elucidations, elaborations or decisions shall be treated as authentic and final and contractor shall be liable to be held responsible for any errors or omissions arising out of his not referring the doubts in advance to the Engineer-in-charge for clarifications.
5. If the bidder has any doubts, whatsoever, as to the contents of the contract he is deemed to have in good time i.e. before submitting his tender, get his doubts clarified authoritatively from the Executive Engineer in writing. Once the tender is submitted by bidder, the matter will be decided according to the tender stipulations.
6. All the time of work in Schedule-B of the tender are completed items of work and no extra claims shall be accepted as regards specifications, labour, materials, all taxes (Sales Tax, Work Contract Tax, VAT, Labour Cess, etc.), royalties, and any other applicable taxes / charges etc.
7. On request from the contractor, the M.M.R.C.L. shall extend all possible help at no extra cost in securing priorities for deliveries, obtaining controlled or scarce materials, permissions, police protection if required or requisition of land-private or public open land-on rental basis required temporarily for the purpose of execution of work etc. However, the M.M.R.C.L. shall not be held responsible for such arrangements or delays arising out of making such arrangements and for which no financial claims shall be entertained against the M.M.R.C.L.
8. The contractor shall have to make his own arrangements for procuring all materials and machinery required for the work and adopts necessary safety measures for protection of men and materials and nearby MMRCL / public or private properties against any accidental damages to life or property arising out of activities on his work.
9. Materials which are not approved shall not be allowed to be brought on site. Materials once brought to the site shall not be allowed to be removed from the site without the prior approval of the Engineer-in-charge.
10. The several documents forming the contract shall be taken as mutually complimentary to each other. Detailed working drawings shall gain preference over small scale drawings, written dimensions shall be in preference to the scaled dimensions and specific conditions shall be in preference to the general conditions. Any errors or omissions in descriptions, quantity or rate shall neither vitiate the contract nor absolve the contractor of his obligation under the contract from the responsibility of executing the work either in part or in whole.
11. In case of any error in giving reference to the specifications, necessary clarifications and guidance shall be taken from the Engineer-in-charge.

12. The bidder shall permit the Engineer-in-charge or his representative to inspect whenever required the stock of controlled materials to be used for the work.
13. The Engineer-in-charge shall have full right to ask for any additions or deletions in the supervisory staff and labour force of the contractor and his should be done immediately by the contractor to his full satisfaction. The contractor shall regularly submit to the Engineer-in-charge weekly reports to the people employed on his work and medical reports etc. Reports on accidents should be submitted within 24 hours.
14. Work Order Book shall be maintained on site and it shall be the property of the MMRCL. The contractor shall promptly sign the orders written in it by the Engineer-in-charge or his authorised representative or his superior officers and comply with the same promptly and correctly.
15. The contractor should report compliance of all such orders recorded in the work order book from time to time to the Engineer-in-charge for his verifications. First carbon copy of the extract from the Work Order Book shall be supplied to the contractor as soon as the entry is made in it by the officer of the MMRCL. The contractor should sign in the Work Order Book to acknowledge receipt of his copy.
16. The contractor shall engage an authorised and full time qualified technical representative on the work capable of managing and guiding the work and understanding all the specifications and contract conditions who will take orders as shall be given by the Engineer-in-charge or his representative from time to time and shall be responsible for carrying out the work promptly and correctly. His technical representative should be posted at the site with prior approval of the Engineer-in-charge and should not be removed from the site without his prior approval.

17. **Permits and Licences:**

The contractor shall procure at his own expenses all permits and licenses comply with rules and regulations laid down by the concerned authority and pay all charges, fees and give all notices necessary and pay all dues in connection with lawful execution of the work.

18. **Patented Devices, materials and processes**

Whenever the contractor desires to use any designed devices, materials or processes covered by letter of patents or copy right, the right for such use shall be secured by suitable legal agreement with the pattern owners and the copy of their agreement shall be supplied to the engineer in charge, if so desired by him.it shall be responsibility of the contract to observe all legal formalities for use of such patterns and consequences, If any, due to any failure on his part to do so shall be the sole responsibility of the contractor.

19. **Indemnity:**

The contractor shall indemnify the MMRC against the all actions, suits, claims, damages and demands brought or made against him in respect of anything done or omitted to be done by the contractor in the execution of or in the connection with the work of this contract and against loss or damage to the MMRC in consequences of any action or suit being brought against the contractor anything done or omitted to be done in execution of the work of this contract.

20. **Corrupt or Fraudulent Practices:**

The MMRCL requires that Bidders/Suppliers/Contractors under contracts, observe the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy MMRCL.

- a. Defines, for the purposes of this provision, the terms set forth below as follows:
  - i) **“Corrupt practice”** means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement process or in contract execution; and
  - ii) **“Fraudulent practice”** means a misrepresentation of facts in order to influence a procurement process or the execution of a contract.
- b. Will reject a proposal for award if it determines that the bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question.
- c. Will declare a firm ineligible, either indefinitely or for a stated period of time, to be awarded a contract if it any time determines that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing, a contract.

## **21. TENDERING UNDER DIFFERENT NAMES:**

- a) Firms with common proprietor/partner or connected with one another either financially or as principal and agent or as master and servant or with proprietor/partners closely related to each as husband, wife, father, mother and minor son/daughter and brother/sister and minor brother/sister, shall not tender separately under different names for the same Contract.
- b) If it is found that firms as described in (a) have tendered separately under different names for the same Contract, all such tender(s) shall stand rejected and tender deposit of each such firm /establishment shall be forfeited. In addition, such firms / establishments shall be liable, at the direction of the Managing Director, for further penal action including blacklisting.
- c) If it is found that clearly related persons as in (a) have submitted separate tender/quotations under different names of firms/establishments but with common address for each establishment/firm, though they have different addresses, are managed or governed by the same person/persons jointly or severally, such Bidders shall be liable for action as in para (b) above
- d) If after the Award of Contract, it is found that the accepted tender violated for cancellation at any time during its currency in addition to penal action against the contractors as well as related firms / establishments.

## **22. Jurisdiction of Courts:**

In case of any claim, dispute or difference rising in respect of the contract, the case of action there of shall be deemed to have arisen in Mumbai and all legal proceedings in respect of any such claim, dispute or difference shall be instituted in competent court in the city of Mumbai only. Employer, and includes collusive practice among bidders (prior to or after Tender submission) designed to establish Tender prices at artificial non-competitive levels and to deprive the employer of the benefits of free an open competition.

## **23. Import License:**

The bidders shall have to make their own arrangements to secure import license and / or release of controlled or scares raw materials or parts if required by them for fulfilment of their contract. The Metropolitan Commissioner shall not be bound to give any assistance to the bidders in that behalf.

## 24. Safe Custody:

All the charges for safe custody and withdrawal of and for the collection of interest etc. on the proper deposit will be payable by the contractors.

## 25. Risk & Cost:

- i) In case the contractor fails to deliver the quantity as stipulated in the delivery schedule, the Engineer in charge reserves right to procure same or similar material from alternate sources at risk, cost and responsibility of the contractor.
- ii) If it is observed that the Contractors carrying out the work fails to comply with instructions given by the authorities at the Superintending Engineer/ Executive Engineer's level during execution of work twice, the work will be carried out at the risk and cost of the contract & penal action will be taken against them. The above condition will be in addition to the relevant condition in General Condition of the Contract regarding cancellation of full or part of the work, finality of the decision of the disputes, differences or claims raised by the contractors relating to any matter arising out of the contract

## 26. Conditions to Form Consortium

The Bidders are allowed to form a Consortium. In case of Consortium, Only the Prime Bidder would be severally responsible for the performance of whole contract.

- 26.1 The number of Consortium members cannot exceed three, including the Prime Bidder.
  - 26.2 Only the Prime Bidder will submit the Proposal and sign the Contract with MMRC.
  - 26.3 Only the Prime Bidder shall be severally responsible to MMRC for the fulfilment of the provisions of the contract
  - 26.4 Only one Bid will be allowed from a Consortium. The partners of a Consortium are not allowed to bid individually or jointly with others. A Bidder who submits or participates in, more than one bid will cause all of the proposals in which the Bidder has participated to be disqualified.
  - 26.5 In case of a Consortium Bid, the Prime Bidder would also need to submit the Agreement letter/MOU between the Consortium members clearly indicating their scope of work, relationship and declaration on association and percentage participation. The Composition and constitution shall not be altered without prior consent of MMRC. Each consortium member shall execute and submit along with the proposal at least the following information in the Consortium Agreement/MOU:
    - 26.5.1 The Consortium Agreement/MOU concluded by the Prime Bidder and Consortium member(S) should also be addressed to MMRC clearly stating that the Agreement/MOU is applicable to this RFP.
    - 26.5.2 The Prime Bidder shall be solely liable to and responsible for all obligations towards MMRC for performance of works/services including that of its partners/associates under the contract.
    - 26.5.3 No Bidder can be a subcontractor while submitting a bid individually or as a partner of a JV in the same bidding process. A Bidder, if acting in the capacity of subcontractor in any bid, may participate in more than one bid, but only in that capacity.
27. The Bidder (All members in case of Consortium) should not be debarred/blacklisted by any Government/PSU in India as on date of submission of the Bid.



## **Section V**

# **Additional General Conditions and Specifications**

## SECTION V

### ADDITIONAL GENERAL CONDITIONS AND SPECIFICATIONS

1. These are to apply as additional to the General Requirements.

2. **Definitions**

Unless excluded by or repugnant to the context,

- 2.1 "**Activity Schedule**" means the priced and completed Activity Schedule forming part of the Bid.
- 2.2 The "**Completion Date**" is the date of completion of the Works as certified by the Engineer.
- 2.3 The expression "**Contract**" as used in the documents shall mean the deed to contract, together with its original accompaniment and those latter incorporated in it by mutual consent.
- 2.4 The expression "**Contractor**" used in the documents shall mean the successful Bidder whose tender has been accepted, and who has been authorized to proceed with the Work.
- 2.5 The "**Contract Price**" or "**Contract Sum**" is the price stated in the Letter of Acceptance and thereafter as adjusted in accordance with the provisions of the Contract.
- 2.6 "**Drawings**" shall mean the drawings referred to in the specifications and any modifications of such drawings approved in writing by the Engineer and such other drawings as may from time to time be furnished or approved in writing by the Engineer.
- 2.7 A "**Defect**" is any part of the Works not completed in accordance with the Contract.
- 2.8 The "**Defects Liability Period**" is the period calculated from the Completion Date.
- 2.9 The "**Employer**" is MMRC and is the party who will employ the Contractor to carry out the Works.
- 2.10 The "**Engineer**" as used in the documents shall mean the Supervision Consultant or his authorized representative of the Work.
- 2.11 "**Equipment**" is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.
- 2.12 The "**Initial Contract Price**" is the Contract Price stated in the Employer's Letter of Acceptance.
- 2.13 The "**Provisional Sum**" or "**Provisional Lump Sum**" shall mean lump sum included by the Employer in tender documents and shall represent the estimated value of work for which details are not available at the time of issue of tender.
- 2.14 The "**Intended Completion Date**" is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date may be revised only by the Employer by issuing an extension of time.

- 2.15 “**Materials**” are all supplies, including consumables, used by the Contractor for incorporation in the Works.
- 2.16 “**Plant**” is any integral part of the Works which is to have a mechanical, electrical, electronic or chemical or biological function.
- 2.17 The “**Site**” shall mean the lands and/or other places, in or through which the Work is to be executed under the Contract including any other lands or places which may be allotted by the Employer or used for the purpose of this Contract.
- 2.18. The “**Day**” shall mean a day of 24 hours from midnight to midnight irrespective of the number of hours worked in any day in that week.
- 2.19. “**Specification**” means the Specification of the Works included in the Contract and any modification or addition made or approved by the Engineer.
- 2.20. The “**Commencement Date**” shall be date to proceed with the Work.
- 2.21. “**Subcontractor**” is a person or corporate body who has a Contract with the Contractor to carry out a part of the Work in the Contract which includes work on the Site.
- 2.22. “**Temporary Works**” are works designed, constructed, installed, and removed by the Contractor which are needed for construction or installation of the permanent Works.
- 2.23. “**Variation**” is an instruction given by the Engineer, after consultation with the Employer, which varies the Works.
- 2.24. “**Urgent works**” shall mean any measure which, in the opinion of the Engineer, become necessary during the progress of the Works to obviate any risk or accident or failure or which become necessary for security of the work or the persons working, thereon. In these documents, the word “**bid**” shall be taken as synonymous with the word “**tender**”.

### **3. Interpretation**

- 3.1 In interpreting these General Requirements, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Engineer will clarify queries about the General Requirements.
- 3.2 If sectional completion is specified in the tender document, references in the Conditions of Contract to the Works, the Completion date, and the Intended Completion Date apply to any section of the Works (Other than references to the Completion date and intended completion date for the whole of the Works.)
- 3.3 In all cases of errors, omissions, doubts or discrepancies in dimensions or description in drawing or in specification, etc., the documents forming the Contract shall be interpreted in the order of priority as stated in the Contract Agreement. Where there are doubts or discrepancies between the General Requirements, Additional General Requirements and Specifications and Conditions of Contract, these three documents are to be taken as mutually complimentary to each other and the Engineer shall clarify the doubt. However, it shall be noted that the Special Conditions of Contract takes priority over the aforesaid three documents.

### **4. Construction Equipment**

The Contractor is required to provide appropriate equipment's for meeting the specifications and tolerance to the satisfaction of the Engineer. All equipment's provided shall be of proven efficiency and shall be operated and maintained at all times in a manner acceptable to the Engineer and no equipment or personnel shall be removed from site without prior written permission of the Engineer.

**5. Responsibilities for Level and Alignment**

The Contractor shall be entirely and exclusively responsible for the setting out of the PTR building and road works, the levels and correctness of every part of the work and shall rectify effectually any errors or imperfections therein; such rectifications shall be carried out by the Contractor, at his own cost, when instructions are issued to that effect by the Engineer.

**6. Damage by Floods or Accidents**

The Contractor shall take all precautions against damage by floods or like or from accident, etc. No compensation will be allowed to the Contractor on this account or for correcting and repairing any such damage to the Work. The Contractor shall be liable to make good at his cost any plant or materials belonging to the Employer lost or damaged by floods or from any other cause which is under his charge.

**7. Police Protection**

For the Special Protection of camp and of the Contractor's work, the Employer will assist the Contractor as far as possible to arrange for such protection with the concerned authorities, if so required by the Contractor in writing. The full cost of such protection shall be borne by the Contractor.

**8. Traffic Regulation during Execution of Work**

- 8.1 Unless separately provided for in the Contract, the Contractor shall have to make all necessary arrangements for regulating traffic, day and night during the period of construction to the entire satisfaction of the Engineer. This includes the construction and maintenance of road diversions, if necessary. The Contractor shall have to provide necessary caution boards, barricades, flags, lights and watchmen, etc. so as to comply with the latest Motor Vehicle rules and regulation and for traffic safety and he shall be responsible for all claims from accidents which may arise due to his negligence whether in regulating the traffic or due to any other reason.
- 8.2 The Contractor shall at all times carry out the Work on the road in a manner creating least interference to the flow of traffic, while consistent with the satisfactory execution of the same. For all works involving improvements to the existing road junctions, the Contractor shall, in accordance with the directives of the Engineer, provide and maintain, during the execution of work a passage for traffic, either along or part of the existing carriageway under improvement or along a temporary diversion constructed close to the road.

**9. Medical and Sanitary Arrangement to be provided for Labour Employed by the Contractor**

- a) The Contractor shall provide an adequate supply of potable water for the use of labours on work and in Camps.
- b) The Contractor shall provide mobile or semi-permanent latrines for the use of the labourers. Separate latrines shall be provided for men and women at both labour camp and work site.

- c) The Contractor shall build sufficient number of huts on a suitable plot of land outside the work site for the use of labourers according to the following specifications:
- i) Huts of Bamboos and Grass may be constructed.
  - ii) A good site not liable to submergence shall be selected on high ground remote from jungle but well provided with trees, shall be chosen wherever it is available. The neighbourhood of tank, jungle, grass or woods should be particularly avoided. Camps should not be established close to large cuttings of earth work.
  - iii) The lines of huts shall have open space of at least ten yards between rows. When a good natural site cannot be produced, particular attention should be given to drainage.
  - iv) There should be no overcrowding. Floor space at the rate of 30 Sq. ft. per head shall be provided. Care should be taken to see that the huts are kept clean and in good order.
  - v) The Contractor must find his own land and if he wants the Employer's land, he should apply for it and pay assessment for it, if made available by the Employer.
  - vi) The Contractor shall construct a sufficient number of enclosed bathing places. Washing places should also be provided for the purpose of washing clothes.
  - vii) The Contractor shall make sufficient arrangements for draining away the surface and sewage water as well as water from the bathing and washing places and shall dispose of this waste water as per government norms.
- d) The Contractor shall engage a Medical Officer with a traveling dispensary for a Camp containing 500 or more persons if there is Government or other private dispensary situated within 8 kilometres from the Camp. In case of emergency the Contractor shall arrange at his cost for transport for quick medical help to his sick worker.
- e) The Contractor shall provide the necessary staff for effecting a satisfactory drainage system and cleanliness of the camp to the satisfaction of the Engineer. At least one sweeper per 200 persons shall be engaged.
- f) The Assistant Director of Public Health shall be consulted before opening a labour camp and his instruction on matters such as water supply, sanitary conveniences, the camp site accommodation and food supply shall be attended to by the Contractor.
- g) The Contractor shall make arrangements at his own cost for all anti-malaria measures to be provided for the labour employed on the Work. The anti-malaria measure shall be provided as directed by the Assistant Director of Public Health.

## **10. Engineer's Decisions**

Except where otherwise specifically stated, the Engineer will decide contractual matters between the Employer and the Contractor in the role representing the Employer.

## **11. Delegation**

The Engineer may delegate any of his duties and responsibilities to other people after notifying the Contractor and may cancel any delegation after notifying the Contractor.

## **12. Communications**

Communications between parties which are referred to in the conditions are effective only when in writing. A notice shall be effective only when it is delivered (in terms of Indian Contract Act).

## **13. Other Contractors**

The Contractor shall cooperate and share the Site with other contractors, public authorities, owners of utilities, and the Employer. The Contractor shall provide facilities and services for them, such as water and electricity. The Contractor may mutually agree with the other parties to install meters and pay for the use. The use of scaffoldings shall be provided free to the other parties, if not yet dismantled.

## **14. Personnel**

The Contractor shall propose the key personnel required in the Tender Notice and submit the experience referred to in Section III, Item 1.5 for the Engineer's approval. The Engineer will approve any proposed replacement of key personnel only if their qualifications, abilities, and relevant experience are equal or better than the staff to be replaced. If the key personnel is not present/available on the Works after the award of the Contract, the Engineer may suspend the portion of the work that is under the responsibility of such key personnel. The Contractor shall bear the implications of any delay to such affected Works.

## **15. Approval by the Engineer**

- 15.1 The Contractor shall submit Specifications and Drawings showing the proposed Temporary Works to the Engineer, who is to approve them if they comply with the Specifications and Drawings.
- 15.2 The Contractor shall be responsible for design of Temporary Works.
- 15.3 The Engineer's approval shall not alter the Contractor's responsibility for design of the Temporary Works.
- 15.4 The Contractor shall obtain approval of third parties to the design of the Temporary Works where required.
- 15.5 All Drawings prepared by the Contractor for the execution of the temporary or permanent Works are subject to prior approval by the Engineer before their use.
- 15.6 All material / equipment shall be conforming to relevant specification / standards and shall require prior approval from MMRC before use.

## **16. Safety**

- 16.1 The Contractor shall be responsible for the safety of all activities on the Site.

## **17. Possession of the Site**

If possession of a part is not given by the date stated in the Contract the Employer is deemed to have delayed the start of the relevant activities and proportionate time period will be extended. In such cases of delay in handing over possession of site for a period not exceeding 6 months, the Contractor will not be entitled to any cost compensation.

## **18. Access to the Site**

The Contractor shall allow the Engineer and any person authorized by the Engineer access to the Site, to any place where work in connection with the Contract is being carried out or is intended to be carried out and to any place where materials or plant are being manufactured / fabricated / assembled for the Works.

## **19. Instructions**

- 19.1 The Contractor shall carry out all instructions of the Engineer which comply with the applicable laws where the Site is located.
- 19.2 The Contractor shall permit the Employer to inspect the Contractor's accounts and records relating to the performance of the Contractor and to have them audited by auditors appointed by the Employer, if so required by the Employer.

## **20. Programme**

- 20.1 Within the time stated in the Contract, the Contractor shall submit to the Engineer for approval a Program including Environmental Management Plan showing the general methods, arrangements, order, and timing for all the activities in the Works along with monthly cash flow forecast.
- 20.2 The Contractor shall submit to the Engineer, for approval, an updated Program at intervals no longer than the period of one month. If the Contractor does not submit an updated Program seven (7) days before the end of each month, the Engineer may withhold the amount Rs.1,00,000/- from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Program has been submitted.
- 20.3 An update of the Program shall show the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work including any changes to the sequence of the activities.
- 20.4 The Engineer's approval of the Program shall not alter the Contractor's obligations. The Contractor may revise the Program and submit it to the Engineer again at any time. A revised Program is to show the effect of Variations and Compensation Events.

## **21. Management Meetings**

- 21.1 The Engineer may require the Contractor to attend management meetings. The business of a management meeting shall be to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure (See Item 23 below).
- 21.2 The Engineer shall record the business of management meetings and is to provide copies of his record to those attending the meeting and to the Employer. The responsibility of the parties for actions to be taken is to be decided by the Engineer either at the management meeting or after the management meeting and stated in writing to all parties.

## **22. Early Warning**

- 22.1 The Contractor is to warn the Engineer at the earliest opportunity or latest within 30 days of specific likely future events or circumstances that may adversely affect the quality of the work, increase the Contract Price or delay the execution of works. The Engineer may require the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Contract Price and Completion Date. The estimate is to be provided by the Contractor as soon as reasonably possible in order for the Engineer and Employer to take appropriate action.

22.2 The Contractor shall cooperate with the Engineer in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the Work and in carrying out any resulting instruction of the Engineer.

### **23. Identifying Defects**

23.1 The Engineer shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Engineer may instruct the Contractor to search for a Defect and to uncover and test any work that the Engineer considers may have a Defect.

23.2 The Contractor shall permit the Employer's Technical auditor to check the Contractor's work and notify the Engineer and Contractor of any defects that are found. Such a check shall not affect the Contractor's or the Engineer's responsibility as defined in the Contract Agreement.

### **24. Tests / Routine Testing**

24.1 Routine Testing of materials / Works: The Contractor shall provide requisite facilities to the Engineer for carrying out Test of materials to be incorporated in the Works to ascertain qualitative requirements. The Contractor shall set up a field laboratory at his own cost for carrying out routine test on soils, aggregate, bitumen, water, cement, steel, concrete, etc. for which necessary lab equipments shall be made available at no extra cost. The Contractor shall also make available qualified and experienced material testing engineer / staff throughout the Contract period.

24.2 Material testing laboratory, equipment required and types of material to be tested may be found in Part 2, Construction Specification.

24.3 The Contractor conduct testing as per IS code requirements and Specifications for each type of materials from the approved laboratory at his own cost. If the Engineer instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no Defect the test charges shall be a borne by the Employer.

### **25. Correction of Defects**

25.1 The Engineer shall give notice to the Contractor of any Defects before the end of the Defects Liability Period. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.

25.2 Every time a notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Engineer's notice.

### **26. Uncorrected Defects**

26.1 If the Contractor has not corrected a Defect within the time specified in the Engineer's notice, the Employer may proceed to obtain quotations, give written notice and carry out the remedial works and shall deduct from moneys due to the Contractor, including administrative costs incurred by both the Engineer and the Employer.

Note: Where in certain cases, the construction specifications provide for acceptance of works within specified tolerance limits at reduced rates, Engineer will certify payments to Contractor accordingly.

### **27. Currencies**

All payments shall be made in Indian Rupees.

### **28. Recovery of compensation for delayed completion**

- 28.1 The Contractor shall pay compensation to the Employer at the rate per day stated in the milestone table for each day that the Completion Date is later than the Intended Completion Date (for the whole of the works or the milestone as stated in the Contract document). The Employer may deduct the compensation from payments due to the Contractor. Payment of delay damages does not reduce the Contractor's liabilities.
- 28.2 If the Intended Completion Date is extended after compensation has been paid, the Engineer shall adjust the same in the next payment certificate.

Time is the essence of the Contract and payment or deduction of compensation shall not relieve the Contractor from his obligation to complete the Work as per agreed construction program and milestones or from any other of the Contractor's obligations and liabilities under the Contract.

**29. Advance Payment**

There is no advance payment.

**30. Completion**

The Contractor shall request the Engineer to issue a Certificate of Completion for the Works and the Engineer will do so upon deciding that the Work is completed.

**31. Taking Over**

The Employer shall take over the Site and the Works within seven days of the Engineer issuing a Certificate of Completion.

**32. Final Account**

The Contractor shall supply to the Engineer a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period. The Engineer shall issue a Defect Liability Certificate and certify any final payment that is due to the Contractor within reasonable period of receiving the Contractor's account if it is correct and complete. If it is not, the Engineer shall issue within reasonable period a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Engineer shall decide on the amount payable to the Contractor and issue a payment certificate, within reasonable period of receiving the Contractor's revised account.

**33. Termination**

- 33.1 The Employer or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract.

33.2 Fundamental breaches of Contract include, but shall not be limited to the following:

- (a) The Contractor stops work for 90 days or more when no stoppage of work is shown on the current Program and the stoppage has not been authorized by the Engineer;
- (b) The Engineer instructs the Contractor to delay the progress of the Works and the instruction is not withdrawn within 180 days;
- (c) The Employer or the Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation;

- (d) The Engineer gives Notice that failure to correct a particular defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Engineer;
- (e) The Contractor does not maintain a security which is required;
- (f) The Contractor has delayed the completion of works by the number of days for which the maximum amount of delay damages can be paid as defined in the Contract; or
- (g) If the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices in competing for or in the executing the Contract.

For the purpose of this paragraph: "Corrupt practice" means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement process or in contract execution. "Fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Employer, and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.

- 33.3 When either party to the Contract gives notice of a breach of contract to the Engineer for a cause other than those listed under Sub Clause 35.2 above, the Engineer shall decide whether the breach is fundamental or not.
- 33.4 Notwithstanding the above, the Employer may terminate the Contract for convenience.
- 33.5 If the Contract is terminated the Contractor shall stop work immediately, make the Site safe and secure, hand over to the Employer and leave the Site as soon as possible.

#### **34. Payment upon Termination**

- 34.1 If the Contract is terminated because of a fundamental breach of contract by the Contractor, the Engineer shall issue a Certificate for the value of the work done less advance payment received up to the date of the issue of the Certificate, less other recoveries due in terms of Contract, less taxes due to deducted at source as per applicable law and less 20% percentage to apply to the amount of work not completed. Additional Delay Damages shall not apply. If the total amount due to the Employer exceeds any payment due to the Contractor the difference shall be a debt payable to the Employer.
- 34.2 If the Contract is terminated at the Employer's convenience or because of a fundamental breach of Contract by the Employer, the Engineer shall issue a Certificate for the value of the work done, the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works and the Contractor's costs of protecting and securing the Works and less advance payments received up to the date of the Certificate, less other recoveries due in terms of Contract, less taxes due to deducted at source as per applicable law.

#### **35. Property**

All materials on the Site, Plant, Equipment, Temporary Works and Works are deemed to be the property of the Employer, if the Contract is terminated because of a Contractor's default.

**Section VI**

**Special Conditions of  
Contract**



## Section: VI

### SPECIAL CONDITIONS OF CONTRACT

These are to apply as additional specifications and conditions, unless otherwise already provided for country elsewhere in this contract.

#### 1. DEFINITIONS: -

- a) Unless excluded by or repugnant to the context. The expression “**Government**” as used in the tender papers shall mean the MMRCL.
- b) The expression “**Executive Director/Electrical OR Authorized representative**” as used anywhere in the tender papers shall mean “**Engineer in-charge**” for this work from MMRCL.
- c) The expression “**Contractor**” used in the tender papers shall mean the successful bidder whose tender has been accepted, and who has been authorized to proceed with the work.
- d) The expression “**Contractor**” as used in the tender papers shall mean the deed to contract together with its original accompaniment and those latter incorporated in it by natural consent.
- e) “**Drawings**” shall mean the drawings referred to in the specifications and any modifications of such drawings approved in writing by Engineer-In-Charge and such other drawings as many from time to time be furnished or approved in writing by the Engineer-In-Charge.
- f) “**Engineer-In-Charge’s representative**” shall mean an assistant of the Engineer-In-Charge notified in writing to the contractor by the Engineer-In-Charge.
- g) ‘**Provisional sum**’ or ‘**Provisional lump sum**’ shall mean lump sum included by MMRCL in the tender documents and shall represent the estimated value of work for which details are not available at the time of issue of tender.
- h) The ‘**site**’ shall mean the lands and/or other places, on under, in or through which the work is to be executed under the contract including any other lands or places which may be allotted by MMRCL or used for the purpose of contract.
- i) The ‘**Work**’ shall mean the works to be executed in accordance with the Contract or part(s) thereof as the case may be and shall include all extra or Additional, altered or submitted works as required for performance of the Contract.
- j) The “**Contract sum**” shall mean the sum for which the tender is accepted.
- k) The “**Accepting Authority**” shall mean the Competent Authority to accept the Tender.
- l) The “**Day**” shall mean a day of 24 hours from midnight to midnight irrespective of the number of hours worked in any in day in that week.
- m) “**Temporary works**” shall mean all temporary works of every kind required in or about the execution, completion, or maintenance of the works.

- n) “**Urgent works**” shall mean any measure which, in the opinion of the Engineer-In-Charge, become necessary during the progress of the works to obviate any risk or accident or failure or which become necessary for security of the work or the persons working, thereon.
- o) Where the context so requires, works importing the singular only also include the plural and vice-versa.
- p) Heading and marginal notes, if any, to the general conditions shall not be deemed to form part thereof or be taken into consideration in the interpretation or construction thereof of the contract.

**2. BID VALIDITY PERIOD: -**

The bid is valid for the period of 120 days (ONE HUNDRED AND TWENTY DAY) (including the monsoon period ).

**3. CONSTRUCTION EQUIPMENT:**

The contractor shall be required to give a trial run of the equipment for establishing their capability to achieve the laid down specifications and tolerance to the satisfaction of the Engineer-In-Charge before commencement of the work. All equipment provided shall be of proven efficiency and shall be operated and maintained at all times, in a manner acceptable to the Engineer-In-Charge and no equipment or personnel will be removed from site without permission of the Engineer-In-Charge.

- 4. The documents forming the Contract shall be interpreted in the following order of priority, however in all cases of errors, omissions or doubts or discrepancies in dimensions or descriptions in drawing or in specifications etc.
  - 1) General Conditions.
  - 2) Special Conditions of Contract.
  - 3) Detailed item wise specifications (Relevant specifications given in Part-2).
  - 4) Technical Specifications

**5. RESPONSIBILITIES FOR LEVEL AND ALIGNMENT:**

The contractor shall be entirely and exclusively responsible for the horizontal and vertical alignment, the levels and correctness of every part of the work and shall rectify effectually any errors or imperfections therein, such rectifications shall be carried out by the contractor, at his own cost, when instructions are issued to that effect by the engineer-in-charge.

**6. DAMAGE BY FLOODS OR ACCIDENTS: -**

The contractor shall take all precautions against damage by floods or like or from accident etc. No compensation will be allowed to the contractor on this account or for correcting and repairing any such damage to the work during construction. The contractor shall be liable to make good at his cost any plant or materials belonging to the MMRCL lost or damaged by floods or from any other cause which is in his charge.

**7. POLICE PROTECTION: -**

For the special protection of camp and of the contractor's work, the MMRCL will help the contractor as far as possible to arrange for such protection with the concerned authorities; if so required by the contractor in writing full cost of such protection shall be borne by the contractor.

**8. TRAFFIC REGULATION:**

- 8.1 Unless separately provided for in the contract the contractor shall have to make all necessary arrangements for regulating traffic, day and night during the period of construction to the entire satisfaction of the engineer-in-charge. This includes the construction and maintenance to diversion if necessary. The contractor shall have to provide necessary caution boards, barricades, flags, lights and watchmen etc., so as to comply with the latest motor vehicles rules and regulation and for traffic safety and contractor shall be responsible for all claims from accidents which may arise due to his negligence whether in regulating the traffic or in stacking materials or due to any other reason, contractor shall be responsible.
- 8.2 The contractor shall at all times carry out the work on the road in a manner creating least interference to the flow of traffic, while consistent with the satisfactory execution of the same.

**9. MEDICAL AND SANITARY ARRANGEMENTS TO BE PROVIDED FOR LABOUR EMPLOYED IN THE CONSTRUCTION BY THE CONTRACTOR:**

- a) The contractor shall provide an adequate supply of potable water for the use of labourers on work and in camps.
- b) The contractor shall construct trench or semi-permanent latrines for the use of the labourers. Separate latrines shall be provided for men and women.
- c) The contractor shall build sufficient number of huts on a suitable plot of land for use of the labourers according to the following specification:
- i. Huts of Bamboo and grass may be constructed.
  - ii. A good site not liable to submergence shall be selected on high ground remote from jungle but well provided with trees, shall be chosen wherever it is available. The neighbourhood of tank, jungle, grass or woods should be particularly avoided. Camp should not be established close to large cuttings of earth work.
  - iii. There should be no over-crowding. Floor space at the rate of 30 sq.ft per head shall be provided. Care should be taken to see that the huts are kept clean and in good order.
  - iv. The contractor must find his own land and if he wants M.M.R.C.L. land, he should apply for it and pay assessment for it as per prevailing terms and conditions, if made available by M.M.R.C.L.
  - v. The contractor shall construct a sufficient number of bathing places. Washing places should also be provided for the purpose of washing clothes.
  - vi. The contractor shall make sufficient arrangements for draining away the surface and silage water as well as water from the bathing and washing places and shall dispose of this waste water in such way as not to cause any nuisance.
- d) The contractor shall engage a Medical Officer with a travelling dispensary for a camp, if there is no Government or other private dispensary situated within 8

kilometres from the camp. In case of emergency the contractor shall arrange at his cost for transport for quick medical help to his sick worker.

- e) The contractor shall provide the necessary staff for effecting a satisfactory drainage system and cleanliness of the camp to the satisfaction of the engineer-in-charge. At least one sweeper per 50 persons should be engaged.
- f) The Assistant Director of Public Health shall be consulted before opening a labour camp and his instruction on matters such as water supply, sanitary conveniences, the camp site accommodation and food supply shall be allowed by the contractor.
- g) The contractor shall make arrangements at his cost for all anti-malaria measures to be provided or the labour employed on the work. The anti-malaria measure shall be provided as directed by the Assistant Director of Public Health.

#### **10. Decisions of Engineer-In-Charge**

Except where otherwise specifically stated, the Engineer-In-Charge will decide contractual matters between the Employer and the Contractor in the role representing the Employer.

#### **11. Delegation:**

The Engineer-In-Charge may delegate any of his duties and responsibilities to other people after notifying the Contractor and may cancel any delegation after notifying the contractor.

#### **12. Communications**

Communications between parties which are referred to in the conditions are effective only when in writing. A notice shall be effective only when it is delivered (in terms of Indian Contract Act).

#### **13. Other Contractors**

The Contractor shall cooperate and share the site with other contractors, public authorities, Owners of utilities, and the Employer between the dates given in the Schedule of Other Contractors. The Contractor shall as referred to in the Contract Data, also provides facilities and services for them as described in the Schedule. The employer may modify the schedule of other contractors and shall notify the contractor of any such modification.

#### **14. Personnel**

The bidder should have competent (Technical and Administrative) employees for the proper Supervising, Monitoring and execution of the contract. The bidder should submit a list of these employees as per Form IV in Section-III stating clearly how these would be involved in this work. The Contractor shall employ the key personnel named in the schedule of key personnel as referred to in the Contract Data to carry out the functions stated in the Schedule or other personnel approved by the Engineer-In-Charge. The Engineer-In-Charge will approve any proposed replacement of key personnel only if their qualifications, abilities and relevant experience.

#### **15. Approval by the Engineer-In-Charge.**

- 15.1 The Contractor shall submit Specification and Drawings showing the proposed works to the Engineer-In-Charge, who is to approve them if they comply with the Specifications and Drawings for necessary approval before execution.
- 15.2 The Contractor shall be responsible for design of Temporary Works.
- 15.3 The Engineer–In–Charge’s approval shall not alter the Contractor’s responsibility for design of the Temporary Works.
- 15.4 The Contractor shall obtain approval of third parties to the design of the Temporary Works as required.
- 15.5 All Drawing prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Engineer –In–Charge before their use.

**16. Safety**

The Contractor shall be responsible for the safety of man & material with all activities on the Site.

**17. Discoveries**

Anything of historical or other interest or of significant value unexpectedly discovered on the site is the property of the Employer. The Contractor is to notify the Engineer –In – Charge of such discoveries and carry out the Engineer –In –Charge’s instructions for dealing with them.

**18. Possession of the site**

If possession of a part is not given by the date stated in the Contract Data, the Employer is deemed to have delayed the start of the relevant activities and proportionately time period will be extended. In such cases of delay in handing over possession of site the contractor will not be entitled for any compensation.

**19. Access to the Site**

The Contractor shall allow the Engineer –In–Charge and any person authorized by the Engineer-In-Charge access to the site, to the Site, to any place where work in connection with the Contract is being carried out or is intended to be carried out and to any place where materials or plant are being manufactured/fabricated/assembled for the works.

**20. Instructions**

- 20.1 The Contractor shall carry out all instructions of the Engineer – In—Charge which comply with the applicable laws which the site is located.
- 20.2 The Contractor shall permit the employer to inspect the Contractor’s accounts and records relating to the performance of the Contractor and to have them audited by auditors appointed by the employer, if so required by the employer.

**21. Programme.**

- 21.1 With the time stated in the Contract the Contractor shall submit to the Engineer-In-Charge for approval a Program including Environmental Management Plan (if needed) showing the general methods, arrangements, order, and timing for all the activities in the Work along with monthly cash flow forecast.

- 21.2 An update of the program shall be a program showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work including any changes to the sequence of the activities.
- 21.3 The Contractor shall submit to the Engineer-In-Charge, for approval, an updated program at intervals no longer than the period stated in the Contract IF the Contractor does not submit an updated program within this period, the Engineer-In-Charge may withhold the amount stated in the Contract from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue program has been submitted.
- 21.4 The Engineer –in Charge’s approval of the program shall not alter the Contractor’s obligations. The contractor may revise the program and submit it to the Engineer-In-Charge again at any time. A revised Program is to show the effect of Variations and Compensation Events.

## **22. Management Meetings**

- 22.1 Either the Engineer-In-Charge or the contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure.
- 22.2 The Engineer-In-Charge shall record the business of management meetings and is to provide copies of his record to those attending the meeting and to the Employer. The responsibility of the parties for actions to be taken is to be decided by the Engineer-In- Charge either at the management meeting or after the management meeting and stated in writing to all who the meeting.

## **23 Test/Routine testing.**

- 24.1 Routine Testing of materials/ works: Contractor to provide requisite facilities to the Engineer-In-Charge for carrying out Test of materials to be incorporated in the works to ascertain qualitative requirements, at no extra cost. Contractor shall also make available qualified and experienced material testing Engineer-In-Charge / staff trough out the contract period.
- 24.2 Contractor shall carry out all required tests for each type of materials from the approved laboratory at his own cost. If the Engineer-In-Charge Instructs the Contractor to carry out a test not specified in the specification to check whether any work has a Defect and the test shows that it does, the contractor shall pay for the test and any samples.

24.3 The contractor shall arrange the testing of the major Equipment and Material as insisted by the Engineer-In-Charge in charge in the factory before dispatch to site.

## **Section VII**

# **Contract Agreement**

## SECTION VII

### CONTRACT AGREEMENT

#### MUMBAI METRO RAIL CORPORATION LTD (MMRCL)

**Name of Work: Supply, Installation and Commissioning of Electrical, Air Conditioning, Fire Alarm Work and Other Allied Services for Mumbai Metro Rail Corporation Project Office at E-Block, Bandra-Kurla Complex, Mumbai-400 051**

THESE ARTICLES OF AGREEMENT made at Mumbai this..... day of .....

Two Thousand Sixteen between the MUMBAI METRO Rail Corporation Ltd (MMRCL) constituted and established and having its principal office on 5th Floor, MMRDA office Building, Plot Nos.C-14/15, "E" Block of BKC Bandra (East), Mumbai – 400 051 hereinafter called "the Employer" (which expression shall unless the context does not admit, include its successor or successors and assign or assigns) of the one part and Shri....., Indian inhabitant and being Proprietor of the partnership firm carrying on business in the name and style of M/s. ....and having their office at .....hereinafter called collectively "the Contractor" (which expression shall unless the context does not admit, included their respective heirs, administrators, executors and surviving partner or partners) of the other part.

WHEREAS the Employer invited by its public advertisement No. ....published in the .....dated..... public tenders for the execution of works referred to there in and more particularly described in the tender documents constituted in the Tender Notice, Tender Guidelines to the Bidders, General Requirements of Contract, Conditions of Contract, Specifications, Schedule of Quantities, Reference Documents and other allied documents.

AND WHEREAS the Contractor submitted his tender dated ..... for a sum of Rs. .... the estimated cost.

WHEREAS in exercise of its power under Clause (IV) of sub section (2) Section 6 of the Mumbai Metropolitan Region Development Authority Act, 1974 as amended up to-date.

AND WHEREAS the parties hereto are desirous of recording the Agreement so concluded between them which they do hereinafter.

#### **NOW THIS AGREEMENT WITNESSES AS FOLLOWS:**

1. In this Agreement, words and expressions shall have the same meaning as are respectively assigned to them in the Conditions of the Contract hereinafter referred to.
2. The following documents shall be deemed to form and be read and construed as a part of this Agreement, and the priority of the documents shall be as follows:
  - (i) The Contract Agreement
  - (ii) Letter of Acceptance
  - (iii) Addendums to the Bid documents
  - (iv) Special Conditions of Contract
  - (v) Conditions of Contract, Addition General Conditions and Specifications, General Conditions
  - (vi) Tender Notice and Scope of Works

- (vii) Bill of Quantities
- (viii) Construction Specifications
- (ix) Tender Drawings
- (x) Contractor's Tender Documents (Form B-1)
- (xi) Reference documents

3. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the works and remedy and defects therein conformity in all respects with the provisions of the Contract.
4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the works and the remedying of defects therein the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

IN WITNESS, whereof the parties hereto have caused this Agreement to be executed the day and year first before written:

SIGNED AND DELIVERED FOR AND ON )  
 BEHALF OF MUMBAI METRO RAIL CORPORATION LTD.)

Name: \_\_\_\_\_ Signature: \_\_\_\_\_  
 Designation: \_\_\_\_\_

In the presence of:

(1) Name: \_\_\_\_\_ Designation: \_\_\_\_\_ Signature: \_\_\_\_\_  
 (2) Name: \_\_\_\_\_ Designation: \_\_\_\_\_ Signature: \_\_\_\_\_

SIGNED AND DELIVERED FOR AND ON )  
 BEHALF OF THE CONTRACTOR )

**Shri .....** )  
 pursuant to Authority of their )  
 Deed of Partnership )

Signature: \_\_\_\_\_

In the presence of:

(1) Name:

Designation:

Signature:

(2) Name:

Designation:

Signature:

# **Section VIII**

## **Declaration by Contractor**

## **Section VIII: DECLARATION BY CONTRACTOR(S)**

I / We hereby declare that I / We have made myself / ourselves thoroughly conversant with the local conditions regarding all materials and labour on which I / We have based my / Our rates for this tender. The specifications and lead on this work have been carefully studied and understood by me / us before submitting the tender. I / We undertake to use only the best materials and method proposed to employ duly approved by the Engineer, during execution of the work and to abide by the decision.

**Signature of Contractor with Stamp**

## **Section IX (a)**

### **Percentage Rate Tender Form B-1**

## **Section IX (a): FORM B-1**

### **Percentage Rate Tender and Contract for Works**

#### **General Rules and Directions for the Guidance of Contractor**

1. All works proposed to be executed by Contractor shall be notified in a Form of invitation to tender pasted on a board hung up in the office of the Employer and made available in the government website.

This Form will state the work to be carried out as well as the date for submitting and opening tenders, and the time allowed for carrying out the work, also the amount of earnest money to be deposited with the tender, and the amount of the security deposit to be deposited by the successful Bidder and the percentage, if any, to be deducted from bills. It will also state whether a refund of quarry fees, royalties, octroi dues and ground rents will be granted. Copies of the specifications, designs and drawings and estimated rates, scheduled rates and any other documents required in connection with the work shall be signed by the Employer for the purpose of identification shall also be open for inspection by contractors at the office of the Employer during office hours.

Where the works are proposed to be executed according to the specifications recommended by a contractor and approved by the Employer such specifications with designs and drawings shall form part of the accepted tender.

2. In the event of the tender being submitted by a firm, it must be signed separately by each partner thereof, or in the event of the absence of any partner, it shall be signed on his behalf by a person holding a power of attorney authorizing him to do so.
  - i) The Contractor shall pay along with the Tender 4.84 Lakh as and by way of Earnest Money Deposit as specified in guidelines for submission of e-Tender in Section-II. The said amount of earnest money shall not carry any interest....
  - ii) In the event of his Tender being accepted subject to the provisions of sub-clause (iii) below the said amount of earnest money shall be appropriated towards the amount of Security Deposit payable by him under Conditions of Contract.
  - iii) If, after submitting the tender, the Contractor withdraws his offer, or modifies the same, or if after the acceptance of his tender the Contractor fails or neglects to furnish the Security Deposit, within 10 days from the date of letter of intent without prejudice to any other rights and powers of the Employer, hereunder or in law, the Employer shall be entitled to forfeit the full amount of the earnest money deposited by him. Please see Clause 1 of Conditions of Contract.
  - iv) In the event of his tender not being accepted, the amount of earnest money deposited by the Contractor shall unless it is prior thereto forfeited under the provisions of sub-clause (iii) above, to be refunded to him on his passing receipt thereof.
3. Receipts for payments made on account of any work, when executed by a firm shall also be signed by all the partners except where the contractors are described in their tender as a firm in which case the receipt shall be signed in the name of the

firm by one of the partners, or by some other person having authority to give effectual receipts for the firm.

4. Any person who submits a tender shall fill up in figures in e-Envelope 'C' (Financial Bid) at the prescribed space, stating at what percentage above/below the estimated rates for the items specified in Schedule B (Memorandum showing items of work to be carried out) shall be named in figures as well as in words. Tenders which propose any alteration in the works specified in the said form of invitation to tender or in the time allowed for carrying out the work or which contain any other conditions, will be liable to rejection.
5. The Employer or his duly authorized assistant shall open tenders in the presence of contractors who have submitted tenders or their authorized representatives who may be present at the time and he will enter the amounts of the several tenders in a comparative statement in a suitable form. In the event of a tender being accepted the Contractor shall, for the purpose of identification, sign copies of the specifications and other documents mentioned in Rule 1 above. In the event of tender being rejected, the Employer shall authorize the Accounts Office concerned to refund the amount of the earnest money deposited to the contractor submitting the tender, on his giving a receipt for the return of the money.
6. The officer competent to dispose of the tenders shall have the right of rejecting all or any of the tenders.
7. No receipt for any payment alleged to have been made by a contractor in regard to any matter relating to this tender or the contract shall be valid and binding on the Employer unless it is signed by the Employer or his authorized assistant.
8. The memorandum of work to be tendered for shall be filled in and completed by the office of Employer before the tender form is issued. If a form issued to an intending Bidder has not been so filled in and completed, he shall request the said office to have this done before he completes and delivers his tender.
9. All work shall be measured out by the standard measure and according to the rules and customs of the MMRCL and their rates shall be subject to any local customs.
10. Under no circumstances shall any contractor be entitled to claim enhanced rates for any items in this Contract.
11. All corrections and additions or pasted slips shall be initiated.
12. The measurements of work will be taken according to the usual method in use in the MMRCL and no proposals to adopt alternative methods will be accepted. The Engineer's decision as to what is "The usual method in use in the MMRCL" will be final.
13. The tendering contractor shall furnish a declaration along with the tender showing all works for which he has already entered into contract, and the value of the work that remains to be executed in each case on the date of submitting the tender.
14. Every Bidder shall submit along with the tender information regarding the income-tax clearance of ward or the district in which he is assessed for income-tax, the reference to the number of the assessment and the assessment year.

15. In view of the difficult position regarding the availability of foreign exchange no foreign exchange would be released by the Employer for the purchase of plant and machinery required for the execution of the work contracted for.
16. The contractor shall produce a year-wise list of works carried out during the last 5 financial years.
17. The contractor shall produce true copies of registration certificate of appropriate class including its validity.
18. True copy of the up to-date Income-tax certificate shall be attached with the tender.

**Section IX (b)**  
**Tender for Works**

## **Section IX(b): TENDER FOR WORKS**

I / We agree that this offer shall remain open for minimum period of 120 (One hundred and twenty days) from the date of financial submission of tender and hereafter until it is withdrawn by me / us by notice in writing duly addressed to the Authority and sent by registered Post A.D. or otherwise delivered at the office of such authority.

In respect of the sum of **Rs. 4.84 Lakh representing the Earnest Money Deposit** is forwarded herewith. The amount of earnest money Rs 4.84 Lakh shall not bear interest and shall be liable to be forfeited to the MMRCL should I / We fail to abide by the stipulation to keep the offer open for the period mentioned above or (ii) sign and complete the contract documents as required by the Engineer and furnish the Security Deposit as specified in item (d) of the memorandum contained in paragraph 1 above within the time limit laid down in clause (i) of the Conditions of Contract. The amount of earnest money may be adjusted towards the Security Deposit or refunded to me / us if so desired by me / us in writing, unless the same or any part thereof has been forfeited as aforesaid.

I / We have secured exemption from payment of Earnest Money after executing the necessary bond in favour of the MMRCL, a true copy of which is enclosed herewith. Should any occasion for forfeit of earnest money for this work arise due to failure on my / our part to (i) abide by the stipulation to keep the offer open for the period mentioned above or (ii) sign and complete the contract documents and furnish the security deposit as specified in item (d) of the memorandum contained in paragraphs above within the time limit laid down in clause (i) of the Conditions of Contract, the amount payable by me / us may at the option of the Engineer be recovered out of the amount deposited in lump sum for securing exemption in so far as the same may be extended in terms of the deficiency out of any other moneys which are due or payable to me / us the MMRCL, under any other contract or transaction of any nature whatsoever or otherwise.

I / We hereby tender for the execution, for the Managing Director, MMRCL (hereinbefore and hereinafter referred to as 'MMRCL') of the work specified in the underwritten memorandum within the time specified in such memorandum at \_\_\_\_\_ percentage above/ below/at par the estimated rates (Offer to be filled in e-Envelop 'C' i.e. Financial Bid) entered in schedule 'B' (Memorandum showing item of work to be carried out) and in accordance in all respects with the specification designs, drawings and instructions in writing referred to in Rule 1 hereof and in clause 12 of the annexed conditions of contract and agree that when materials for the work are provided by the MMRCL such materials and the rates to be paid for them shall be as provided in Schedule 'A' hereto.

## **Section IX (c)**

# **Conditions of Contract**

**Section: IX(c): CONDITIONS OF CONTRACT**

<p><b>Clause 1:</b> <b>Security Deposit</b></p>	<p>The person / persons whose tender may be accepted (hereinafter called "the Contractor" which expression shall unless excluded by or repugnant to the context include its heirs, executors, administrators, and assigns) shall:</p> <p>(A) within 10 days (which may be extended by the Employer concerned up to 15 days if he thinks fit to do so) of the receipt by him of the notifications of the acceptance of his tender, deposit with the Employer (if deposited for more than 12 months) of sum sufficient which will make up the full security deposit specified in the tender, or</p> <p>(B) Permit the Employer at the time of making any payment to him for work done under the Contract to deduct such sum as will amount to five percent of all moneys so payable such deductions to be held by the Employer by way of security deposit;</p> <p>provided always that in the event of the Contractor depositing a lump sum by way of security deposit as contemplated at (A) above, then and in such case, if the sum so deposited shall not amount to five percent of the total estimated cost of the work, it shall be lawful for the Employer at the time of making any payment to the Contractor for work done under the Contract to make up the full amount of two and half percent by deducting a sufficient sum from every such payment as last aforesaid until the full amount of the security deposit is made up.</p>
	<p>All compensation or other sums of money payable by the Contractor to the Employer under the terms of his Contract may be deducted from or paid by the sale of sufficient part of his security deposit or from the interest arising there from, or from any sums which may be due or may become due by the Employer to the Contractor under any other contract or transaction of any nature on any account securities endorsed as aforesaid, any sum or sums which whatsoever and in the event of his security deposit being reduced by reason of any such deduction or sale as aforesaid, the Contractor shall, within ten days thereafter, make good in cash or the Employer may have been deducted from, or raised by sale of his security deposit or any part thereof.</p> <p>The security referred to when paid in cash may at the cost of the depositor, be converted into interest bearing securities provided that the depositor has expressly desired this in writing. Amount of the security deposit to be paid in a lump sum within the period specified at (A) above is not paid, the tender / contract already accepted</p>

	<p>shall be considered as cancelled and legal steps taken against the Contractor for recovery of the amounts.</p> <p>As per Special Conditions the amount of security deposit retained by the Employer shall be released after expiry of Defect Liability Period. In the event of the Contractor failing or neglecting to complete rectification work within the period up to which the Contractor has agreed to maintain the work in good order then subject to provision of Clause 17 and 20 hereof the amount of Security Deposit retained by the Employer shall be adjusted towards the excess cost incurred by the Employer on rectification work.</p>
<p><b>Clause 2:</b> <b>Compensation for delay</b></p>	<p>The time allowed for carrying out the work i.e <b>5 month</b> as entered in the tender shall be strictly observed by the Contractor and shall be reckoned from the date on which the order to commence the work is given to the Contractor. The work shall through the stipulated period of the contract be proceeded with, with all due diligence (time being deemed to be the essence of the contract on the part of the Contractor) and Contractor shall pay as <b>compensation an amount equal to Rs 10000/- per day</b> or such smaller amount as the Executive Director(Elect.) (whose decision in writing shall be final) may decide, of the amount of the estimated cost of the whole work as shown by the tender for every day that the work remains terminated, or unfinished after the proposed dates and further to ensure good progress during execution of the work, the contractor shall be bound in all cases in which the time allowed for any work exceeds one month to complete.</p>
<p><b>Clause 3:</b> <b>Action when whole of Security deposit is forfeited</b></p>	<p>In any case in which under any clause of this Contract the Contractor shall have rendered himself to pay compensation amounting to whole of his security deposit (whether paid in one sum or deducted by instalments) or in case of abandonment of the work owing to serious illness or death of the Contractor or any other cause the Employer, shall have power to adopt any of the following courses as he may deem best suited to the interest of the Employer.</p>
<p>a)</p>	<p>To rescind the contract (for which decision notice in writing to the Contractor under the hand of the Employer shall be conclusive evidence) and in that case the security Deposit of the Contractor shall stand forfeited and be absolutely at the disposal of the Employer.</p>
<p>b)</p>	<p>To carry out the work or any part of the work departmentally debiting the Contractor with cost of the work, expenditure incurred on tools and plant and charges on additional supervisory staff including the cost of the work charges establishment employed for getting the unexecuted part of the work completed and crediting him with the value of the work done departmentally in all respects in the same manner and at the rates as if it had been carried out by the</p>

	<p>Contractor under the terms of this Contract. The certificate of the Engineer as to the cost and other allied expenses so incurred and to the value of the work so done departmentally shall be final and conclusive as against the Contract.</p>
c)	<p>To order that the work of the Contractor be measured up to date such part thereof as shall be unexecuted out of his hands and to give it to another contractor to complete in which case all expenses incurred on advertisement for fixing new contracting agency, additional supervisory staff including the cost of work charged establishment and cost of the work executed by the new contract agency will be debited to the Contractor and the value of the work done or executed through the new contractor shall be credited to the Contractor in all respects and in the same manner and at the same rates as if it had been carried out by the Contractor under the terms of this Contract. The certificate of the Engineer as to all the cost of the work and other expenses incurred as aforesaid for or in getting the unexecuted work done by the new contractor and as per the value of the work so done be final and conclusive against the Contractor.</p>
	<p>In case the Contract shall be rescinded in above clause 34 the Contractor shall be entitled to recover or be paid any sum for any work therefore actually performed by him under this Contract unless and until the Engineer shall have certified in writing the performance of such work and the amount payable to him in respect thereof and he shall only be entitled to be paid the amount so certified, in the event of either of the course referred in tender documents being adopted and the cost of the work executed departmentally or through a new contractor and other allied expenses exceeding the value of such work credited to the Contractor, the amount of excess shall be deducted from any money due to the Contractor by the Employer under the Contract or otherwise however for, from his Security Deposit or the sale proceed thereof provided however the Contractor shall have no claim against the Employer even if certified cost of such work and allied expenses, provided at least that whichever of three courses mentioned is adopted by the Engineer the Contractor shall have no claim to compensation for any loss sustained by him by reasons of his having purchased procured any materials or entered into any engagements or made any advances on account of or with a view to the execution of the work of the performance of the Contract.</p>
<p><b>Clause 4:</b>  <b>Action when the progress of any particular portion or the</b></p>	<p>If the progress of any particular portion of the work is unsatisfactory, the Engineer shall notwithstanding that the general progress of the work is in accordance with</p>

<p><b>work is unsatisfactory</b></p>	<p>the conditions mentioned, be entitled to take action under after giving the Contractor 10 days' notice in writing. The Contractor will have no claim for compensation, for any loss sustained by him owing to such action.</p>
<p><b>Clause 5:</b></p> <p><b>Contractor remains liable to pay compensation if action is not taken under Clause 3 &amp; 4.</b></p> <p><b>Power to take possession of required removal of or sale of Contractor's plant.</b></p>	<p>In any case in which any of the powers conferred upon the Engineer by Clause 3 and 4 hereof shall have become exercisable and the same shall not constitute a waiver of any of the Conditions hereof and such powers shall notwithstanding be exercisable in the event any future case of default by the Contractor for which under any clause or clauses hereof he is declared liable to pay compensation amount to the whole of his security deposit and the liability of the Contractor for past and future compensation shall remain unaffected. In the event of the Engineer taking action under sub-clause (a) or (c) of Clause 3, he may, if he so desires, take possession of all or any tools, land, materials and stores in or upon the work or the site thereof or belonging to the Contractor, or procured by him and intended to be used for the execution of the work or any part thereof paying or allowing for the same in account at the contract rates or in the case of contract rates not being applicable at current market rates, to be certified by the Engineer may, after giving notice in writing to the Contractor or his clerk of the work, or foreman or other authorized agent require him to remove such tools, plant, materials or stores from the premises within a time to be specified in such notice and in the event of the Contractor failing to comply with any such requisition the Employer may remove them at the Contractor's expense or sell them by auction or private sale on account of the Contractor and at his risk in all respects, and the certificate of the Engineer as to the expense of any such removal and the amount of the proceeds and expense of any such be final and conclusive against the Contractor.</p>
<p><b>Clause 6:</b></p> <p><b>Extension of time</b></p>	<p>Contractor shall desire an extension of the time for completion of work on the ground of his having been unavoidably hindered in its execution or on any other ground. He shall apply in writing to the Engineer in-charge before the expiration of the period stipulated in the tender or before the expiration of 30 days from the date of which he was hindered as aforesaid or on which the cause for asking for extension occurred, whichever is earlier and the Employer, may if in his opinion there was reasonable grounds for granting an extension, grant such extension as he thinks necessary or proper. The decision of the Employer in this matter shall be final.</p>

<p><b>Clause 7:</b></p> <p><b>Final Certificate</b></p>	<p>On completion of the work the Contractor shall be furnished with a certificate by the Engineer of such completion but no such certificate shall be given nor shall the work be considered to be complete until the Contractor shall have removed from the premises on which the work shall have been executed all scaffolding, surplus materials and rubbish, and shall have cleaned off the dirt from all wood work, doors, windows, walls, floor or other parts of any building in or upon which the work has been executed or of which he may hand possession for the purpose of executing the work nor until the works shall have been measured by the Engineer or where the measurement have been take by his subordinates until they have received the approval of the Engineer, the said measurements being binding and conclusive against the Contractor. If the Contractor fails to comply with the requirements of this Clause as to the removal of scaffolding, surplus materials and rubbish and cleaning of dirt on or before the date fixed for the completion of the Work the Employer may at the expense of the Contractor remove such scaffolding, surplus materials and rubbish and dispose off the same as he thinks fit and clean off such dirt as aforesaid and the Contractor shall forthwith pay the amount of all expenses so incurred, but shall have no claim in respect of any such scaffolding or surplus materials as aforesaid except for any sum actually realized by the sale thereof.</p>
<p><b>Clause 8:</b></p> <p><b>Payments on interim certificates to be regarded as advances</b></p>	<p>No payment shall be made for any work, estimated to cost less than rupees one lakh till after the whole of the work shall have been completed and a certificate of completion given. But in the case of works estimated to cost more than rupees one lakh, the <b>Contractor shall on submitting a monthly bill</b> therefore, be entitled to receive payment proportionate to the part work then approved and passed by the Engineer, whose certificate of such approval and passing of the sum so payable shall be final and conclusive against the Contractor. All such interim payments shall be regarded as payments by way of advance against the final payments only and not as payments for works actually done and completed, and shall not preclude the Engineer from requiring any bad, unsound, imperfect or unskilled work to be removed or taken away and reconstructed or re-erected nor shall any such payment be considered as an admission of the date performance of the contract or any part thereof in any respect or the accruing of any claim, nor shall it conclude, determine, or affect in any other way the powers of the Engineer as to the final settlement and adjustment of the accounts or otherwise or in any other way vary or effect within one month of the date fixed for the completion of the work, otherwise the Engineer's certificate of the measurements and of the total amount payable for the work shall be final and binding on all parties.</p>

<p><b>Clause 9:</b></p> <p><b>Payment at reduced rates on account of items of work not accepted as completed to be at the discretion of Engineer.</b></p>	<p>The rates for several items of works estimated to cost more than Rs. 1,000 agreed within, shall be valid only when the item concerned is accepted as having been completed fully in accordance with the sanctioned specifications. In cases where the items of work are not accepted as so completed the Engineer may recommend payment on account of such items at such reduced rates as he may consider reasonable in the preparation of final or on account bills.</p>
<p><b>Clause 10:</b></p> <p><b>Bill to be submitted monthly</b></p>	<p>A bill shall be submitted by the Contractor each month on or before the date fixed by the Engineer shall take or cause to be taken the requisite measurement for the purpose of having the same verified and the claim, so far as it is admissible, shall be adjusted if possible within 30 days from the presentation of the bill. If the Contractor does not submit the bill within the time fixed as aforesaid, the Engineer may depute a subordinate to record the measurement of said work in the presence of the Contractor or his duly authorized agent whose counter signature to the measurement list shall be sufficient warrant, and the Engineer may prepare a bill from such list which shall be binding on the Contractor in all respects.</p>
<p><b>Clause 11:</b></p> <p><b>Bill to be on printed forms</b></p>	<p>The Contractor shall submit all bills on the printed forms to be had on an application at the office of the Engineer. The charges to be made in the bills shall always be entered at the rates specified in the tender or in the case of any extra work ordered in pursuance of these conditions, and not mentioned or provided for in the tender, at the rates hereinafter provided for such work.</p>
<p><b>Clause 12:</b></p> <p><b>Store supplied by Employer</b></p>	<p>If the specification or estimate of the works provides for the use of any special description of materials to be supplied from the store of the MMRCL or if it is required that the contractor shall use certain stores to be provided by the Engineer (such material and stores and the prices to be charged therefore as hereinafter mentioned being so far as practicable for the convenience of the contractor but not so as in any way to control the meaning or effect of this contract specified in the schedule or memorandum hereto annexed) the contractor shall be supplied with such materials and stores as may be required from time to time to be used by him for the purposes of the contract only, and the value of the full quantity of the materials and stores so supplied shall be set off or deducted from any sums then due or thereafter to become due to the contractor under the contract, or otherwise, or from the security deposit, or the proceeds of sale thereof if the security deposit is held in government securities the same or a sufficient portion thereof shall in that case be sold for the purpose. All materials supplied to the contractor shall remain the absolute property of MMRCL and shall on no account be removed from the site of the work and shall at all times be open to inspection by the Engineer in-charge. Any such materials unused and in perfectly good in writing given under his hand but the contractor shall not be entitled to return any such material except with consent of the Engineer and he shall have no claim</p>

	<p>for compensation on account of any such material supplied to him as aforesaid but remaining unused by him or for any wastage in or damage to any such materials.</p>
<p><b>Clause 13:</b>  <b>Works to be executed in accordance with specifications, drawings, orders, etc.</b></p>	<p>The Contractor shall execute the whole and every part of the work of the most substantial and workman like manner and both as regards materials and in every other respect in strict accordance with specifications. The Contractor shall also confirm exactly fully and faithfully to the designs, drawings and instructions in writing relating to the work signed by the Engineer and lodged in this office to which the Contractor shall be entitled to have access for the purposes of inspection such office or on the site of work during office hours. The Contractor will be entitled to receive three sets of contract drawings as well as one certified copy of the accepted tender along with the work order free of cost. Further copies of the Contract drawings and other working drawings if required by him shall be supplied at Rs.2000/- per set.</p>
<p><b>Clause 14:</b></p> <p><b>Alteration in specification and designs not to invalidate Contract.</b></p> <p><b>Rates for works not entered in estimate, for schedule of rates of the district.</b></p>	<p>The Engineer in-charge shall have power to make any alteration in or additions to the original specifications, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the work, and the Contractor shall be bound to carry out the work in accordance with any instructions in this connection which may be given to him in writing signed by the Engineer and such alteration shall not invalidate the Contract and any additional work which the Contractor may be directed to do in the manner above specified as part of the work shall be carried out by the Contractor on the same conditions in all respects on which he agreed to do the main work, and at the same rates as are specified in the tender for the main work. And if the additional and altered work includes any class of work for which no rate is specified in this Contract then such class of work shall be carried out at the rates entered in the Schedule of Rates of the Division (if any) or at the rates mutually agreed upon between the Engineer and the Contractor, whichever are lower, if the additional or altered work for which no rate is entered in Schedule of Rates of Division, is ordered to be carried out before the rates are agreed upon then the Contractor shall, within seven days of the date of receipt by him of the order to carry out the work, inform the Engineer of the rate which it is his intention to charge for such class of work, and if the Engineer does not agree to this rate he shall by notice in writing be at liberty to cancel his order to carry out such class of work, and arrange to carry it out in such manner as he may consider advisable, provided always that if the Contractor shall commence work or incur expenditure in regard thereto before the rates shall have been mentioned as lastly herein before mentioned, then in such case he shall only be entitled to be paid in respect of the work carried out or expenditure incurred by him prior to the date of the determination of the rate as aforesaid according to such rate of rates as shall be fixed by the Engineer. In the event of a dispute, the</p>

	<p>decision of the Employer shall be final. Where, however, the work is to be executed according to the designs, drawings and specifications and accepted by the Engineer the alterations above referred to shall be within the scope of such designs, drawings and specifications appended to the tender.</p>
<p><b>Extensions of time in consequence of additions or alterations</b></p>	<p>The time limit for the completion of the work shall be extended in the proportion that the increase in its cost occasioned by alterations of additions bears to the cost of the original contract work, and the certificate of the Engineer as to which proportion shall be conclusive.</p>
<p><b>Clause 15: No claim to any payment or compensation for alteration in or restriction of work</b></p>	<p>(1) If at any time after the execution of the Contract documents, the Engineer shall for any reason whatsoever (other than default on the part of the Contractor for which the Employer is entitled to rescind the contract) desire that the whole or any part of the work specified in the tender should be suspended for any period or that the whole part of the work should not be carried out at all he shall give to the Contractor a notice in writing of such desire and upon the receipt of such notice the Contractor shall forthwith suspend or stop the work wholly or in part as required, after having due regard to the appropriate stage at which the work should be stopped or suspended so as not to cause any damage or injury to the work already done or endanger the safety thereof provided that the Engineer as to the stage at which the work or any part of it could be or could have been safely stopped or suspended shall be final and conclusive against the Contractor. The Contractor shall have no claim to any payment or compensation whatsoever by reasons of or in pursuance of any notice as aforesaid, on account of any suspension, stoppage or curtailment except to the extent specified hereinafter.</p>
	<p>(2) Where the total suspension of the work ordered as aforesaid continued for a continuous period exceeding 180 days the Contractor shall be at liberty to withdraw from the contractual obligation under the Contract so far as it pertains to the un-executed part of the work by giving a 10 days prior notice in writing to the Engineer, within 30 days of the expiry of the said period of 180 days of such intention and requiring the Engineer to record the final measurements of the work already done and to pay the final bill. Upon giving such notice the Contractor shall be deemed to have been discharged from his obligation to complete the remaining un-executed work under this contract. On receipt of such notice the Engineer shall proceed to complete the measurements and make such payment as may be finally due to the contractor within a period of 90 days from the receipt of such notice in respect of the work already done by the Contractor. Such payment shall not in any manner prejudice the right of the Contractor to any further</p>

	compensation under the remaining provisions of this clause.
	(3) Where the Engineer requires the Contractor to suspend the work for a period in excess of 30 days at any time or 60 days in the aggregate, the Contractor shall be entitled to apply to the Engineer within 30 days of the resumption of work such suspension of payment of compensation to the extent of pecuniary loss suffered by him in respect of working machinery rendered idle on the site or on account of his having had to pay the salary or wages of labour engaged by him during the said period of suspension, provided always that the Contractor shall not be entitled to any claim in this respect. Compensation to the Contractor does not apply if the suspension is due to the Contractor's fault e.g. no key personnel at Site. The Employer is entitled to compensation in such a situation.
	(4) In the event of :-  i) Any totally stoppage of work on notice from the Engineer under sub-clause (1) in this behalf ii) Withdrawal by the Contractor from the contractual obligations to complete the remaining executed work under sub-clause (2) on account of continued suspension of work for a period exceeding 90 days. iii) Where, however, the work is to be executed according to the designs, drawings and specifications and accepted by the Engineer the alterations above referred to shall be within the scope of such designs, drawings and specifications appended to the tender.
<b>No claim to compensation on account of loss due to delay of materials by Employer</b>	It shall be open to the contractor, within 90 days from the service of (i) the notice of stoppage of work or (ii) the notice of withdrawal from the contractual obligations under the contract account of the continued suspension of work or (iii) notice under Clause 14 (1) resulting in such curtailment to produce to the Engineer satisfactory documentary evidence that he had purchased or agreed to purchase materials for use in the contracted work, before receipt by him of the notice for stoppage, suspension or curtailment and required the Employer to take over on payment, such materials at the rates determined by the Engineer. The Employer shall thereafter take over the material so offered, provided the quantities offered are not in excess of the requirements of the un-executed work as specified in the accepted tender and are of quality and specification approved by the Engineer.
	The contractor shall not be entitled to claim any compensation from MMRCL for the loss suffered by him on account of delay by MMRCL in the supply of materials, entered in Schedule-A where such delay is caused by -

	<p>i) Difficulties relating to the supply of railway wagons.</p> <p>ii) Force Major</p> <p>iii) Act of God</p> <p>iv) Act of enemies of the State or any other reasonable cause beyond the control of MMRCL.</p> <p>In the case of such delay in the supply of materials MMRCL shall grant such extension of time for the completion of the works as shall appear to the Chief Engineer to be reasonable in accordance with the circumstance of the case. The decision of the Employer as to the extension of time shall be accepted as final by the contractor.</p>
<b>Clause 16:</b>	Under no circumstance whatever shall the Contractor be entitled to any compensation from the Employer on any account unless the Contractor shall have submitted a claim in writing to the Engineer within one month of the cause of such claim occurring.
<b>Clause 17:</b>	<p>If at any time before the security deposit is refunded to the Contractor it shall appear to the Engineer or his subordinate in charge of the work, that any work has been executed with unsound, imperfect or unskilful workmanship or with materials of inferior quality, or that any material or articles provided by him for the execution of the work are unsound, or of a quality inferior to that contracted for, or are otherwise not in accordance with the Contract it shall be lawful for the Engineer to intimate this fact in writing to the Contractor and then notwithstanding the fact, the work, materials or articles complained of may have been in advertently passed, certified and paid for the Contractor shall be bound forthwith to rectify or remove and reconstruct the work so specified in whole or in part, as the case may require or if so required, shall remove the materials or articles at his own charge and cost and in the event of his failing to do so within a period to be specified by the Engineer in the written intimation aforesaid, the Contractor shall be liable to pay compensation at the rate of one percent on the amount of the estimate for every day not exceeding 10 days, during which the failure so continue and in the case of any such failure the Engineer may rectify or remove and re-execute the work or remove and replace the materials or articles complained of as the case may be at the risk and expense in all respects of the contractor. Should the Engineer consider that any such inferior work or materials as described above may be accepted or made use of it shall be within his discretion to accept the same at such reduced rates as he may fix therefore.</p>
<b>Clause 18:</b> <b>Works to be open to inspection Contractor or responsible agent to be</b>	All works under or in course of execution or executed in pursuance of the Contract shall at all times be open to the inspection and supervision of the Engineer and his subordinates, and the Contractor shall at all times during the usual working hours, and at all other times at which reasonable notice of the intention of the Engineer

<p><b>present</b></p>	<p>or his subordinate to visit the works shall have been given to the Contractor, either himself be present to receive orders and instructions, or have a responsible agent duly accredited in writing present for that purpose. Orders given to the Contractor's duly authorized agent shall be considered to have the same force and effect as if they had been given to the Contractor himself.</p>
<p><b>Clause 19:</b>  <b>Notice to be given before work is covered up</b></p>	<p>The Contractor shall give not less than five days' notice in writing to the Engineer or his subordinate in charge of the work before covering up or otherwise placing beyond the reach of measurement any work in order that the same is so covered up or placed beyond the reach of measurement any work without the consent in writing of Engineer or his subordinate in charge of the work, and if any work shall be covered up or placed beyond the reach of measurement without such notice having been given or consent obtained the same shall be uncovered at the Contractor's expense, and in default thereof no payment or allowance shall be made for such work or for the materials with which the same was executed.</p>
<p><b>Clause 20:</b> <b>Contractor liable for damage done, and imperfection</b></p>	<p>If during the period of <b>Twenty Four (24) calendar months</b> from the date of completion as certified by the Engineer (Please refer Milestone Table in Special Conditions of Contract) pursuant to Clause 7 of the Conditions of Contract or a period to cover one monsoon from 07<sup>th</sup> June to 07<sup>th</sup> October whichever is later in the opinion of the Engineer, the said work is defective in any manner whatsoever, the Contractor shall forthwith on receipt of notice in that behalf from the Engineer duly commence execution and completely carry out at his cost in every respect all the work that may be necessary for rectifying and setting right the defect specified therein including dismantling and reconstruction of unsafe portions strictly in accordance with and in the manner prescribed and under the supervision of the Engineer in the event of the Contractor failing or neglecting to commence execution of the said rectification work within the period prescribed thereof in the said notice and / or to complete the same as aforesaid as required by the said notice. The Employer to get the same executed and carried out departmentally or by any other agency at the risk on account and at the cost of the Contractor. The Contractor shall forthwith on demand pay to the Employer amount of such costs, charges and expenses sustained or incurred by the Employer of which the certificate of the Engineer shall be final and binding on the Contractor. Such costs, charges and expenses shall be deemed to be arrears of land revenue and in the event of the Contractor failing or neglecting to pay the same on demand as aforesaid without prejudice to any other rights and remedies of the Employer; the same may be recovered from the Contractor as arrears of land revenue. The Employer shall also be entitled to deduct the same from any amount which may then be payable or which may thereafter become payable by the Employer to the Contractor either in respect of the said work or any other work whatsoever or from the amount</p>

<p><b>Clause 21:</b>  <b>Contractor to supply plant ladders, scaffolding, etc. and is liable for damages arising from on-provisions of lights, fencing, etc.</b></p>	<p>of security deposit retained by the Employer.</p> <p>The Contractor shall supply at his own cost all materials, plant, tools, appliances, implements, ladders, cordage, tackle scaffolding, temporary works requisite or proper for execution of the work, whether the original, altered or substituted form, and whether included in specifications, or other documents forming part of the contract or referred to in these Conditions or not and which may be necessary for the purpose of satisfying or complying with the requirements of the Engineer as to pay matter as to which under these Conditions he is entitled to be satisfied, or which he is entitled to require together with carriage therefore and from the work. The Contractor shall also supply without charge the requisite number of persons with the means and materials necessary for the purpose of setting out works, and counting, weighing and assisting in the measurement or examination at any time and from time to time of the work or the materials. Failing this the same may be provided by the Engineer at the expense of the Contractor and the expenses may be deducted from any money due to the Contractor under the Contract or from his security deposit or the proceeds of sale thereof, or of a sufficient portion thereof. The Contractor shall provide all necessary fencing and lights required to protect the public from accident, and shall also be bound to bear the expenses of defense of every suit, action or other proceedings, that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any such suit, action or proceedings to any such person or which may with the consent of the Contractor be paid for compromising any claim by any such person.</p>
<p><b>Clause 21-A:</b></p>	<p>The Contractor shall provide suitable scaffold and working platforms gangways and stairways and shall comply with the following regulations in connection herewith –</p> <ul style="list-style-type: none"> <li>a) Suitable scaffolds shall be provided for workmen for all works that cannot be safely done from a ladder or by other means.</li> <li>b) A scaffold shall not be constructed, taken down, or substantially altered except - <ul style="list-style-type: none"> <li>i) under the supervision of a competent and responsible person, and</li> <li>ii) As far as possible by competent worker possessing adequate experience in this kind of work.</li> </ul> </li> <li>c) All scaffolds and appliances connected therein and all ladders shall - <ul style="list-style-type: none"> <li>i) be of sound material,</li> <li>ii) be of adequate strength having regard to the loads and strains to which they will be</li> </ul> </li> </ul>

	<p>subjected, and</p> <p>iii) be maintained in proper condition.</p> <p>d) Scaffolds shall be so constructed that no part thereof can be displaced in consequence of normal use.</p> <p>e) Scaffold shall not be overloaded and so far, as practicable the load shall be evenly distributed.</p> <p>f) Before installing lifting gear on scaffolds special precaution shall be taken to ensure the strength and stability of the scaffolds.</p> <p>g) Scaffolds shall be periodically inspected by a competent person.</p> <p>h) Before allowing a scaffold to be used by his workman the Contractor shall check whether the scaffold has been erected by his workmen or not, take steps to ensure that it complies fully with the regulations herein specified.</p> <p>i) Working platforms, gangways and stairways shall-</p> <p>ii) be so constructed that no part thereof can sag unduly or</p> <p>iii) unequally,</p> <p>iv) be so constructed and maintained, having regard to the prevailing conditions as to reduce as far as practicable risks of persons tripping or slipping, and</p> <p>v) be kept free from any unnecessary obstruction.</p>
	<p>j) In the case of working platforms, gangways, working places and stairways at a height exceeding 2.4m.</p> <p>i) every working platform and every gangway shall be closely boarded unless other adequate measures are taken to ensure safety,</p> <p>ii) every working platform and gangway shall have adequate width, and</p> <p>iii) every working platform, gangway, working place and stairway shall be suitably fenced.</p>
	<p>k) Every opening in the floor of a building or in a working platform shall except for the time and to the time and to the extent required to allow the excess of persons or the transport or shifting of material; be provided with suitable means to prevent the fall of persons or materials.</p>
	<p>l) When persons are employed on a roof where there is a danger of falling from a height exceeding suitable precaution shall be taken to prevent the fall of persons or materials.</p>

	<p>m) Suitable precautions shall be taken to prevent persons being struck by article which might fall from scaffolds or other working places.</p> <p>n) Safe means of access shall be provided to all working platforms and other working places.</p> <p>o) The Contractor shall have to make payment to the labours as per minimum wages act.</p>
<p><b>Clause 21-B:</b></p>	<p>The Contractor shall comply with the following regulation as regards the hoisting appliances to be used by him.</p> <p>a) Hoisting machines and tackle, including their attachments, anchorage's and supports shall:</p> <p style="margin-left: 40px;">i) be of good mechanical construction, sound material and adequate</p> <p style="margin-left: 40px;">ii) strength and free from patent defect, and</p> <p style="margin-left: 40px;">iii) be kept in good repair and in good working order.</p> <p>b) Every rope used in hoisting or lowering materials or as a means of suspension shall be of suitable quality and adequate strength and free from patent defect.</p> <p>c) Hoisting machines and tackle shall be examined and adequately tested after erection on the site and before use and be re-examined in position at intervals to be prescribed by the Engineer.</p> <p>d) Every chain, ring, hook, shackle, swivel and pulley block used in hoisting or lowering materials or as a means of suspension shall be periodically examined.</p> <p>e) Every crane driver or hoisting appliance operator shall be properly qualified.</p> <p>f) No person who is below the age of 21 years shall be in control of any hoisting machine, including any scaffold which or give signals to the operator.</p> <p>g) In the case of every hoisting machine and of every chain, ring hook shackle, swivel and pulley block used in hoisting or lowering or as a means of suspension the safe working load shall be ascertained by adequate means.</p> <p>h) Every hoisting machine and all gear referred to in the proceeding regulation shall be plainly marked with the safe working load.</p> <p>i) In the 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.</p> <p>j) No part of any hoisting machine or of any gear referred to in regulation 7 above shall be loaded beyond the safe working load except for the purpose of testing.</p> <p>k) Motors, gearing transmissions, electric wiring and other dangerous parts of hoisting appliances</p>

	<p>shall be provided with efficient safeguards.</p> <p>l) Hoisting appliances shall be provided with such means as will reduce to a minimum the risk of the accidental descent of the load.</p>
	<p>m) Adequate precautions shall be taken to reduce to a minimum risk of any part of a suspended load becoming accidentally displaced.</p>
<b>Clause 21-C:</b>	The Contractor / contractors shall make payments to the labourers as per Minimum Wages Act, (1950).
<b>Clause 22: Measures for prevention of fire</b>	<p>The Contractor shall not set fire to any standing jungle, trees, brushwood or grass without a written permit from the Engineer.</p> <p>When such permit is given and also in all cases when destroying of dug up trees, brushwood, grass etc., by fire, the Contractor shall take necessary measures to prevent such fire spreading to or otherwise damaging surrounding property.</p>
<b>Clause 23: Liability of Contractor for any damage done in or outside work area</b>	<p>Compensation for all damages done intentionally or unintentionally by Contractor's labour whether in or beyond the limits of the Employer's property including any damage caused by the spreading of the fire mentioned in Clause 22 shall be estimated by the Engineer or such other officer as he may appoint and the estimates of the Engineer shall be final and the Contractor shall be bound to pay the amount of the assessed compensation on demands failing which the same shall be recovered from the Contractors as damages in the manner prescribed in Clause 1 or deducted by the Engineer from any sums that may be due or become due from the Employer to the Contractor under this Contract or otherwise.</p>
	<p>The Contractor shall bear the expenses of defending any action or other legal proceedings that may be binding by any person for injury sustained by him owing to neglect of precautions to prevent the spread of fire and he shall pay any damages and cost that may be awarded by the court in consequence.</p>
<b>Clause 24: Employment of female labour</b>	The employment of female labours on works in the neighbourhood of soldier's barracks should be avoided as far as possible.
<b>Clause 25: Work on Sundays</b>	Work shall be undertaken as per labour regulations(GoM/GoI).
<b>Clause 26: Work not to be sublet unless it is permitted Contract may be rescinded and security deposit forfeited for subletting it without approval or for bringing a public officer if Contractor become insolvent</b>	<p>The Contractor shall not assign or sublet without the written approval of the Engineer. And if the Contractor shall assign or sublet his Contract or attempt to do so or become insolvent or commence any proceedings to get himself adjudicated an insolvent or make any composition with his creditors, or attempt to do or if bribed, grateful, gift, loan perquisite, reward or advantage, pecuniary or otherwise shall either directly or indirectly be given, promised or offered by the Contractor or any of his servants or agents to any public officer or person in the employment of the Employer in any way relating to his officer or employment or if any such officer or person shall become in any way directly or indirectly interested in the Contract, the Employer may thereupon by notice in writing rescind the Contract,</p>

	and the security deposit of the Contractor shall thereupon stand forfeited and be absolutely at the disposal of the Employer and the same consequences shall ensue as if the Contract had been rescinded under Clause 3 hereof and in addition the Contractor shall not be entitled to recover or be paid for any work therefore actually performed under the Contract.
<b>Clause 27:</b>  <b>Sum payable by way of compensation to be considered as reasonable compensation without reference to actual loss</b>	All sums payable by a Contractor by way of compensation under any of these Conditions shall be considered as reasonable compensation to be applied to the use of the Employer without reference to the actual loss or damage sustained, and whether any damage has or has not be sustained.
<b>Clause 28:</b>  <b>Changes in the constitution of firm to be notified</b>	In the case of tender by partners any change in the constitution of a firm shall be forthwith notified by the Contractor to the Engineer for his information.
<b>Clause 29:</b>  <b>Work to be under direction of the Engineer</b>	All works to be executed under the Contract shall be executed under the direction and subject to the approval in all respects of the Engineer for the time being, who shall be entitled to direct at what point or points and in what manner they are to be commenced, and from time to time carried on.
<b>Clause 30 (1):</b> <b>Engineer's decision shall be final</b>	Except where otherwise specified in the Contract and subject to the powers delegated to him by the Employer then in force the decision of the Engineer for the time being shall be final, conclusive and binding on all parties to the Contract upon all questions relating to the meaning of the specifications, designs, drawings, and instructions, hereinbefore mentioned and as to the quality of workmanship or materials used on the work or as to any other question, claim, right, matter or things, whatsoever if any, way arising out of or relating to the Contract, designs drawings, specifications, estimates, instructions, orders or other conditions or otherwise concerning the works or the execution of failure to execute the same, whether arising, during the progress of the work or after completion of abandonment thereof.
<b>Clause 30 (2):</b>  <b>Appeal against Engineer's decision</b>	The Contractor, may within thirty days of receipt by him of any order passed by the Engineer as aforesaid, appeal against it to the Employer provided that – The accepted value of the Contract exceeds Rs.10 lacs (Rupees Ten lacs) Amount of claim is not less than Rs.1.00 lac (Rupees One lac)

<p><b>Clause 30 (3):</b></p> <p><b>Appeal against Employer's decision</b></p>	<p>Contractor is not satisfied with the order passed by the Employer as aforesaid, the Contractor may, within thirty days of receipt by him of any such order, appeal against it to the Metropolitan Commissioner who, if convinced that prima-facie the Contractor's claim rejected by Engineer is not frivolous and that there is some substance in the claim of the Contractor as would merit a detailed examination through a suitable committee appointed for the purpose by the Metropolitan Commissioner if necessary and in that case decision taken by the committee shall be finalized by the Engineer and same shall be binding to the Contractor.</p>
<p><b>Clause 31:</b></p> <p><b>Stores of European or American manufacturer to be obtained from the Employer</b></p>	<p>No stores of European or American manufacture will be supplied by the Employer.</p>
<p><b>Clause 32:</b></p> <p><b>Action where no specification mentioned</b></p>	<p>In the case of any class of work for which there is no such specification as mentioned in Rule 1 (in Form B-1), such work shall be carried out in accordance with the construction specifications and in the event of there being no specification, then in such case the work shall be carried out in all respects in accordance with the instructions and requirements of the Engineer.</p>
<p><b>Clause 33:</b></p> <p><b>Definition of work</b></p>	<p>The expression "Work" where used in these conditions, shall unless there be something in the subject or context repugnant to such construction, be constructed to mean the work or works contracted to be executed under on in virtue of the Contract, whether temporary or permanent and whether original, altered, substituted or additional.</p>
<p><b>Clause 34:</b></p> <p><b>Contractor's percentage whether applied to net or gross amounts of bills</b></p>	<p>The percentage referred to in the tender shall be adjusted to the gross amount of the bill issued.</p>
<p><b>Clause 35:</b></p> <p><b>Refund or quarry fees and royalties</b></p>	<p>All quarry fees, royalties and ground rent for stacking materials, if any shall be paid by the Contractor.</p>
<p><b>Clause 36:</b></p> <p><b>Compensation under the Workmen's Compensation Act</b></p>	<p>The Contractor shall be responsible for and shall pay any compensation to his workman payable under the Workmen's Compensation Act, 1923 (VIII) of 1923 (hereinafter called the said Act) for injuries caused to the workmen. If such compensation is payable, paid by the Employer as principal under sub-section (1) of Section 12 of the said Act on behalf of the Contractor, it shall be recoverable by the Employer from the Contractor under Sub-section (2) of the said section. Such compensation shall be recovered in the manner laid down in Clause 1 above.</p>
<p><b>Clause 37-A:</b></p>	<p>The Contractor shall provide all necessary personal</p>

	<p>safety equipment and first aid apparatus available for the use of the persons employed on the Site, shall maintain the same condition suitable for immediate use at any time and shall comply with the following regulations in connection therewith.</p> <p>a) The workers shall be required to use the equipment so provided by the Contractor and the Contractor shall take adequate steps to ensure proper use of the equipment by those concerned.</p> <p>b) When work is carried on in proximity to any place where there is a risk of drawing all necessary equipment shall be provided and kept ready for use and all necessary steps shall be taken for the prompt rescue of any person in danger.</p> <p>c) Adequate provision shall be made for prompt first-aid treatment of all injuries likely to be sustained during the course of the work.</p>
<p><b>Clause 38:</b></p> <p><b>Claim for quantities entered in the tender</b></p>	<p>(1) Quantities in respect of the several items shown in the tender are approximate and in respect of any of the items so long as, subject to any special provision contained in the specifications prescribing a different percentage of permissible variation, the quantity varies by more than 25 percent and so long as the value of the excess quantity beyond this limit, at the rate of item specified in the tender, no variation in rate will be entertained. However, no rate revision for earth works irrespective of any variation.</p> <p>(2) The Contractor shall, if ordered in writing by the Engineer so to do, also carry out any quantities in excess of the limit mentioned in sub-clause (1) hereof on the same conditions as and in accordance with the specifications in the tender and the rates (i) derived from the rates entered in the current schedule of rates and in the absence of such rates, (ii) at the rate prevailing in the market, the said rates being increased or decreased as the case may be by the percentage which the total tendered amount bear to the estimated cost of the work as put to tender based upon the Schedule of Rates applicable to the year in which the tenders were invited for the purpose of operation of this clause.</p>
<p><b>Clause 39:</b></p> <p><b>Employment of famine, etc. labour</b></p>	<p>The Contractor shall employ any famine, convict or other labour of a particular kind of class if ordered in writing to do so by the Engineer.</p>
<p><b>Clause 40:</b></p> <p><b>Claim for compensation for delay in the starting the work</b></p>	<p>No compensation shall be allowed for any delay caused in the starting of the work on account of acquisition of land or in the case of clearance works, on account of any delay in according sanction to estimates; unless the delay caused by the Employer is in excess of 6 months.</p>

<p><b>Clause 41:</b></p> <p><b>Claim for compensation for delay in the execution of work</b></p>	<p>No compensation shall be allowed for any delays in the execution of the work on account of water standing in borrow pits or compartments. The rates are inclusive of hard or cracked soil, excavation in mud, sub-soil water or water standing in borrows and no claim for an extra rate shall be entertained, unless otherwise expressly specified.</p>
<p><b>Clause 42:</b></p> <p><b>Entering upon or commencing any portion of work</b></p>	<p>The Contractor shall not enter upon or commence any portion of work except with the written authority and instructions of the Engineer or of his sub-ordinate in charge of the work, failing which the Contractor shall have no claim to ask for measurements or payment for work.</p>
<p><b>Clause 43:</b></p> <p><b>Minimum age of persons employed</b></p>	<p>(i) No Contractor shall employ any person who is under the age of 18 years.</p> <p>(ii) No contractor shall employ donkeys or other animals with breaching of string or thin rope. The breaching must be at least three inches wide and should be of tape (Nawar).</p> <p>(iii) No animal suffering from sores, lameness or emaciation or which is immature shall be employed on the work.</p> <p>(iv) The Engineer or his Agent is authorized to remove from the work any person or animal found working which does not satisfy these conditions and no responsibility shall be accepted by MMRCL for any delay caused in the completion of the work due to such removal.</p> <p>(v) The contractor shall pay fair and reasonable wages to the workmen employed by him in the contract undertaken by him. In the event of any dispute arising between the contractor and his workmen on the grounds that the wages paid are not fair and reasonable the dispute shall be referred to workmen on the grounds that the wages paid are not fair and reasonable the dispute shall be referred without delay to the Engineer, who shall decide the same. The decisions of the Engineer shall be conclusive and binding on the contractor, but such decision shall not in any way effect the conditions in the contract regarding the payment to be made by MMRCL at the sanctioned rates.</p> <p>(vi) Contractor shall provide drinking water facilities to the workers. Similar amenities shall be provided to the workers engaged on large work in urban areas.</p>
<p><b>Clause 44:</b></p> <p><b>Method of payment</b></p>	<p>Payment to Contractor shall be made by cheque drawn on any bank with division convenient to them provided the amount exceeds Rs. 10/-. Amount not exceeding Rs. 10/- will be paid in cash.</p>
<p><b>Clause 45:</b></p> <p><b>Acceptance of condition before tendering for works</b></p>	<p>Any contractor who does not accept these conditions shall not be allowed to tender for work.</p>

<p><b>Clause 46:</b></p> <p><b>Employment of Scarcity of Labour</b></p>	<p>If Government declares a state of scarcity of famine to exist in any village situated within 10 miles of the Work, the Contractor shall employ upon such parts of the work, as are suitable for unskilled labour, any person certified to him by the Engineer or be any person to whom the Engineer may have delegated this duty in writing to be in need of relief and shall be bound to pay to such persons, wages not below the minimum which Government may have fixed in this behalf. Any disputes which may arise in connection with the implementation of this clause shall be decided by the Engineer whose decision shall be final and binding on the Contractor.</p>
<p><b>Clause 47:</b></p>	<p>The price quoted by the Contractor shall not in any case exceed the control price, if any, fixed by Government or reasonable price which it is permissible for him to charge a private purchaser for the same class and description, the controlled price of the price permissible under Hoarding and Profiteering Ordinance 1943 as amended from time to time. If the price quoted exceeds the controlled price or the price permissible under Hoarding and Profiteering Prevention Ordinance, the Contractor shall specifically mention this fact in this tender along with the reasons for quoting such higher prices. The Employer at his discretion will in such case exercise the right of revising the price at any stage so as to conform to the controlled price on the permissible under the Hoarding and Profiteering Prevention Ordinance. The discretion will be exercised without prejudice to any other action that may be taken against the Contractor.</p>
<p><b>Clause 48:</b></p>	<p>The Contractor shall employ at least 80 percent of the total number of unskilled labour to be employed by him on the said work from out of the persons ordinarily residing in the district in which site of the said work is located.</p> <p>Provided, however, that if the required number of unskilled labour from that district is not available, the Contractor shall in the first instance employ such number of persons as is available and thereafter may with the previous permission in writing of the Engineer of the said work, obtain the rest of his requirement of unskilled labour from outside the district.</p>
<p><b>Clause 49:</b></p>	<p>In case of materials that may remain surplus with the contractor's from those issued for the work contracted for the date as containment of the materials being surplus will be taken as the date of sale for the purpose of sales tax and the sales tax will be recovered on such sale.</p>
<p><b>Clause 50:</b></p>	<p>The Contractor shall engage the requisite number of Apprentices in respect of building crafts renders had provided in the Apprenticeship Act, 1961 through the State Apprenticeship Advisor Department of Technical Education, Dhobi Talao, Mumbai.</p>
<p><b>Clause 51:</b></p>	<p>"All amounts, whatsoever, which the contractor is liable to pay to the MMRCL in connection with the execution of the work including the amount payable in respect of</p>

	(i) materials and or stones supplied/issued hereunder by the MMRCL to the contractor (ii) hire charges in respect of heavy plant, machinery and equipment given or hired by the MMRCL to the contractor shall be deemed to be arrears of land revenue and the MMRCL may without prejudice to any other rights and remedies of the MMRCL, recover the same from the contractor as arrears of land revenue”.
<b>Clause 52:</b>	The Contractor shall comply with the provision of the Apprentice Act, 1961 and the rules and orders issued there under from time to time if he fails to do so, his failures will be breach of the Contract and the Employer may in his direction cancel the Contract. The Contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provision of the Act.
<b>Clause 53:</b>	The Contractor shall duly comply with all the provisions of the Central Government (Regulation and Abolition Act, 1970 (37 of 1970) and the Maharashtra Contract Labour (Regulation and Abolition) Rules, 1971 as amended from time to time and all other relevant statutes and statutory provisions concerning payment of wages particularly to workmen employed by the Contractor and working on the site of the work. In particular the Contractor shall pay wages to each worker employed by him on the site of the work at the rates prescribed under the Maharashtra Contract Labour (Regulation and Abolition) Rules, 1971. If the Contractor fails or neglects to pay wages at the sates or makes short payment and the Employer makes such payment of wages in full or part thereof less paid by the Contractor as the case may be, the amount so paid by the Employer to such workers shall be deemed to arrears of land revenue and the Employer shall be entitled to recover the same as such from the Contractor or deduct the same from the amount payable by the Employer to the Contractor hereunder or from any other amounts payable to him by the Employer.

## **Section IX (d)**

### **Price Variation Clause**

**SECTION – IX (d): PRICE VARIATION CLAUSE-Deleted**

## **Section IX (e)**

### **Schedule A: Materials to be Issued by MMRCL**

**SECTION IX (e): SCHEDULE A – MATERIALS TO BE ISSUED BY MMRCL**

**NAME OF WORK: Supply, Installation and Commissioning of Electrical, Air Conditioning, Fire Alarm Work and Other Allied Services for Mumbai Metro Rail Corporation Project Office at E-Block, Bandra-Kurla Complex, Mumbai-400051**

Schedule showing (approximately) the materials to be supplied from the Employer's Stores for works contracted to be executed and the rates at which they are to be charged for.

<b>Particulars</b>	<b>Rate at which the materials will be charged to the Contractor</b>	<b>Place of delivery</b>
Aa applicable	Unit           Rs.    Ps.  As applicable	As applicable
-----	-----NIL-----	-----

- Note:**
- 1) The person or firm submitting the tender should see that the rates in the above schedule are filled up by the Engineer on the issue of the form prior to the submission of the tender.
  - 2) Loading, transportation to work site from the place of delivery, unloading etc., will be contractor's responsibility for which no extra payment shall be made.

**Section IX (F)**

**Schedule B: Bill of Quantities**

## Schedule-B: Bill of Quantities

Item No./Item Description	Unit	Qty.	Rate (Rs.) In Figures	Amount (Rs.)	
<b>SECTION-1: DESIGN, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF ELECTRICAL WORKS</b>					
<b>1.1</b>	<b>Internal Wiring and Panelling Works</b>				
1.1.1	Point wiring for light/fan/bell (concealed type) in min 20(or 25) mm rigid PVC conduit with <u>1.5 sq.mm.</u> FR grade copper wires with flush type switch and required accessories (up to 6 metre) (instead of flush type use modular type material) (with required size of Concealed GI switch boxes of the same make as that of modular switching accessories all for light/fan/bells/ 6Amp plug / 16 Amp plug / 20 Amp metallic plug points & blanks plate as per direct of electrical in-charge and as per additional specifications.) (for Modular Material Note No. 6) (Ground-229) (Bell Point- 33, Building extension-40)	Point	300	603.00	180900
1.1.2	Point wiring for light/fan/bell in 20 mm metal conduit with <u>1.5 sq.mm</u> FR grade Copper wire with flush type switch and required accessories (up to 6 metre) (with required size of Concealed GI switch boxes of the same make as that of modular switching accessories all for light/fan/bells/ 6 Amp plug / 16 Amp plug / 20 Amp metallic plug points & blanks plate as per direct of electrical in-charge and as per additional specifications.) (instead of flush type use modular type material) (for Modular Material Note No. 6)	Point	228	835.00	190380

1.1.3	2-way Light Point wiring for light (concealed type) in min 20(or 25) mm rigid PVC conduit with <u>1.5 sq.mm.</u> FR grade copper wires with flush type switch and required accessories (up to 6 metre) (instead of flush type use modular type material) (with required size of Concealed GI switch boxes of the same make as that of modular switching accessories all for light/fan/bells/ 6Amp plug / 16 Amp plug / 20 Amp metallic plug points & blanks plate as per direct of electrical in-charge and as per additional specifications.) (for Modular Material Note No. 6)	Point	2	904.50	1809
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1.1.4	Point wiring for plug on concealed type light-fan switch board with copper wire and modular accessories	Point	87	412	35844
1.1.5	Supplying and erecting unbreakable concealed type <b>modular GI switch box with double mounting plate for 3 modules</b> duly erected flush to wall with required chiselling and finishing with cement mortar / POP as per required to match the background in an approved manner with 1No. 16A switch & socket. (Power).	Each	9	425	3825
1.1.6	Supplying and erecting unbreakable concealed type <b>modular GI switch box with double mounting plate for 3 modules</b> duly erected flush to wall with required chiselling and finishing with cement mortar / POP as per required to match the background in an approved manner with 1No. 6A switch & socket. (Independent plug point)	Each	2	318	636
1.1.7	Supplying and erecting unbreakable concealed type modular GI switch box with double mounting plate for 6 modules duly erected flush to wall with required chiselling and finishing with cement mortar / POP as per required to match the background in an approved manner with 2No. 6A switch & socket.	Each	22	525	11550
1.1.8	Supplying and erecting unbreakable concealed type modular switch GI box with double mounting plate for 4 modules duly erected flush to wall with required chiselling and finishing with cement mortar / POP as per required to match the background in an approved manner. (computer point) (as per shown in furniture drawing) (1 plate for- 6A 2 Nos. switch & 6A. 1 No. socket) (1-plate for 6A. 2 Nos. socket).	Each	300	233	69900
1.1.9	Supplying and erecting <b>modular type switch 6A / 10A</b> ISI mark approved make duly erected on provided plate and box with wiring connections complete. (comp point at Ground Floor A-Wing, B-Wing and first floor A-wing and B-Wing)	Each	300	87	26100
1.1.10	Supplying and erecting <b>modular type 3 pin 6A multi socket</b> with safety shutter ISI mark approved make duly erected on provided plate and box with wiring connections complete. (computer point) (as per shown in furniture drawing) (1 plate for- 6A 2 Nos. switch & 6A. 1 No. socket) (1-plate for 6A. 2 Nos. socket). (comp point at Ground Floor A-Wing, B-Wing and first floor A-wing and B-Wing)	Each	300	101	30300
1.1.11	Supplying and erecting modular type telephone socket one gang with safety shutter ISI mark approved make duly erected on provided plate and box with	Each	259	82.00	21238

	wiring connections complete.				
1.1.12	Supplying and erecting unbreakable <b>concealed</b> type <b>modular GI switch box</b> with double mounting plate for 1 <b>module</b> duly erected flush to wall with required chiselling and finishing with cement mortar / POP as per required to match the background in an approved manner with Telephone socket	Each	259	211	54649
1.1.13	Supplying and erecting unbreakable <b>concealed</b> type <b>modular GI switch box</b> with double mounting plate for 1 <b>module</b> duly erected flush to wall with required chiselling and finishing with cement mortar / POP as per required to match the background in an approved manner with TV socket. (for TV socket).	Each	22	208	4576
1.1.14	Supplying & erecting mains 2x1.0 sq.mm FR PVC copper wire, I.S.I. mark Rigid P.V.C. conduit 20/ 25/ 32 mm. dia. with necessary accessories in wall/floor with chiselling appropriately	Mtrs.	1722	72	123984
1.1.15	Supplying & erecting mains 2x1.0 sq.mm FR PVC copper wire, ISI mark Rigid Steel conduit 16 SWG 20/ 25/ 32 mm. dia. with necessary accessories in wall/floor with chiselling appropriately	Mtrs.	1722	210	361620
1.1.16	Supplying & erecting mains 2x1.5 sq.mm and earth wire 1.5 sq.mm FR PVC copper wire, in rigid PVC conduit min.20mm dia., para no. 1.4.1. (for Switch board circuit)	Mtrs	1178	211	248558
1.1.17	Supplying & erecting mains with 2x2.5 sq.mm. and earth wire 1.5 sq.mm FR PVC copper wire, in rigid PVC conduit min.20mm dia,(for power, IP, TV & Computer board circuit)	Mtrs	293	126	36918
1.1.18	Supplying & erecting mains with 2x2.5 sq.mm. F.R. copper wire, in 16 gauge 20/ 25/ 32 mm dia. Rigid Steel conduit, with continuous GI earth wire of 2.5sq.mm.	Mtrs	974	181	176294
1.1.19	Supplying & erecting mains with 1x1.5 sq.mm F.R copper PVC insulated wire laid in provided conduit/trunking/inside pole/Bus bars or any other places (earth wire with 2x2.5 sq.mm)	Mtrs	1267	19	23439.5
1.1.20	Supplying & erecting mains with 2x2.5 sq. mm. and earth wire 1.5 sq.mm FR PVC copper wire, in rigid PVC conduit min.20mm dia.	Mtrs	1236	132	163152
1.1.21	Supplying & erecting mains with 2x2.5 sq.mm. F.R. copper wire, in 16gauge 20/ 25/ 32 mm dia. Rigid Steel conduit, with continuous GI earth wire of 2.5sq.mm.,	Mtrs	989	181	179009

	(for AC indoor unit supply circuit)				
1.1.22	Supplying & erecting mains with 1x1.5 sq.mm F R copper PVC insulated wire laid in provided conduit/trunking/inside pole/Bus bars or any other places (earth wire with 2x2.5 sq.mm)	Mtrs	989	19	18296.5
1.1.23	Supplying & erecting mains with 4x4 sq.mm and earth wire 2.5 sq. mm FR PVC copper wire, in rigid PVC conduit min.25mm dia., (for Sub DB of Lighting, Computer, AC/Power). (ground Floor & first floor in wall drops)	Mtrs	555	248	137640
1.1.24	Supplying & erecting mains with 4x4 sq.mm. F.R copper wire, in 16gauge 25 mm dia. Rigid Steel conduit, with continuous GI earth wire of 2.5sq.mm., (for Sub DB of Lighting, AC/Power). (First floor).	Mtrs	477	317	151209
1.1.25	Supplying & erecting mains with 1x2.5 sq. mm F.R copper PVC insulated wire laid in provided conduit/trunking/inside pole/Bus bars or any other places. (earth wire with 4x4 sq. mm)	Mtrs	477	27	12640.5
1.1.26	Supplying & erecting Co-axial (RG-11) cable with ISI mark rigid PVC conduit 20/ 25mm dia. With necessary accessories in wall/ floor with chiselling appropriately (for TV co-axial cable/ wiring).	Mtrs	660	84	55440
1.1.27	Supplying and erecting PVC ROHS complied Non flame propagating under floor ducts/raceways of 90mm Width x 35 mm depth x 3000 mm Length including the connectors and the clamps at required intervals. The ducts shall be in trapezoidal shape tested for 750 N point load suitable for inscribed application	Mtrs	498	283.00	140934
1.1.28	Supplying and erecting PVC ROHS complied Non-flame propagating under floor ducts/raceways of 60mm Width x 25 mm depth x 3000 mm Length including the connectors and the clamps at required intervals complete. The ducts shall be in trapezoidal shape tested for 750 N point load suitable for inscribed application. as per specification no. WG-MA/UFD	Mtrs	1125	379.00	426375
1.1.29	Supplying & erecting ISI mark rigid PVC conduit 20/ 25/ 32mm dia. With necessary accessories in wall/ floor with chiselling appropriately (for Telephone & LAN wiring).	Mtrs	1623	59.00	95757
1.1.30	Supplying installation & commissioning of Five Star Rated Energy Saving Wall bracket Fan, 230 V A.C, 50 cycles, 400 mm, with down rods complete erected in	Each	30	1989	59670

	position				
1.1.31	Supplying and erecting fresh air cum Exhaust fan of light duty 250 V A.C. 50 cycles 225mm. 1400 RPM rust proof body & blades, wire mesh, duly erected in an approved manner and marking Sr. No. and date of erection.	Each	9	1316	11844
1.1.32	Supplying & erecting approved make 1 x 28W T-5 white stove enamelled / powder coated, decorative end caps box type fluo fitting with 28W electronic ballast having pf>0.9 fixed at ceiling or on wall	Each	30	678	20340
1.1.33	Supplying, erecting & marking SPMCB 6A to 32A (C-Series power/ TV, D- for AC, B-series for Lighting) in provided distribution board	Each	492	176	86592
1.1.34	Supplying, erecting & marking TPMCB 6 A to 32A in provided distribution board (25-8, 32A-11)	Each	19	778	14782
1.1.35	Supplying, erecting & marking TPMCB 40A to 63A in provided distribution board (40A-17)	Each	17	1034	17578
1.1.36	Supplying, fixing and commissioning RCCB+MCB, electromagnetic type with 30/100/300 mA sensitivity and having capacity of 6A/ 10A/ 16A/ 20A/ 25/A 4 Pole 3 phase (16/20A-30/100mA- 14, 25A-30/100mA- 10, 32A-100mA- 1 No) (RCBO as a incomer of Sub DB)	Each	25	3278	81950
1.1.37	Supplying, fixing and commissioning RCCB+MCB, electromagnetic type with 30/100/300 mA sensitivity and having capacity of 32A/40A 4 Pole 3 phase (40A-100mA- 2) (RCBO as an incomer of Sub DB)	Each	2	3530	7060
1.1.38	Supplying, fixing and commissioning RCCB+MCB, electromagnetic type with 30/100/300 mA sensitivity and having capacity of 63A 4 Pole 3 phase (63A-100mA-4) (RCBO as an incomer of Sub DB)	Each	4	3530	14120
1.1.39	Supplying & erecting triple pole and neutral distribution board (TPNDB) with door surface/ flush mounted SPMCB of 12 ways, on iron frame/wooden board (Horizontal type) (4-Way- Sub LDB-4 & UPS DB-4)	Each	8	2588	20704
1.1.40	Supplying & erecting triple pole and neutral distribution board (TPNDB) with door surface/ flush mounted SPMCB of 24 ways, on iron frame/laminated board. (Horizontal type) (6-Way- 8 & 8-Way- 6 ETPN).	Each	14	3741	52374
1.1.41	Supplying & erecting triple pole and neutral distribution board (TPNDB) with door surface/ flush mounted SPMCB of	Each	3	4954	14862

	12 ways (36 Poles) on iron frame/wooden board. (Horizontal Bus bar type) (12-way ACDB-2, Comp DB-1)				
1.1.42	Supplying & erecting triple pole and neutral distribution board (TPNDB) with door surface/ flush mounted SP / TP MCBs total 12 ways, on iron frame/wooden board. (Vertical Bus bar type) (4-way VTPN main)	Each	8	5213	41704
1.1.43	Supplying & erecting triple pole and neutral distribution board (TPNDB) with door surface/ flush mounted SP / TP MCBs 24 Poles on iron frame/wooden board. (Vertical Bus bar type) (6-way VTPN main)	Each	1	6537	6537
1.1.44	Supply, Installation, Testing and commissioning of UL Certified / CPRI Tested Maintenance Free Earthing comprising of Electrode of 17.2 mm diameter Low Carbon Steel with 250 micron Molecular Copper Bonded Earthing Rod of Length 3m along with 25 kg Carbon Based environment friendly back fill Ground Enhancing compound required to fill up the excavated earth with required quantity as per specification no EA-MOBI (1 No. for Panel & 1 for Internal) (Safe Earthing Electrode Kit) (Maintenance free Earthing) (pH value : 6.9 - 7.2 of 1000gm/ lit at 20 degree Celsius) (Panel-2, Main DB-3, Main Outdoor AC panel-2) (equivalent SGI)	Each	7	15216.00	106512
1.1.45	Supplying and erecting aluminium strip of required sizes used for earthing on wall and/or any other purpose with necessary aluminium clamps fixed on wall painted with bituminous paint in an approved manner with joints required. (25x5 mm)	kg	70	397.00	27790
1.1.46	Supplying and erecting Ding Dong / electronic musical type call bell with heavy duty coil suitable to operate on 230V A.C. supply erected on polished double wooden block/sun mica block of suitable size with indicator to be mounted on plastic sheet as required.	Nos	33	98	3234
<b>1.2</b>	<b>SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF CABLING WORKS ASSOCIATED WITH ELECTRIFICATION</b>				
1.2.1	Supplying, erecting, laying & terminating <u>PVC cable</u> 3 core 2.5 sq. mm copper conductor complete erected with glands & lugs, on wall/ trusses/pole or laid in trench/ pipe (Motor) as required.	Mtrs	160	179	28640
1.2.2	Supplying, erecting & laying & terminating <u>PVC cable</u> 4 core 4 sq. mm copper conductor complete erected with glands & lugs, on wall/ trusses/pole or	Mtrs	210	298	62580

	laid in trench/ pipe as required.				
1.2.3	Supplying, erecting/laying & terminating <u>PVC cable</u> 4 core 6 sq. mm copper conductor, complete erected with glands & lugs, on wall/ trusses/pole or laid in trench/ pipe as required.	Mtrs	120	402	48240
1.2.4	Supplying, erecting/laying & terminating PVC armoured cable 4 core 16 sq. mm aluminium conductor complete erected with glands & lugs, on wall/ trusses/pole or laid in trench/ pipe (main panel to UPS) s required.	Mtrs	540	198	106920
1.2.5	Supplying, erecting/laying & terminating PVC armoured cable 3½ core 50 sq. mm aluminium conductor complete erected with glands & lugs, on wall/ trusses/pole or laid in trench/ pipe as required.	Mtrs	350	360	126000
1.2.6	Supplying, erecting/laying & terminating PVC armoured cable 3½ core 120 sq. mm aluminium conductor complete erected with glands & lugs, on wall/ trusses/pole or laid in trench/ pipe as required.	Mtrs	140	741	103740
1.2.7	Supplying, erecting/laying & terminating PVC armoured cable 3½ core 300 sq.mm aluminium conductor complete erected with glands & lugs, on wall/ trusses/pole or laid in trench/ pipe, as required.	Mtrs	400	1637	654800
1.2.8	Supplying and laying (including excavation and refilling after cable laying with cushioning of sand, bricks etc., as per direction of electrical in-charge) 200 mm outside dia., double wall corrugated pipes (DWC) of HDPE for enclosing cable below (900mm deep) ground/road surface, to required depth complete. (for main supply cable) as required.	Mtrs	390	610	237900
1.2.9	Supplying and laying (including excavation and refilling after cable laying with cushioning of sand, bricks etc., as per direction of electrical in-charge) 175 mm outside dia., double wall corrugated pipes (DWC) of HDPE for enclosing cable below ground/road surface, to required depth complete. (for 16/ 50/ 120 sq. mm cable) as required.	Mtrs	180	525	94500
1.2.10	Supplying and laying (including excavation and refilling after cable laying with cushioning of sand, bricks etc, as per direction of electrical in-charge) 90 mm outside dia. double wall corrugated	Mtrs	370	269	99530

	pipes (DWC) of HDPE for enclosing cable below ground/road surface, to required depth complete (for motor cable, Street light cable, fire cable)				
1.2.11	Supplying & erecting cast iron cable indicator plate buried along with route of cable for PVC / XLPE armoured cable	Each	300	189	56700
1.2.12	Supplying, erecting & terminating PVC armoured cable 3½ core 35 sq. mm aluminium conductor with continuous 5.48 sq. mm (12 SWG) G.I. earth wire complete erected with glands & lugs, on wall/ trusses/pole or laid in provided trench/ pipe	Mtrs	46	277	12742
1.2.13	Supplying and laying (including excavation and refilling after cable laying with cushioning of sand, bricks etc., as per direction of electrical in-charge) 90 mm outside dia. double wall corrugated pipes (DWC) of HDPE for enclosing cable below ground/road surface, to required depth complete	Mtrs	17	269	4573
1.2.14	Supplying & erecting cast iron cable indicator plate buried along with route of cable for PVC / XLPE armoured cable as per specification No. CB-CIP	Each	6	189	1134
<b>1.3</b>	<b>DESIGN, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF MAIN AC PANELLING WORKS</b>				
1.3.1	Providing and fixing sheet metal work in CRCA sheet (1.6mm, 16 gauge) with fabrication of boxes panel boards etc. including cutting, bending, drilling, welding, riveting etc. treated with anti-rust treatment and duly power coated or painted with one coat of red lead paint and 2 coats of enamel paint as directed (in an approved manner). (above rates shall be inclusive of work along with angle iron work and erection). (with locking arrangement of door, as per direction of electrical in-charge)	kg	294	181	53214
1.3.2	Providing and erecting Analog type moving iron voltmeter for A.C Voltage 0 to 500V range, 50Hz, Accuracy class 1.5, flush type; on provided box / panel and connected with necessary PVC wire leads and lugs.	Each	1	1010	1010
1.3.3	Providing and erecting Analog type moving iron Ammeter for A.C current CT operated of suitable size in scale between 0 to 1000A, 500V accuracy class 1.5, flush type; on provided box /panel and connecting with provided CTs	Each	1	1787	1787

	and necessary PVC wire leads and lugs.				
1.3.4	Providing and erecting Selector Switch suitable for Voltmeter/Ammeter for 3 phase A.C supply 500V, 50Hz, on provided box / panel and duly connecting with necessary PVC wire leads and lugs.	Each	2	291	582
1.3.5	Supplying & erecting LED type indicating pilot lamp with LED colours Red / Yellow / Green, 230 / 250V on provided box / panel with necessary material, wiring & connections etc.	Each	2	284	568
1.3.6	Supplying & erecting LED type indicating pilot lamp with LED colours Blue, 230 / 250V on provided box / panel with necessary material, wiring & connections etc.	Each	1	681	681
1.3.7	Providing & erecting LT current transformer with bar primary 50/5, 1000/5 Ratio with 15 VA burden erected in provided crsa box duly secured with insulating material connected to the meter with test certificate.	Each	3	693	2079
1.3.8	Providing & erecting 4 Pole MCCB of 250A,415V capacity with S.C. rating 36 kA (Ics=100% of Icu), thermal and magnetic setting with provided leads on iron frame/wooden board	Each	1	23052	23052
1.3.9	Supplying and erecting terminal spreaders for use on MCCB incoming and outgoing terminals for 4 pole up to 400A MCCB. (New)	Each	1	2511	2511
1.3.10	Supplying and erecting extended rotary handle for MCCB with adjustable telescopic rod suitable for up to 800 MCCB. (New)	Each	1	3064	3064
1.3.11	Supplying and erecting Bus bar chamber triple pole with neutral with four aluminium bars, 500V 200A complete as per specification no. CP-BB (with complete wiring and connection in an approved manner)	Mtrs	8	4798	38384
1.3.12	Supplying and erecting self-locking arrangement with duplicate keys, made of brass duly erected, flush with surface of panel/cupboard.	Each	18	199	3582
1.3.13	Providing & erecting 3 Pole MCCB upto 100A, 415V capacity with S.C. rating 25 kA (Ics=100% of Icu), thermal setting with provided leads on iron frame/wooden board	Each	6	4918	29508
1.3.14	Supplying and erecting terminal spreaders for use on MCCB incoming and outgoing terminals for 4 pole up to 100A MCCB.	Each	6	261	1566

1.3.15	Supplying and erecting extended rotary handle for MCCB with adjustable telescopic rod suitable for upto 100A MCCB.	Each	6	1281	7686
1.3.16	Providing cement concrete & Bricks foundation including excavation for Panel (as per drawing of Panel Foundation) (50cm x 50cm x2.0 mtr.) plinth duly plastered and with necessary curing & finishing in an approved manner. (as per direction of electrical in-charge).	Each	1	11000	11000
<b>1.4</b>	<b>DESIGN, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING WORKS FOR MAIN LT PANEL (2 Nos.)</b>				
1.4.1	Providing and fixing sheet metal work in CRCA sheet (1.6mm, 16 gauge) with fabrication of boxes panel boards etc. including cutting, bending, drilling, welding, riveting etc. treated with anti-rust treatment and duly power coated or painted with one coat of red lead paint and 2 coats of enamel paint as directed (in an approved manner). (above rates shall be inclusive of work along with angle iron work and erection). (with locking arrangement of door, as per direction of electrical in-charge)	kg	884	181	160004
1.4.2	Providing and erecting Analog type moving iron voltmeter for A.C Voltage 0 to 500V range, 50Hz, Accuracy class 1.5, flush type; on provided box / panel and connected with necessary PVC wire leads and lugs.	Each	2	1010	2020
1.4.3	Providing and erecting Analog type moving iron Ammeter for A.C current CT operated of suitable size in scale between 0 to 1000A, 500V accuracy class 1.5, flush type; on provided box /panel and connecting with provided CTs and necessary PVC wire leads and lugs.	Each	2	1787	3574
1.4.4	Providing and erecting Selector Switch suitable for Voltmeter/Ammeter for 3 phase A.C supply 500V, 50Hz, on provided box / panel and duly connecting with necessary PVC wire leads and lugs.	Each	4	291	1164
1.4.5	Supplying & erecting LED type indicating pilot lamp with LED colours Red / Yellow / Green, 230 / 250V on provided box / panel with necessary material, wiring & connections etc.	Each	4	284	1136
1.4.6	Supplying & erecting LED type indicating pilot lamp with LED colours Blue, 230 / 250V on provided box / panel with necessary material, wiring & connections etc.	Each	2	681	1362
1.4.7	Providing & erecting LT current transformer with bar primary 50/5, 1000/5 Ratio with 15 VA burden erected in provided crsa box duly secured with	Each	6	693	4158

	insulating material connected to the meter with test certificate.				
1.4.8	Providing & erecting 3 Pole (4-Pole Instead of 3-Pole) MCCB of 315/400A, 415V capacity with S.C. rating 36 kA (Ics=100% of Icu), thermal and magnetic setting with provided leads on iron frame as per specification No. SW-SWR/MCCB (400Amp)	Each	2	27977	55954
1.4.9	Supplying and erecting terminal spreaders for use on MCCB incoming and outgoing terminals for 4 pole up to 400A MCCB.	Each	2	2511	5022
1.4.10	Supplying and erecting extended rotary handle for MCCB with adjustable telescopic rod suitable for up to 800 MCCB.	Each	2	3064	6128
1.4.11	Supplying and erecting Bus bar chamber triple pole with neutral with four aluminium bars, 500V 300A complete as per specification no. CP-BB (with complete wiring and connection in an approved manner)	Mtrs	18	5012	90216
1.4.12	Supplying and erecting self-locking arrangement with duplicate keys, made of brass duly erected, flush with surface of panel/cupboard.	Each	18	199	3582
1.4.13	Providing & erecting 3 Pole MCCB of 200A,415V capacity with S.C. rating 25 kA (Ics=100% of Icu) thermal and magnetic setting with provided leads on iron frame/wooden board as per specification no. SW-SWR/MCCB (200A-2, 125A-2)	Each	4	14232	56928
1.4.14	Supplying and erecting terminal spreaders for use on MCCB incoming and outgoing terminals for 4 pole up to 250A MCCB.	Each	4	1150	4600
1.4.15	Supplying and erecting extended rotary handle for MCCB with adjustable telescopic rod suitable for up to 100-250A MCCB.	Each	4	1323	5292
1.4.16	Providing & erecting 3 Pole MCCB up to 100A, 415V capacity with S.C. rating 25 kA (Ics=100% of Icu), thermal setting with provided leads on iron frame/wooden board as per specification No. SW-SWR/MCCB (63A-6, 80/ 100A-4)	Each	10	4918	49180
1.4.17	Supplying and erecting terminal spreaders for use on MCCB incoming and outgoing terminals for 4 pole up to 100A MCCB.	Each	10	261	2610
1.4.18	Supplying and erecting extended rotary handle for MCCB with adjustable telescopic rod suitable for up to 100A MCCB.	Each	10	1281	12810

1.4.19	Supplying & erecting on load Four-pole Iron clad/metal clad ON LOAD change over switch 300A, 415/500V erected on angle iron frame approved make.	Each	2	15420	30840
<b>1.5</b>	<b>DESIGN, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING WORKS FOR DG SET</b>				
1.5.1	Supplying, Erecting and Commissioning of Diesel generating set with alternator of 82.5 kVA output continuous rating, 3 Phase, 415 V, 50c/s 0.8 p. f. A.C a totally enclosed liquid cooled multi-cylinder diesel engine developing suitable BHP at 1500 rpm with 10% overload for 1 hour in 12 hours, along with standard accessories, self-excited, self-regulated, screen protected alternator with static excitation system running at 1500 RPM as per IS 4722-1968 with voltage regulation +/- 5 %. Both the engine and alternator direct coupled on a common fabricated steel base frame and mounted on anti-vibrating pads with standard control panel comprising meters, switchgears, indicators connected with suitable wires/cables, the complete set enclosed in composite Acoustic enclosure as fully assembled integral unit made of 16 SWG CRCA Sheet, sound absorbing material to restrict sound level up to 75 dB at 1.0 m, provided with first filling of oil, diesel etc. and obtaining necessary approval from Electrical Inspector as per specification no. GEN-DG.	Each	1	672440	672440
1.5.2	Supplying, erecting, testing and commissioning of Microprocessor based AMF panel suitable for Diesel Generating Set of 75/82.5 kVA capacity Single/Three phase, 230/415 Volts, 50Hz A.C. with all standard features, safeties etc. as per specification no. GEN-AMF	Each	1	117159	117159
1.5.3	Supply, Installation, Testing and commissioning of UL Certified / CPRI Tested Maintenance Free Earthing comprising of Electrode of 17.2 mm diameter Low Carbon Steel with 250 micron Molecular Copper Bonded Earthing Rod of Length 3m along with 25 kg Carbon Based environment friendly back fill Ground Enhancing compound required to fill up the excavated earth with required quantity as per specification no EA-MOBI (1 No. for Panel & 1 for Internal) (Safe Earthing Electrode Kit) (Maintenance free Earthing) (pH value : 6.9 - 7.2 of 1000gm/ lit at 20 degree Celsius) (DG neutral-4 DB body- 4, Panel- 2, UPS-4	Each	4	15216	60864

	Main DB-3, Main Outdoor AC panel-2) (equivalent SGI)				
1.5.4	Supplying and erecting aluminium strip of required sizes used for earthing on wall and/or any other purpose with necessary aluminium clamps fixed on wall painted with bituminous paint in an approved manner with joints required. as per specification No (EA-EP).	kg	10	397	3970
1.5.5	Providing and fixing sheet metal work in CRCA sheet with fabrication of boxes panel boards etc. including cutting, bending, drilling, welding, riveting etc. treated with anti-rust treatment and duly power coated or painted with one coat of red lead paint and 2 coats of enamel paint as directed. (DG set smoke pipe extension, as per electrical in-charge)	kg	500	181	90500
<b>1.6</b>	<b>DESIGN, SUPPLY, ERECTION, TESTING AND COMMISSIONING WORKS FOR UPS (FOR COMPUTER &amp; LIGHTING SUPPLY)</b>				
1.6.1	Supplying & erecting On line UPS pure sine wave of 30 kVA capacity complete with standard features, along with necessary (12V/ 100AH Tubular battery with battery terminal) SMF batteries for 15 mins. battery backup.	Each	2	500000	1000000
1.6.2	Supply, Installation, Testing and commissioning of UL Certified / CPRI Tested Maintenance Free Earthing comprising of Electrode of 17.2 mm diameter Low Carbon Steel with 250 micron Molecular Copper Bonded Earthing Rod of Length 3m along with 25 kg Carbon Based environment friendly back fill Ground Enhancing compound required to fill up the excavated earth with required quantity as per specification no EA-MOBI (1 No. for Panel & 1 for Internal) (Safe Earthing Electrode Kit) (Maintenance free Earthing) (pH value : 6.9 - 7.2 of 1000gm/ lit at 20 degree Celsius) (UPS NEUTRAL-1 & UPS BODY-1 For each). (equivalent SGI)	Each	8	15216	121728
1.6.3	Supplying and erecting aluminium strip of required sizes used for earthing on wall and/or any other purpose with necessary aluminium clamps fixed on wall painted with bituminous paint in an approved manner	kg	10	397	3970

	with joints required. as per specification No (EA-EP).				
<b>1.7</b>	<b>DESIGN, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF LIGHTING WORK</b>				
<b>1.7.1</b>	<b>STREET LIGHT</b>				
1.7.1.1	Providing & erecting 6 m high (clear height) galvanised OCTAGONAL pole with foundation bolt having bottom of 130 mm A/F Top 70 mm A/F on provided foundation as per specification no. OH-PL/OPL (including 10A. Neutral Link in connection Box)	Each	9	11270	101430
1.7.1.2	Supplying & erecting mains with 3x2.5 Sq.mm F.R copper PVC insulated wire laid in provided conduit/trunking/inside pole/Bus bars or any other places as per specification No: WG-MA/BW (for 6 m pole-28 & Bollards-85)	Mtrs	54	79	4266
1.7.1.3	Supplying, erecting & marking SPMCB 6A to 32A, B- series (for lighting) in provided distribution board as per specification No. SW-SWR/MCB (Street Light Pole).	Each	9	165	1485
1.7.1.4	Supplying & erecting approved make 500V 16A porcelain base neutral link complete erected in provided M.S. box.	Each	9	48	432
1.7.1.5	Providing cement concrete foundation including excavation for poles (45cm x 45cm x1.2 m) deep in 1:3:6 cement concrete (20 to 25 mm stone metal) and 45 cm x 45 cm x 45 cm / 45cm Dia. x 45 cm height plinth duly plastered and with necessary curing & finishing in an approved manner. (for 6 m pole)	Each	9	1341	12069
1.7.1.6	Supplying and erecting Street light bracket for erection of Single fitting made from 40 mm. dia. 'B' class G.I. pipe 1.0 m in length along with pole cap of 300 mm length 100 mm dia. duly welded as per specification no. FG-BKT/BPC.	Each	8	733	5864
1.7.1.7	Supplying and erecting Street light bracket for erection of Double fitting made from 40 mm. dia. 'B' class G.I. pipe 1.0 m in length along with pole cap of 300 mm length 100 mm dia. duly welded as per specification no. FG-BKT/BPC	Each	1	1033	1033
1.7.1.8	Supplying and erecting Pole type LED street light fitting 60W, 75 lm minimum, Distribution: elliptical beam, having PF > 0.95, class IP 65 or above. Housing of pressure die cast aluminium alloy and heat sink extruded aluminium as per specification no. FG-ODF/FLS2. Dimensions: L-650mm, W-350 mm, H-50mm, Pole height-6000mm.	Each	8	20000	160000

1.7.1.9	Providing pipe type earthing with 20mm Dia. GI Pipe rod complete with all material as per specification no. EA-EP (for road side light).	Each	9	1585	14265
1.7.1.10	Supply & Erecting GI earth wire of high purity of 8 SWG sizes used for earthing or any other purposes (Pole earthing) on wall/ pole with necessary GI clamps fixed on cable/ wall/pole conduit with screws in an approved manner	Kg	32	160	5120
1.7.1.11	Supplying and erecting bollard type LED street light fitting 25W, having PF > 0.95, class IP 65 or above. Housing of pressure die cast aluminium alloy and heat sink extruded aluminium as per specification no. FG-ODF/FLS2. Dimensions: dia-200mm, H-900mm. 75 lm minimum, distribution: 360 degree.	Each	10	15000	150000
<b>1.7.2</b>	<b>STREET LIGHT PANEL (IP-55) (The outer door of the panel is such that user can work/handle it properly, locking arrangement with key should be provided by panel maker)</b>				
1.7.2.1	Providing and fixing sheet metal work in CRCA sheet (1.6mm, 16 gauge) with fabrication of boxes panel boards etc. including cutting, bending, drilling, welding, riveting etc. treated with anti-rust treatment and duly power coated or painted with one coat of red lead paint and 2 coats of enamel paint as directed (in an approved manner). (above rates shall be inclusive of work along with angle iron work and erection) (Outdoor type IP-65, Feeder Panel)	kg	16	181	2896
1.7.2.2	Supplying, erecting & marking TPN MCB 6A to 32A, C- series in provided distribution board as per specification No. SW-SWR/MCB (110Amp)	Each	1	990	990
1.7.2.3	Supplying, erecting & marking SPMCB 6A to 32A (C-Series power/ TV, D- for AC, B-series for Lighting) in provided distribution board as per specification No. SW-SWR/MCB	Each	4	176	704
1.7.2.4	Supplying and erecting Programmable Digital Almanac Timer Micro-controller based with real time clock to operate on derived switching "ON" & switching "OFF" street light as per daily sunset and sunrise respectively automatically having 4 digit LED continuous time display, relay output 230V / 10A with 10 Hrs battery backup and manual over drive facility capable to drive different capacity contactors timer erected in MS box in an approved manner	Each	1	7221	7221
1.7.3	<b>LIGHTING FIXTURES</b>				

1.7.3.1	Supplying and erecting square shaped CRCA / die-cast aluminium powder coated housing LED/CEILING RECESSED 10W LED MEDIUM BEAM DOWNLIGHT Panel light up to 10 W with provision for plane front frame with translucent cover fixed to the housing complete. DIMENSION Dia. - 100mm; H - 150mm, WATT / LUMENS 10W / 75lm minimum, CCT/CRI 4000°k / 80+DISTRIBUTION Medium Beam DRIVER/POWER24V / 12V / 240V..	Each	400	1200	480000
1.7.3.2	Supplying and erecting square shaped CRCA / die-cast aluminium powder coated housing LED/CEILING RECESSED 10W LED DOWNLIGHT Panel light, 10 W with provision for plane front frame with translucent cover fixed to the housing complete. DIMENSION Dia. - 100mm; H - 150mm, WATT / LUMENS: 10W / 75lm minimum, CCT/CRI 4000°k / 80+DISTRIBUTION Diffused Beam. DRIVER/POWER24V / 12V / 240V.	Each	285	1000	285000
1.7.3.3	Supplying and erecting Square shaped decorative down lighter complete with LED 30 Watt surface mounting downlighter, die-cast aluminium powder coated housing or/as per direction of electrical in-charge, suitable fitting arrangements, ceiling surface 30w LED provision for proper dimension Length-600mm, width -600mm h-75mm, minimum 75lumens/W, CCT/CRI-4000°k / 80+ diffused beam, driver power-24V/12V/240V.	Each	139	13000	1807000
1.7.3.4	Supplying and erecting linear recess in ceiling 20 Watt per meter LED down light to be mount inner part of false ceiling such that diffuser surface will match with false ceiling and only output effect i.e. light will come out. with LED 20 watt per meter, die-cast aluminium powder coated housing or/as per direction of electrical in-charge, suitable fitting arrangements, having suitable mounting arrangement 20w LED provision for proper dimension W - 80mm: H - 100mm max, minimum 75lumens/W, CCT/CRI-4000°k / 80+ Distribution-Symmetric Beam, driver power-24V/12V/240V	meter	136.0	5000	680000
1.7.3.5	Supplying and erecting linear recess in ceiling 20 Watt per meter down light to be mount inner part of false ceiling such that diffuser surface will match with false ceiling and only output effect i.e. light will come out. with LED 20 watt per meter, die-cast aluminium powder coated housing or/as per direction of electrical in-charge, suitable fitting arrangements,	meter	75.5	5000	377500

	having suitable mounting arrangement 20w LED provision for proper dimension W - 80mm: H - 100mm max., minimum 75lumens/W, CCT/CRI-4000°k / 80+ Distribution-Symmetric Beam, driver power-24V/12V/240V				
1.7.3.6	Supplying and erecting linear built in slot 10 Watt per meter down light with profile to be mount inner part of slot of wall or furniture or false ceiling such that diffuser effect of light will come out. with LED 10 watt per meter, die-cast aluminium powder coated housing or/as per direction of electrical in-charge, suitable fitting arrangements, having suitable mounting arrangement 10w LED provision for proper dimension L - AS PER PLAN: W - 25mm: H - 25mm, minimum 75lumens/W, CCT/CRI-4000°k / 80+ Distribution-Symmetric Beam, driver power-24V/12V/240V	meter	9.8	3000	29400
1.7.3.7	Supplying and erecting linear built in table 10 Watt per meter LED flexible strips to be install near reception table as per direction of electrical in-charge dimension L - L - AS PER PLAN: W - 12mm: H - 9mm minimum 75lumens/W, CCT/CRI-4000°k / 80+ Distribution- Symmetric Beam, driver power- 24V/12V/240V Location-Wash room as shown in drawings.	meter	2.9	3000	8700
1.7.3.8	Supplying and erecting linear built in table 10 Watt per meter LED flexible strips to be install near reception table as per direction of electrical in-charge dimension L - L - AS PER PLAN: W - 12mm: H - 9mm minimum 75lumens/W, CCT/CRI-4000°k / 80+ Distribution- Symmetric Beam, driver power- 24V/12V/240V	meter	34	3000	102000
1.7.3.9	Supplying and erecting WALL SURFACE 10W LED LINEAR LIGHT WITH DIFUSSER to be install on wall as per direction of electrical in-charge housing body dimension-L - 450mm; W - 50mm; H - 50mm minimum 75lumens/W, CCT/CRI-4000°k / 80+ distribution- diffuser Beam, low glare, driver power- 24V/12V/240V	Each	44	3200	140800
1.7.3.10	Supplying and erecting WALL SURFACE 10W LED LIGHT WITH DIFUSSER to be install on wall as per direction of electrical in-charge housing body dimension-L - 450mm; W - 50mm; H - 50mm minimum 75lumens/W, CCT/CRI- 4000°k / 80+ distribution-diffuser Beam, low glare, driver power-24V/12V/240V	Each	4	3500	14000

1.7.3.11	Supplying and erecting CEILING PENDANT 6W CYLINDRICAL DOWNLIGHT light, 6 W with translucent cover fixed to the housing complete. DIMENSION Dia. - 50mm; H - 450mm, WATT / LUMENS 6W / 75lm minimum, CCT/CRI 4000°k / 80+, DISTRIBUTION Medium Beam, DRIVER/POWER: 24V / 12V / 240V.	Each	10	7000	70000
<b>1.8</b>	<b>DESIGN, SUPPLY, ERECTION, TESTING AND COMMISSIONING WORKS FOR LIGHTNING PROTECTION</b>				
1.8.1	Designing Providing and fixing LIGHTNING ARRESTER OPR 60 ,90, TECHNOLOGY complete with all accessories like Air terminal, support Mast, lightning struck counter, test joint, PVC protective sheath, Earth terminal, required size of earth strips with proper supported insulator, Earthing with complete accessories earth pit, CT pipe or maintenance free earthing having capacity of discharge current capacity, The protector is an ESE type active lightning conductor that provides zonal protection in accordance with standard NF C 17 102. The protector is a study robust device made of 304 L stainless steel. it is protected against corrosion and needs no maintenance, with Struck Counter needs no external power source. compact & easy to install. Minimum warranty should not less than five year. Testes & certified by CPRI & necessary lab. (Equivalent to SGI) (Bidder shall take approval of product by Electrical authority & Consultant before installation)	Each	2	138000	276000
1.8.2	Supply, Installation, Testing and commissioning of UL Certified / CPRI Tested Maintenance Free Earthing comprising of Electrode of 17.2 mm diameter Low Carbon Steel with 250 micron Molecular Copper Bonded Earthing Rod of Length 3m along with 25 kg Carbon Based environment friendly back fill Ground Enhancing compound required to fill up the excavated earth with required quantity as per specification no EA-MOBI (1 No. for Panel & 1 for Internal) (Safe Earthing Electrode Kit) (Maintenance free Earthing) (pH value : 6.9 - 7.2 of 1000gm/ lit at 20 degree Celsius) (for LA) (equivalent SGI)	Each	4	15216	60864
1.8.3	Supplying and erecting aluminium strip of required sizes used for earthing on wall and/or any other purpose with necessary aluminium clamps fixed on wall painted with bituminous paint in an approved manner with joints required. as	Each	50	397	19850

	per specification No (EA-EP). (25mm X 5mm SIZE)				
<b>1.9</b>	<b>SOLAR POWER GENERATION PLANT INSTALLATION WORK</b>				
	Design, Drawing, supply, erection, testing and commissioning including sanctioning from MSEDCL and other power supply company & Electrical Inspector and other necessary department of Solar Power Generation Plant with all accessories PV module's with adequate capacity 75 KW, 3 no's unit having capacity not less than 25KW will connect synchronization arrangement so that total output shall not less than 75KW to be connected on single node of supply in one panel or 2 no's unit in synchronization arrangement & one unit individual so that total output not less than 75KW to be connected on two node (50+25KW) of supply in two different panel by two power source arrangement, as per direction of electrical in-charge, 3-phase inverter PCU with advance technology having arrangement of power generation records current, voltage all type of data access system, RS-45 port can connect with computer to bring out the data etc. complete with all required protection proper size of incoming & outgoing cables up to energy meter as per direction of electrical in-charge and electrical consultant. MPPT maximum power point tracker, automatic reconnection after grid failure, array junction boxes main junction boxes as per specification ,DC distribution panel, synchronization panel as required, etc. (Bidder has to take approval of drawing, make before start the erection. (as per specification details, including all required material as shown below up to testing & smooth working).	Each	1	5449500	5449500
	<b>Bill of Quantities for Solar Power Plant</b>				
1.9.1	Solar PV Modules, Poly-crystalline min 300 Wp, 72 cells; min 75 kWp	kWp	75	40000	3000000
1.9.2	Solar Module Mounting Structure as per specifications	Lot	1	562500	562500
1.9.3	Solar Inverters (Grid Tied) with Data Manager min 66 kW-ac output with required accessories for mounting	kW-ac	66	9000	594000
	<b>AC Cables and BOS</b>				
1.9.4	5C, 16sq-mm CU Flex Cable (Inv. to ACDB) with required accessories for	Mtr	60	650	39000

	horizontal/vertical cable laying				
1.9.5	4C, 50sq-mm AL XLPE Cable (ACDB to Evacuation) with required accessories for horizontal/vertical cable laying	Mtr	50	650	32500
1.9.6	ACDB (2x63A MCB, 1x125A MCCB, RS485-Energymeter) with required accessories for wall mounting	No.	1	55000	55000
	<b>Lightning and Protection System (LPS)</b>				
1.9.7	Lightning/Surge Arrestor	set	1	65000	65000
1.9.8	Earthing Rod, 17.2 mm diameter, 3 mtr	Nos	4	7500	30000
1.9.9	Earthing Chemical Filling Compound (25KG Bag)	Pack	8	2000	16000
1.9.10	NE GI Strip for earthing 25mm*3mm	Mtr	150	85	12750
1.9.11	Saddle clamps for GI Strip	No.	100	50	5000
1.9.12	Canopy for Inverters, SMU, ACDB and other electrical components	Lot	1	15000	15000
1.9.13	First Aid Box, Fire Extinguisher, Sand Buckets and Safety Signboard	Lot	1	25000	25000
	<b>DC Cables &amp; BOS</b>				
1.9.14	1C X 4 Sq.mm DC Solar Cable, RED	Mtr	200	50	10000
1.9.15	1C X 4 Sq.mm DC Solar Cable, BLACK	Mtr	200	50	10000
1.9.16	1C X 4 Sq.mm Earthing Cable, GREEN	Mtr	300	20	6000
1.9.17	MC4 Connectors, male & female	Pair	30	115	3450
1.9.18	Cable Tray	Mtr	100	120	12000
1.9.19	Cable Ties	Pack	10	50	500
1.9.20	4 Sq.mm Cu Lugs	Nos	480	30	14400
1.9.21	Module Mounting Nut-Bolts, SS-304, M6/M8, 25mm	Nos	960	30	28800
1.9.22	Module Earthing Nut-Bolts, SS-304, M5, 25mm	Nos	480	20	9600
1.9.23	Array Junction Box / String Monitoring Unit (SMU) with required accessories for mounting	Lot	1	78000	78000
	<b>Energy Meter, Remote Monitoring, Weather monitor</b>				
1.9.24	Remote Monitoring System with Desktop Software for Client	Nos	1	225000	225000
1.9.25	POA Pyranometer and Ambient Temperature Sensor	Nos	1	150000	150000
1.9.26	Installation and Commissioning of Plant	Lot	1	450000	450000
<b>SECTION-2: DESIGN, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF MECHANICAL WORKS</b>					
<b>2.1</b>	<b>WATER PUMPING SYSTEM - DOMESTIC AND FLUSHING</b>				
2.1.1	Supplying & Fixing, Testing, erecting & Commissioning Works of Vertical Inline pumps having SS casing, BRONZE impellers, EN8 shaft and driven by 2900 RPM 415 Volts, 50 cycles, AC 3 phase TEFC motor. Each pump should be capable of delivering 80 LPM at 40 M head, from all causes.	Set		361250	722500
			2		

2.1.2	Supplying & fixing, Erecting, testing & Commissioning Vertical pre-charged diaphragm tank 100 Ltrs. suitable to operate at a maximum pressure of 15 Kg. and should be complete with necessary inlet & outlet connections for water, air and control. Vessel should be fitted with suitable rubber diaphragm to form partition between air & Water.		2		
2.1.3	Supplying & Fixing, Erecting, testing & Commissioning Auto-control panel with VFD operations. Etc. complete.		2		
2.1.4	with necessary pressure Translator & pressure gauge		2		
2.1.5	all internal wiring to ensure that the entire equipments works as a composite system.		2		
2.1.6	NON-RETURN VALVES		6		
2.1.7	Air release valves of 20 mm dia.		6		
2.1.8	Necessary inlet & outlet valves		12		
2.1.9	Bronze strainer on inlet side		2		
2.1.10	Complete Skid mounted system		0		
<b>2.2</b>	<b>FIRE HYDRANT SYSTEMS</b>				
2.2.1	Supplying, Fixing, jointing, testing & commissioning GI C class pipe of Jindal make with welded / flanged joint including Supplying providing & fixing nuts, bolts, rubber gaskets, drilling holes in RCC slab, column etc. as required, painting of the pipes with 2 coat of post office red paint over a coat of red oxide primer.				
	A) 80 mm (3") dia.	RM	18	808	14544
	B) 100 mm (4") dia.	RM	40	1,063	42520
	C) 150 mm (6") dia.	RM	230	1,785	410550
2.2.2	Supplying & Fixing G.I. flanged welded fittings such as bends, tees, reducers - do - do - as above				
	A) 80 mm (3") dia.	Nos.	8	442	3536
	B) 100 mm (4") dia.	Nos.	12	604	7248
	C) 150 mm (6") dia.	Nos.	16	1,258	20128
2.2.3	Supplying, laying & jointing G.I. weldable slip on flanges including welding to M.S. pipes nuts, bolts etc. complete.				
	A) 80 mm (3") dia.	Nos.	8	400	3200
	B) 100 mm (4") dia.	Nos.	8	540	4320
	C) 150 mm (6") dia.		12	1190	14280
2.2.4	Supplying, Fixing standard G.M. branch pipe with G.M. nozzle & with 63 mm instantaneous type coupling.	Nos	14	2423	33922
2.2.5	Supplying, fixing flanged C.I. tested Butterfly valve with necessary nuts, bolts, rubber gaskets etc.				
	a) 150 mm (6") dia.	Nos	4	7225	28900

	b) 100 mm (4") dia.	Nos	6	6375	38250
	c) 80 mm (3") dia.	Nos	1	3825	3825
2.2.6	Supplying, Fixing C.I. flanged tested Non-return valve to IS 780 -do- -do- as above.				
	a) 150 mm (6") dia.	Nos	2	8500	17000
	b) 100 mm (4") dia.	Nos	1	5950	5950
2.2.7	Supplying, fixing single ball acting air release valve with 25 mm G.M. stop valve.	Nos	4	1233	4932
2.2.8	Supplying, Fixing quadruple Siamese (4 Nos.) fire bridge inlet on 150 mm G.I. stand pipe each inlet consisting of a 63 dia. instantaneous male coupling, check valve & cap secured with chain along with 150 mm back pressure valve & 150 mm Sluice valve etc. complete.	Nos	1	15300	15300
2.2.9	Supplying, fixing mild steel fabricated fire hydrant hose cabinet with glass front, suitable to house 2 length of canvas hose of 50' (15M) long & nozzle 2'3" X 2'0" X 1'0" size (70 X 60 x 30cm) painted in 2 coats of post office red over a coat of red oxide primer.	Nos	6	3825	22950
2.2.10	Supplying & fixing fire hose cabinet door & frame fabricated out of heavy gauge M.S. channel powder coated in post office red paint of dimensions 1.5 M high X 1.0 M wide as per drawing (or the nearest size to suit the site conditions) with double key & locking arrangement & support for wall gouching.	Nos	8	7650	61200
2.2.11	Supplying, fixing 65 mm dia. X 15M long 2 nos. canvas hose pipe having 1 no male instantaneous coupling with plunger locking arrangement wired on either ends and scrawled down type jet nozzle on either end.	Nos	14	6375	89250
2.2.12	Supplying, Fixing drum type wall mounting hose reel swivelling 180-degree Celsius having 20 mm dia. 24 M long best quality approved make armoured rubber hose pipe with 10 mm dia. outlet bronze jet nozzle & shut off cock on the outlet end & also one 20 mm dia. to 65 mm dia. male instantaneous type adopter on the inlet and supporting bracket etc. complete.	Nos	6	7225	43350
2.2.13	Supplying, fixing 65 mm dia. Single hydrant outlet with separate control G.M. flanged best quality fire hydrant landing valve with companion flanges, nuts, bolts washers, gaskets etc. complete. as directed.	Nos	14	6800	95200
2.2.14	Making holes in RCC slab/beam for pipes of 65 dia. and above.	Nos	8	170	1360
2.2.15	Providing & fixing M.S. brackets including	KG	200	102	20400

	supplying & fixing dash fastener.				
2.2.16	Supplying, Fixing galvanised steel bucket of 9 ltrs. cap. with round bottom, cover painted with post office red paint.	Nos	18	319	5742
2.2.17	Supplying, Fixing ABC gas type (9 Kg.) fire extinguishers with initial fill, hose, wall brackets, including supply of nuts, bolts, etc. complete.	Nos	30	4973	149190
2.2.18	Supplying, Fixing Siamese fire brigade inlet connection having 4 Nos. 65 mm dia. male instantaneous plunger locking type blank cap & chain as well as welded companion flanged & sundries like gasket inserts, bolts, nuts & washers & 150 mm dia. G.I. C class common stand pipe.	Set	1	13175	13175
2.2.19	Supplying, laying & jointing G.I. C class pipe of Approved make with fittings to IS 1239 in welded joints including cutting the pipe to required length & size, drilling of holes for the same, painting of the pipes with 2 coat of post office red paint over a coat of red oxide primer. 10 cm mm (2") dia.	Meter	30	608	18240
2.2.20	Supplying, fixing suitable orifice plate (brass) on pipe lines 4" to 3" dia. to reduce pressure to 3.2 Kg/sqm.	Nos	14	850	11900
2.2.21	Supplying, Fixing foam type (9 ltrs cap.), CO <sub>2</sub> fire extinguisher with brackets for wall mounting & necessary accessories. (D. G. room)	Nos	1	2975	2975
2.2.22	Constructing 600 x 600 valve chamber up to 800 deep, in 230 thick brick (external main) including CI cover & Frame.	Nos	1	8500	8500
2.2.23	Fixing C.I. strainer.				
	a) 100 mm (4") dia.	Nos	1	5950	5950
	b) 150 mm (6") dia.	Nos	1	8075	8075
2.2.24	Providing 1:3:6 PCC Bed/encasing the pipes in 150 mm (6") thick PCC including benching, curing etc.	CM	2	3315	6630
2.2.25	Supplying, Fixing & Putting in working condition standard pressure gauge with 15 mm dia. brass check nut & capable of showing pressure reading from 0.00 kg. to 30 kg.	Nos	2	1275	2550
2.2.26	Supplying, fixing screwed Brass Ball valve of quality (IS:778-1971) 20 Kg. class. 15 mm (1/2") dia.	Nos	2	245	490
2.2.27	Supplying, fixing, testing & commissioning horizontal multistage single outlet centrifugal pump set capable of delivering 1800 LPM at 65 M head, having cast iron casing, bronze impellers, EN-8 shaft with bronze shaft sleeves directly coupled, 1450 RPM, TEFC motor having class 'F' insulation	Nos	1	382500	382500

	complete on MS channel base plate with coupling guard (Main Fire Pump)				
2.2.28	Fixing testing & commissioning horizontal centrifugal pump set capable of delivering 180 LPM at 65 M head due to all causes with TEFC squirrel cage induction motor of 2900 RPM, foundation bolts, etc. complete (Jockey Pump Fire)	Nos	1	68000	68000
2.2.29	Supplying, Fixing Pre-charged diaphragm Operated Air Cushion tank of 500 Ltrs. capacity suitable for 25 Kg/Sq. Cm	Nos	1	21250	21250
2.2.30	ELECTRICAL CONTROL PANEL FOR FIRE PUMPS				
2.2.30.1	Sheet steel clad wall -mounting control panel approximate size 2500 mm x 2100mm x 300mm (h w x d) for control of Fire pumps having suitably rated incoming isolating switch incoming voltmeter with selector switch and fuses. DOL starter with hand reset overload cum shock preventer type relay, VOLTMETER, Ammeter to read current in any one phase. OFF/AUTO/MANUAL selector switch and NHT Italian make or equivalent level switch for automatic control of pump including 5 nos. of pressure switch. LIST OF PUMPS MAIN FIRE PUMP AUTO ON, MANUAL OFF FIRE JOCKEY PUMP AUTO ON, AUTO OFF Includes all Wiring & Cabling from Panel to pump, water tank, Booster pump, & pressure Switches This panel should have provision for connectivity with BMC system.	Qty	1	212500	212500
<b>2.3</b>	<b>DESIGN, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING WORKS FOR ADDRESSABLE SMOKE DETECTION SYSTEM</b>				
2.3.1	Supply, Installation, Testing & Commissioning of Intelligent Fire Alarm Control Panel. Single Loop expandable up to 2 Loops,1 Loop card inbuild,235 Addressable points per loop,30 Zone, 2 Bell Circuit, Integrated PSU with Battery Charger, Excluding Batteries, requires network card additionally for networking (Certificated by LPCB)	Nos.	1	98975.00	98975
2.3.2	Supply, Installation, Testing & Commissioning of Intelligent Addressable Optical Detector, Drift Compensation, Sensitivity Adjustment, 8 Bit Processor with Remote Indicator	Nos.	192	2733.50	524832

	Output (Certificated by LPCB)				
2.3.3	Supply, Installation, Testing & Commissioning of Intelligent Fixed Temperature and Rate of Rise Heat Detector, 8 Bit Processor with Remote Indicator Output (Certificated by LPCB)	Nos.	5	2733.50	13667.5
2.3.4	Supply, Installation, Testing & Commissioning of Addressable Manual Call Point Semi Flush Mounting Resettable (Non-Breaking Glass), Supplied with Special Reset Tool compatible with both I & DI Series (Certified by LPCB)	Nos.	10	4322.00	43220
2.3.5	Supply, Installation, Testing & Commissioning of Addressable Combined Sounder and Strobe, 24VDC, (Certificated by LPCB)	Nos.	6	5003.00	30018
2.3.6	Supply, Installation, Testing & Commissioning of Addressable Control Module (Certificated by LPCB)	Nos.	6	5003.00	30018
2.3.7	Supply, Installation, Testing & Commissioning of Addressable Fault Isolator Module	Nos.	18	3868.00	69624
2.3.8	Response Indicator	Nos.	131	160	20960
2.3.9	Supply, Installation, Testing & Commissioning of 2 Core x 1.5 mm <sup>2</sup> , Multi-stranded AT Copper, FRLS Armoured cable, Including all required accessories	Mtr.	1250	98	122500
<b>2.4</b>	<b>DESIGN, SUPPLY WORKS FOR HVAC INSTALLATION</b>				
2.4.1	<b>Supply, installation, testing &amp; commissioning of Variable Refrigerant System / Variable Refrigerant Flow modular type air-conditioning system suitable for cooling by using minimum 30% as variable capacity Inverter based compressors in each Module complete with outdoor units with controller and with accessories &amp; sub-assemblies fittings etc. full charging of R-410A refrigerant gas complete, powder coating complete as per specifications, with connectivity to BMS for A/M status, RUN status &amp; Remote start / stop command. (Module / Bacnet / IP) Including multi-connecting KIT.</b>				
2.4.1.1	<b>Outdoor units</b>				
2.4.1.1.1	14.00 HP	Nos.	1	412837.00	412837.00
2.4.1.1.2	32.00 HP	Nos.	1	794600.00	794600.00
2.4.1.1.3	28.00 HP	Nos.	1	643671.00	643671.00
2.4.1.1.4	36.00 HP	Nos.	1	883383.00	883383.00

2.4.1.1.5	38.00 HP	Nos.	1	896700.00	896700.00
2.4.1.1.6	54.00 HP	Nos.	1	1215207.00	1215207.00
2.4.1.2	<b>Indoor units</b>				
2.4.1.2.1	<b>4-Way Compact Cassette Unit - (900x900)</b>				
2.4.1.2.1.a	0.66 TR	Nos.	13	36622.00	476086.00
2.4.1.2.1.b	0.83 TR	Nos.	13	36622.00	476086.00
2.4.1.2.1.c	1.08 TR	Nos.	7	37622.00	263354.00
2.4.1.2.2	<b>4-Way Regular Cassette Unit - (900x900)</b>				
2.4.1.2.2.a	1.33 TR	Nos.	2	38287	76574
2.4.1.2.2.b	1.66 TR	Nos.	29	38287	1110323
2.4.1.2.2.c	2.08 TR	Nos.	19	39287	746453
2.4.1.2.2.d	2.66 TR	Nos.	15	39952	599280
2.4.1.2.2.e	3.33 TR	Nos.	2	42726	85452
2.4.1.2.2.f	4.13 TR	Nos.	2	44946	89892
2.4.1.2.3	<b>Round Cassette Unit</b>				
2.4.1.2.3.a	1.60TR	Nos.	1	49607.00	49607.00
2.4.1.2.3.b	2.00 TR	Nos.	1	52603.47	52603.47
2.4.1.2.3.c	2.60 TR	Nos.	1	56376.71	56376.71
2.4.1.2.3.d	3.20 TR	Nos.	1	58263.33	58263.33
2.4.1.2.3.e	4.00 TR	Nos.	1	59539.58	59539.58
2.4.1.2.4	<b>Remote control</b>				
2.4.1.2.4.a	Corded remote control for common area	Nos.	12	4772.00	57264.00
2.4.1.2.4.b	Cordless remote control for cabin area	Nos.	69	1942.00	133998.00
2.4.1.2.5	All refrigerant Joints	Lot	1	665867.00	665867.00
2.4.1.2.6	Touch Screen Controller for VRV system for all the indoor & outdoor units installed at Ground floor. The above controller should be compatible with BMS / central BMS controller.	Nos.	2	72690	145380
2.5	<b>ERECTION, TESTING AND COMMISSIONING WORKS FOR Variable Refrigerant System</b>				
2.5.1	<b>Outdoor units</b>				

2.5.1.1	14.00 HP (Reception & Cafeteria Area)	Nos.	1	15000	15000
2.5.1.2	32.00 HP (First Floor B Wing)	Nos.	1	30000	30000
2.5.1.3	28.00 HP (First Floor A Wing)	Nos.	1	30000	30000
2.5.1.4	36.00 HP (First Floor A Wing) MD & Directors' Cabin on DG Set	Nos.	1	40000	40000
2.5.1.5	38.00 HP (Ground Floor B Wing)	Nos.	1	40000	40000
2.5.1.6	54.00 HP (Ground Floor A Wing)	Nos.	1	50000	50000
2.5.2	<b>Indoor units</b>				
2.5.2.1	<b>4-Way Compact Cassette Unit - (900x900)</b>				
2.5.2.1.a	0.66 TR	Nos.	13	3000	39000
2.5.2.1.b	0.83 TR	Nos.	13	3000	39000
2.5.2.1.c	1.08 TR	Nos.	7	3000	21000
2.5.2.2	<b>4-Way Regular Cassette Unit - (900x900)</b>				
2.5.2.2.a	1.33 TR	Nos.	2	3000	6000
2.5.2.2.b	1.66 TR	Nos.	29	3000	87000
2.5.2.2.c	2.08 TR	Nos.	19	3000	57000
2.5.2.2.d	2.66 TR	Nos.	15	3000	45000
2.5.2.2.e	3.33 TR	Nos.	2	3000	6000
2.5.2.2.f	4.13 TR	Nos.	2	3000	6000
2.5.2.3	<b>Round Cassette Unit</b>				
2.5.2.3.a	1.60TR	Nos.	1	3500	3500
2.5.2.3.b	2.00 TR	Nos.	1	3500	3500
2.5.2.3.c	2.60 TR	Nos.	1	3500	3500
2.5.2.3.d	3.20 TR	Nos.	1	3500	3500
2.5.2.3.e	4.00 TR	Nos.	1	3500	3500
2.5.2.4	<b>Remote control</b>				
2.5.2.4.a	Corded remote control for common area	Nos.	12	350	4200
2.5.2.4.b	Cordless remote control for cabin area	Nos.	69	150	10350
2.5.2.5	All refrigerant Joints	Lot	1	59400	59400
2.5.2.6	Touch Screen Controller for VRV system for all the indoor & outdoor units installed at Ground floor. The above controller should be compatible with BMS / central BMS controller.	Nos.	2	20000	40000
2.6	<b>DESIGN, SUPPLY, ERECTION, TESTING AND COMMISSIONING WORKS FOR following components of VRV system:</b>				

2.6.1	All refrigerant piping between indoor & outdoor units duly insulated and covered with Al. foil as per specifications. All piping inside the room shall on GI Perforated cable tray / MS Ladder type & exposed piping shall be properly supported in GI Perforated cable tray. Pipe line must be tested for requisite pressure & must be supported. All refrigerant piping to be insulated with 19 mm thick class "O" arm flex nitrile rubber with UV protection as per manufacturer.				
2.6.1.1	6.35 MM Dia.	RMT	58	305	17690
2.6.1.2	9.50 MM Dia.	RMT	473	415	196295
2.6.1.3	12.70 MM Dia.	RMT	88	535	47080
2.6.1.4	15.90 MM Dia.	RMT	449	780	350220
2.6.1.5	19.10 MM Dia.	RMT	54	810	43740
2.6.1.6	22.20 MM Dia.	RMT	138	890	122820
2.6.1.7	28.60 MM Dia.	RMT	75	1355	101625
2.6.1.8	34.90 MM Dia.	RMT	28	1950	54600
2.6.1.9	38.10 MM Dia.	RMT	127	2240	284480
2.6.1.10	41.30 MM Dia.	RMT	40	2650	106000
2.6.2	<b>Enclosure / Sleeves for Refrigerant Piping / Cabling:</b>				
2.6.2.1	Provide adequate size enclosed GI cable tray with necessary fittings to cover and protect the refrigerant pipes and cabling for all the VRV units. Cable Tray (covered) will be used only on Terrace where the refrigerant piping / cabling is exposed to atmosphere.	Lot	1	592700	592700
2.6.2.2	All control cables between indoor and outdoor unit laid in PVC Piping and clamped				
2.6.2.2.a	2C x 0.75 / 1mm <sup>2</sup> Copper shielded Cable	Lot	1	106743	106743
2.6.2.2.b	3C x 2.5mm <sup>2</sup> Copper shielded Cable	Lot	1	41310	41310
2.6.2.3	All power cables with earthing between indoor and outdoor supported with M.S. Angles frame work (ELMCB's provided 8m from Outdoor unit)				
2.6.2.3.a	4C x 10mm <sup>2</sup> Copper shielded armoured cable	Lot	1	26000	26000
2.6.2.3.b	4C x 16mm <sup>2</sup> Copper shielded armoured cable	Lot	1	42500	42500
2.6.3	MS Structure for installing VRV outdoor units duly epoxy coated	Kg	900	125	112500
2.6.4	PVC Drain piping for the units	RFT			
2.6.4.a	50 mm Dia.		110	50	5500
2.6.4.b	40 mm Dia.		300	46	13800
2.6.4.c	32 mm Dia.		450	40	18000
2.6.4.d	25 mm Dia.		900	35	31500
2.6.5	Testing & Commissioning charges along with topping-up of refrigerant	Lot	1	262600	262600

2.6.6	GI sheet metal duct work for Ductable VRV Units				
2.6.6.1	GI sheet metal Rectangular Duct for Fresh Air Fan	FT <sup>2</sup>			
2.6.6.1.a	24 gauge		2800	65	182000
2.6.6.2	Flexible Duct Connection	RFT			
2.6.6.2.a	150 mm Dia.		50	650	32500
2.6.6.2.b	100 mm Dia.		714	515	367710
2.6.6.3	fresh air controller for all the indoor units	Nos.			
2.6.6.3.a	50 CFM		33	2650	87450
2.6.6.3.b	70 CFM		74	2950	218300
2.7	<b>DESIGN, SUPPLY, ERECTION, TESTING AND COMMISSIONING WORKS FOR INSULATION WORK</b>				
2.7.1	Acoustic Insulation of Ducts with Nitrile Rubber. The density of the same shall be $\geq 140 \text{ Kg/m}^3$ , 10 MM	FT <sup>2</sup>	50	115	5750
2.7.2	Thermal Insulation of Supply Ducts with Nitrile Rubber. Density of Material shall be $\geq 40 \text{ Kg/m}^3$	FT <sup>2</sup>			
2.7.2.a	09 MM THK		250	45	11250
2.7.2.b	13 MM THK		2800	65	182000
2.7.3	Under deck Insulation material shall be Closed Cell 13MM Nitrile Rubber. Density of Material shall be $\geq 40 \text{ Kg/m}^3$ .	FT <sup>2</sup>	1415 5	65	920075
2.8	<b>DESIGN, SUPPLY, ERECTION, TESTING AND COMMISSIONING WORKS FOR Ventilation Work</b>				
2.8.1	Ceiling Suspended Inline type Fresh Air Unit With Filter Section for VRV Units for following capacities:	Nos.			
2.8.1.a	1040 CFM, 25 mm St. Pr. For First Floor (B wing)		1	39351	39351
2.8.1.b	1250 CFM, 25 mm St. Pr. For Ground Floor (B wing)		1	39351	39351
2.8.1.c	2440 CFM, 25 mm St. Pr. For First Floor (A wing)		1	44972	44972
2.8.1.d	2590 CFM, 25 mm St. Pr. For Ground Floor (A wing)		1	50077	50077
2.8.2	Ceiling Suspended Inline Type Exhaust Unit for Toilet area for following capacities:	Nos.			
2.8.2.a	150 CFM, 25 mm St. Pr.		6	16800	100800
2.8.2.b	700 CFM, 25 mm St. Pr.		2	26900	53800
2.8.3	Propeller Type fan for Toilet area for following capacities:	Nos.			
2.8.3.a	100 CFM		21	4550	95550
2.8.3.b	150 CFM		2	6500	13000
2.8.4	GI sheet Metal Duct work for Toilet Room for the following capacities:				
2.8.4.1	GI sheet metal rectangular duct	FT <sup>2</sup>			
2.8.4.1.	24 gauge		400	65	26000

a					
2.8.4.1.			50	85	4250
b	22 gauge				
2.8.5	Powder Coated Extruded Aluminium Linear Grilles for Ex. Air of Required Airflow Angles with Out VCD.	FT <sup>2</sup>	16	550	8800
2.8.6	Non-Vision Doors Grille/Louvers	FT <sup>2</sup>	16	900	14400
<b>SECTION-3: DESIGN, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING WORKS OF OTHER SERVICES (I)</b>					
<b>3.1</b>	<b>Computer Networking system</b>				
3.1.1	Supplying and fixing 36U Floor Mount Rack (Dimension-DxWXH - 800X600X1600 mm) as per specification in approved manner (37U Standard 19" Vented Rear Door Glass Front Door, 600mm wide & 800mm deep, Basic Frame + Front Perforated Door + Rear Split Perforated Door + Side Panels + Castors & Feet + M6 screw pack) (Product details as above: VALRACK 36U Floor Mount Rack (Dimension-DxWxH - 800X 600X 1600 mm) as per specification in approved manner (37U Standard 19" Vented Rear Door Glass Front Door, 600mm wide & 800mm deep, Basic Frame + Front Perforated Door + Rear Split Perforated Door + Side Panels + Castors & Feet + M6 screw pack) 2 Site Full perforated cable tray and Cable Brush entry in Rack Bottom, as per direction of Elect./ IT in-charge). (as per technical specification with all accessories complete as required.	Each	3	58318	174954
3.1.2	Supplying & Laying UTP networking Cat-6 cable suitable for LAN / WAN Computer net-working as per specification No. WG-COC/NC (as per technical specification with all accessories complete as required.)	Mtrs	2200 0	47	1034000
3.1.3	Supplying and Installing UTP CAT6 U/UTP -TWIST 48 Port Patch Panel Unloaded without IO (as per technical specification with all accessories complete as required.)	Each	8	10070	80560
3.1.4	Supplying and Installing UTP CAT6 U/UTP -TWIST 24 Port Patch Panel Unloaded without IO (as per technical specification with all accessories complete as required.)	Each	1	6905	6905
3.1.5	Supplying installing & Punching Tool-less Cat-6 Information Outlet (Ethernet) flush/surface type in position as per specification no. WG-NAS/IO (Information Outlet socket) (as per technical specification with all accessories complete as required.)	Each	700	481	336700

3.1.6	Supplying and fitting unbreakable concealed type modular switch box with Single & Double mounting IO Face plate for 1 module duly erected flush to wall with required chiselling and finishing with cement mortar / POP as per required to match the background in an approved manner. (for LAN- 350) (as per technical specification with all accessories complete as required.)	Each	350	202	70700
3.1.7	Supplying and fixing 1 meter length, UTP Patch cord of Cat 6 type in position as per specification No. WG-COC/PC (UTP CAT6 Patch Cord 3Fit. -100) (as per technical specification with all accessories complete as required.)	Each	350	279	97650
3.1.8	Supplying and fixing 3-meter length, UTP Patch cord of Cat 6 type in position as per specification No. WG-COC/PC (UTP CAT6 Patch Cord 7Fit. -350)	Each	350	339	118650
3.1.9	Supply, installation & testing with configuring of Horizontal - PVC Closed (Cable Manager) Available in 2U - 37-inch Rack Mountable. Colour available is Black. (as per technical specification with all accessories complete as required.)	Each	20	850	17000
3.1.10	Supply and Installation 12 Port SC Fibre Patch Panel Multimode (loaded 1u) front Patching Type, 1U high and rack mountable on standard 37" rack with mounting arrangements SC type supplied with fusion splicing sleeves for termination of fibre OM3, MM with pigtail, all accessories including coupler plates pre-loaded with SC couplers (OM3) for terminating fibres on the FOPP Multimode OFC Compatible (as per technical specification with all accessories complete as required.)	Each	2	6693	13386
3.1.11	Supply and installation with testing of DUPLEX SC to SC Connectivity UP-Link Optical Fibre Patch Cord, OM3 & OM4, MM, SC to SC (as per technical specification with all accessories complete as required.)	Each	20	5000	100000
3.1.12	Supply and installation with testing of SC Connectivity UP-Link Switch to Switch Fibre Optic SFP-10G-SR Compatible 10GBASE SR SFP10 Gig SFP+ uplink module for switch (MM) end of the Multimode OFC 10G SFP+ module will be connectivity to Cisco 24 Port L3 and 48 L2 Port Switch (For Uplink) (as per technical specification with all accessories complete as required.)	Each	20	12000	240000

3.1.13	The Supply, Installation, Configuring Enterprise Manager of Next Generation Firewall 450 User with Access Point Controller Every feature available on every appliance firewall, VPN, ATP, IPS, email, web filtering and app control Hardware, virtualized, software or cloud based appliance Intuitive browser based interface Built-in reporting on all models Two-factor authentication with one-time password (OTP) in many areas Integrated wireless controller. The (as per technical specification with all accessories complete as required.)	Each	1	592000	500000
3.1.14	The Supply, Installation, Configuring Enterprise Manager Controller with Same Firewall High Performance Manageable Wireless N Selectable Dual band Access Point w PoE in WLAN network as per specification no. WG-NAS/LAP2 (Access Point) (as per technical specification with all accessories complete as required.)	Each	5	30451	152255
3.1.15	The Supply, Installation, configuring 10/100/1000 Mbps switch L3 24 Port Manageable switch (as per technical specification with all accessories complete as required.)	Each	1	180300	180300
3.1.16	The Supply, Installation, configuring 10/100/1000 Mbps switch L2 48 Port Manageable switch (as per technical specification with all accessories complete as required.)	Each	8	47950	383600
3.1.17	Testing and commissioning of all Networking system (Tagging, Dressing, Testing Point to Point and Reporting DATA Sheet)	Job	1	30000	30000
3.1.18	Supplying and erecting FR grade, PVC armoured multimode armoured multimode Optical Fibre Cable with 6 fibres, with core dia. 50/125 µm (OM3) suitable for 1 Gbps Ethernet distance at 850 nm of wavelength, on wall/ceiling or laid in provided pipe/trench as per specification No. WG-COC/OFC LSZH	Mtrs	100	247	24700
3.1.19	SC type Multimode Fibre Supply, underground laying and Splicing Termination with OTDR testing Of OFC 6 core multiple mode fibre optic cable meeting the specified standards (Fibre Optic cable should be as per the NSI/TIA/EIA Standards) -make OR Equivalent,	Mtrs	700	247	172900
3.1.20	Supply and laying of HDPE pipe, ISI branded with required bends and couplers	Mtrs	700	68	47600

3.1.20.1	(Digging and laying of HDPE pipe shall be done at a depth of 4 Ft. in a horizontal directional digging mode), Hard/soft Soil digging and properly refilling of the same Road cutting and digging trench and resurfacing with cement concrete / similar materials (on as it is basis)	Mtrs	600	75	45000
3.1.21	SC type Multimode Fibre Splicing & Termination Point to Point Testing	Each	12	400	4800
3.1.22	10 Mbps (1:1 last mile fibre, ring topology) Internet leased line Connectivity for 1 Years on rental basis with router and all allied devices and accessories Service Review Reports & S/W The bidder shall provide following reports on the WEB for reviewing service parameters for location. a) Actual Bandwidth utilization, b) Summary of usage weekly, monthly, c) Monthly network bandwidth availability. Bidder shall respond with a solution within one working hour of reporting of a problem and restore satisfactory operation within four working hours.	10 MBPS	1	280000	280000
<b>3.2</b>	<b>TELEPHONE SYSTEM (EPABX)</b>				
3.2.1	Supply, installing, testing & commissioning of Communication Server with minimum 4 PRI, 6 CO, 24 Digital Extensions & 128 Analog Extensions expendable up to 300 ports and system also have a Boss-Secretary features. Minimum warranty of EPABX system is 1 year.	Each	1	319125	319125
3.2.2	Supply, laying, termination and testing of telephone cable 2 pair with 0.5 mm dia. FRLS PVC insulated provided in PVC casing / conduit as per specification No. WG-TW and including all labours and materials as required.	Mtrs	20000	20	400000
3.2.3	(A)- Supply, installation of Junction box suitable for 100 pairs with one anti rust coat of primer and two finished coats of epoxy paint, made out 2.03 mm (14 gauge) sheet steel with hinged and lockable door, detachable gland plate at the bottom/top connection of incoming/outgoing hole for 2P cables, 50P cable with gland, including all labours and materials as per specification No. WG-TW	Each	1	2936	2936
3.2.4	(B)- Supply, installation, termination & punching, commissioning Krone module of 10 pairs including all labours and materials as required as per specification No. WG-TW (ISI/ISO approved)	Each	10	270	2700

3.2.5	(A)- Supply, installation of MDF suitable for 200 pair with one anti rust coat of primer and two finessed coats of epoxy paint, made out 2.03mm (14 gauge) sheet steel with hinged and lockable door, detachable gland plate at the bottom/top connection of incoming/outgoing 2P cables, 1 no. 50P cable with gland, including all labours and material as required as per specification.	Each	1	9638	9638
3.2.6	(B)- Supply, installation, termination & Punching commissioning Krone module of 10 pairs including all labours and materials as required (ISI /ISO approved)	Each	20	270	5400
3.2.7	Supply, installing, testing and commissioning of Communication digital phone including all labours and materials as required (equivalent to Panasonic DT546).	Each	16	12560	200960
3.2.8	Supply, installing, testing & commissioning of communication speaker phone for Meeting Room and conference Room including all labours and materials as required.	Each	12	5650	67800
3.2.9	Supply, installing, testing and commissioning of communication Panasonic TSC-60S Analog Phone (Boss-Secretary feature) including all labours and materials as required.	Each	84	1540	129360
3.2.10	Providing and fixing modular type telephone socket one gang with safety shutter ISI mark approved make duly erected on provided plate and box with wiring connections, supplying, installation, termination and testing including all labours and materials as required.	Each	300	82	24600
3.2.11	Providing and fixing unbreakable concealed type modular switch box with double mounting plate for 1 module duly erected flush to wall with required chiselling and finishing with cement mortar / POP as per required to match the background in an approved manner including all labour and materials as required. (for Tele. socket).	Each	300	202	60600
3.2.12	Supply, installing, testing & commissioning of Panasonic Server Reception Phone with Keypad	Each	2	24800	49600
3.2.13	Testing and commissioning of EPABX system with associated accessories including numbering/tagging/ferruling and dressing of cables.	Job	1	23000	23000
3.2.14	Supply, laying, testing of Jelly filled armoured telephone cable 50 pair with 0.5 mm coper dia. Including termination at both end of MDF and all labours and	Mtrs	150	347	52050

	materials as required and provided trench				
3.2.15	The number of required PSTN (MTNL) PRI/CO lines shall be arranged by vendor's free of cost only initial cost & recurring cost paid by MMRC.	Job			
3.2.16	Interfacing of proposed EPABX system with existing Panasonic TDA 100D (EPABX) installed in NaMTTRI building, MMRC through PRI on optical fibre cable in vendor's scope including all labours and materials as required (Optical Fibre cable media will be provided by MMRC).	Job	1	15000	15000
<b>3.3</b>	<b>Audio-Visual System (New Building)</b>				
3.3.1	Supplying and installing, testing & commissioning of High Definition Video Conferencing System conferencing device with 1+3 Multiparty License. as per technical specification with all mounting accessories complete as required.)	Each	1	529250	529250
3.3.2	Supplying, installation, testing & commissioning of Projector 2700 Lumens (1024 x 768) (as per technical specification with all accessories complete as required.)	Each	9	49500	445500
3.3.3	Motorised Projector Screen 5 FEET X 7 FEET 100 INCH DIAGONAL MOTORISED 100" MATT WHITE PROJECTION SCREEN FOR ULTIMATE PROJECTION FOR HOME AND OFFICE Features: Durable square-shaped steel housing with powder coated. Universal mounting bracket with endcap making installation easy whether it is mounted on a wall, suspended or recessed above the ceiling. Hand switch, IR or RF Remote control at option.	Each	9	16500	148500
3.3.4	Supplying, erecting & commissioning Projector Ceiling Mount kit: - Basic Frame + Front Perforated Door + Rear Split Perforated Door + Side Panels + Castors & Feet + M6 screw pack	Each	9	2825	25425
3.3.5	Supplying and fixing MX ADVANCED HIGH SPEED HDMI CABLE 1.4V WITH NYLON MESH 22 AWG & SUPPRESSION CORE - 20 MTR	Each	15	3375	50625
3.3.6	Supplying and fixing MX ADVANCED HIGH SPEED HDMI CABLE 1.4V WITH NYLON MESH 22 AWG & SUPPRESSION CORE - 2 MTR Male/Female	Each	12	1350	16200
3.3.7	Supplying and fixing MX ADVANCED HIGH SPEED VGA CABLE SUPPRESSION CORE - 20 MTR	Each	15	2025	30375

3.3.8	Supplying and erecting MX ADVANCED HIGH SPEED VGA CABLE SUPPRESSION CORE - 2 MTR.	Each	12	506	6072
3.3.9	Supplying and fixing 2 in and 4 Out (2x4) (2x1 & 1x4) HDMI Switcher (Multi Media Switcher)	Each	4	12600	50400
3.3.10	Supplying and fixing 2 in and 4 Out (2x4) (2x1 & 1x4) VGA Switcher (Multi Media Switcher)	Each	4	9400	37600
3.3.11	Supplying and fixing 2 in and 4 Out (2x4) (2x1 & 1x4) AV/ Switcher (Multi Media Switcher)	Each	4	2350	9400
3.3.12	conference room pop-up boxes 1DATA/1VOICE/1HDMI/1VGA/1AV/2Switcher	Each	4	8350	33400
3.3.13	Supply, installation, Testing and commissioning of PA system Amplifier CONFERENCE ROOM with 2 Conference STAND MICS with Cabling: (as per technical specification with all accessories complete as required.)	Each	1	56375	56375
3.3.14	Ceiling Mount Type for Mall Common Area: Supply, Installation, Testing & Commissioning of Ceiling mount type Round Speakers of 6 Watts, Rated Power with Dual Cone High Sensitivity Loudspeaker Drivers, Opening Angle of 180o and built in 100 Volts Matching Transformer as per technical specification with all mounting accessories complete as required.)	set	1	1810	1810
3.3.15	Testing and commissioning of all system Numbering Tagging, Dressing, Testing Point to Point.	Job	1	11500	11500
3.3.16	55" LED TV Samsung/LG/Panasonic (as per Specification ISI /ISO approved Make)	Each	4	60000	240000
3.3.17	32" LED TV Samsung/LG/Panasonic (as per Specification ISI /ISO approved Make)	Each	1	27000	27000
3.3.18	40" LED TV Samsung/LG/Panasonic (as per Specification ISI /ISO approved Make)	Each	1	39500	39500
3.3.19	Supply and Commissioning 55" Digital Signage Providing and fixing of signage boards at new office building at Reception for Advertising ( as per Specification ISI /ISO approved Make )	Each	2	92000	184000
<b>3.4</b>	<b>PA System for Fire Alarm, New Building</b>				
<b>3.4.1</b>	<b>Public Address System (Fire Alarm system)</b>				
3.4.1.1	Supply, Installation, Termination, Loop Checking, Ferruling, Glanding, Testing & Commissioning of below mentioned with all required items to make the system working				
3.4.1.1.1	<b>PA RACK</b>				

3.4.1.1.1.a	System Controller: Supply, Installation, Testing & Commissioning of System Controller. The System should be capable to EVAC, paging, PA and BGM and as per technical specification with all mounting accessories complete as required.	Nos.	1	101245.00	101245
3.4.1.1.1.b	Amplifier: Supply, Installation, Testing & Commissioning of amplifier 480 Watts as per technical specification with all mounting accessories complete as required.	Nos.	2	35415.00	70830
3.4.1.1.1.c	Goose Neck Microphone: Supply, Installation, Testing & Commissioning of Goose Neck Micro Phone 6 Zones as per technical specification with all mounting accessories complete as required.	Nos.	1	28739.00	28739
3.4.1.1.2	<b>SPEAKERS</b>				
3.4.1.1.2.a	Ceiling Mount Type for Mall Common Area: Supply, Installation, Testing & Commissioning of Ceiling mount type Round Speakers of 6 Watts Rated Power with Dual Cone High Sensitivity Loudspeaker Drivers, Opening Angle of 180° and built in 100 Volts Matching Transformer as per technical specification with all mounting accessories complete as required.	Nos.	131	985.00	129035
3.4.1.1.2.b	Supply, Installation, testing & Commissioning of Floor Mounted Closed racks with front glass door, 24 U Fan tray on top, perforated rear doors, vertical cable management system, casters & openable entry at the bottom for the cable & 2 nos. vertical power strip with standard accessories. (racks shall be suitable for housing all components for the system with spare capacity)	Nos.	1	56282.00	56282
3.4.1.1.2.c	Supply installation of 2 Core x 1.5 mm <sup>2</sup> , Multi-stranded AT Copper, FRLS Armoured cable. Including all required accessories	Mtr.	1000	98	98000
<b>3.5</b>	<b>SECURITY SYSTEM (CAMERA)</b>				
3.5.1	SITC of IP mini dome camera equipped with a 1/3" 1.3 MP progressive scan CMOS imager to capture 2304×1296 (20 fps)/Full HD 1080p (25/30 fps) images;2.8 mm fixed lens; and a waterproof (IP66) enclosure, true day/night solution, camera shall use 12 LED Smart IR technology and provide up to 100 ft. (30 m) of IR illumination, shall accept PoE (802.3af) or 12 V DC power input.	Nos.	11	13411.00	147521

3.5.2	SITC of 1.3 Megapixel 720P IP IR PTZ camera, 18X optical zoom, WDR, 100 Meters IR distance, TDN, DWDR, BLC, AGC, DNR, OSD, H.264 High Profile dual-stream, ONVIF 2.0, 24 privacy zones, 255 Pre-set, Support 8 auto cruise, 5 auto patrol tracks, 5 auto scan, 12VAC, Wall Mount, IP-66	Nos.	4	114405	457620
3.5.3	SITC of Network video management software expandable up to unlimited cameras in single directory, currently loaded with 120 Camera licenses, 5 concurrent client licenses, 5 concurrent system administration licenses, Unlimited storage license, report generation tools, Virtual matrix capability with all the client, Audio capability, Maps and alarm management, Automatic scheduled backup facility, Redundant - Failover License and also inclusive of 3-year OEM backup support and upgrades.	Lot	1	61750.00	61750
3.5.4	Supply, Installation, Testing & Commissioning of 16 channel NVR with HDD.	Lot	1	101475.00	101475
3.5.5	Supply, installation, testing and commissioning of CLIENT WORKSTATION.	Nos.	1	127275.00	127275
3.5.6	SITC of 24 port layer 2 switch with 10/100/1000 POE Managed Switches with IP multicast snooping and data-driven IGMP support and with two 1000baseT single mode FO uplink ports and all related termination accessories as per site specific System requirement.	Nos.	1	99728.00	99728
3.5.7	Supply, Installation, Testing & Commissioning of Supply & Laying of Armoured, FRLS, Cat-6 cable, laid on Surface with GI Saddle- Spacers	Mtr.	1000	108.00	108000
4.1	<b>SECTION-4: Supply, Installation, Testing and Commissioning work of OTHER SERVICES (II)</b>				
4.1.1	Supplying pedestal type air circulator 450 mm. sweep oscillating type suitable to work on 230 Volts 50 cycles 1440 RPM with speed regulator, overhead protection unit, totally enclosed, flame proof motor with additional 3 core wire, 5 metre length and Hand Shield type 3 pin 6A. plug top complete with moisture proof treatment and 'E' class insulation and marking Sr. No. and date of erection.	Each	10	4868	72540
4.1.2	Supplying refrigerator domestic type approved make 285 to 310 litres storage capacity, suitable for operation on 230/250 V 50 cycles complete with automatic temperature control conforming to IS specifications No. 1476/79 with one year guarantee for	Each	1	26868	26868

	sealed unit in refrigeration system and marking Sr. No. and date of erection. (Cafeteria)				
4.1.3	Supplying refrigerator domestic type approved make 100 litres storage capacity, suitable for operation on 230/250 Volts, 50 cycles complete with automatic temperature control conforming to IS specifications No. 1476/79 with one year guarantee for sealed unit in refrigeration system and marking Sr. No. and date of erection.	Each	4	8100	32400
4.1.4	Supplying microwave domestic type approved make 20 litres storage capacity, suitable for operation on 230/250 Volts, 50 cycles complete with automatic temperature control conforming to IS specifications No. 1476/79 with minimum 3 years guarantee for sealed unit and marking Sr. No. and date of erection. (as per direction of electrical in-charge).	Each	1	18900	18900
4.1.5	Supplying HOT PLATE domestic type (induction type) approved make, suitable for operation on 230/250 Volts, 50 cycles complete with automatic temperature control conforming to IS specifications No. 1476/79 with minimum 3 years guarantee for sealed unit and marking Sr. No. and date of erection. (as per direction of electrical in-charge).	Each	2	2800	5600
4.1.6	Supplying Erecting testing and commissioning Multi Dwelling unit , direct to Home antenna system for TV , comprising of following items: 1) Installation of Dish antenna (120 CM diameter) for office building- 1 No 2) vertical cabling in the communication(LV) shaft of the building 3) supplying and fixing of Enclosure boxes (Height;45 cms., breadth 30 cms depth 9 cms approx., which includes associated components like 4 X 8 switches, Tap off and connectors on every floor in the LV shaft of building 4) supplying and fixing of amplifiers with 230 v ,5A power supply arrangement , with enclosure box ,Height 30 Cms, breadth 35 cms Depth 11 cms. on top floor for G+1 storey office building in the LV shaft of office building. (as per direction of elect. In-charge).	Each	1	36200	36200

5.1	<b>SECTION-5: Supply, Installation, Testing and Commissioning Works of Public Addressing System and Portable Public Addressing System (NaMTTRI Building, MMRCL)</b>				
5.1.1	Supply, erection, installation of 16U Wall Mount Rack required minimum one no. of Cable Manager and 2 Self 1 pkt. Of Mount Vented Rear Door Glass Front Door, Basic Frame + Front Perforated Door + Rear Split Perforated Door + Side Panels + Castors & Feet + M6 screw pack + PDU) 2 Site Full perforated cable tray and Cable Brush entry in Rack Bottom including all labours and materials as required. (as per Specification ISI /ISO approved)	Each	2	12500	25000
5.1.2	Supply, installation, commissioning, testing of Projector, Specification of Projector System: DLP; Native Resolution: 1080p Aspect Ratio: 16:10 native, supports 4:3 and 16:9 Projector 3200 Lumens Resize: 800 x 600 (SVGA), 1024 x 768 (XGA), 1152 x 864 (SXGA), 1280 x 800 (WXGA), 1280 x 960 (SXGA2), 1280 x 1024 (SXGA3), 1440 x 900 (WXGA+), 1400 x 1050 (SXGA+), 1600 x 900 (WXGA++), 1680 x 1050 (WSXGA+) Display Performance: NTSC: 480 lines PAL: 576 line (Depends on observation of the multi-burst pattern) Input Signal: NTSC / NTSC4.43 / PAL / M-PAL / N-PAL / PAL60 / SECAM Interfaces: HDMI x 2 (1 supports MHL connectivity) Computer/component video: D-sub 15 pin x 1 Composite video: RCA (Yellow) x 1 Audio in: RCA x 1 (White/Red) USB connector Type A x 1: PC-free USB and other USB connector Type B x 1: USB Plug 'n Play and interfacing with other systems including all labours and materials as required.	Each	2	49500	99000
5.1.3	Supplying, installation, & commissioning Ceiling Mount Kit:- Basic Frame + Front Perforated Door + Rear Split Perforated Door + Side Panels + Castors & Feet + M6 screw pack including all labours and materials as required.	Each	2	2825	5650.00
5.1.4	Supply, installation, commissioning and testing of projector screen motorized - specification: • 1 Brightness 4000 Lumens • Contrast Ratio minimum 2000: • Aspect Ratio 16.10 (WXGA) Input Two HDMI, One VGA Resolution Minimum 1280*800 and higher preferable • Screen 5 FEET X 7 FEET 100 INCH DIAGONAL MOTORISED 100" MATT WHITE PROJECTION SCREEN FOR	Each	2	16500	33000.00

	ULTIMATE PROJECTION FOR HOME AND OFFICE Features: Durable square-shaped steel housing with powder coated. Universal mounting bracket with endcap making installation easy whether it is mounted on a wall, suspended or recessed above the ceiling. Hand switch, IR or RF Remote control at option including all labours and materials as required.				
5.1.5	Supply, commissioning and testing of Hand-held Wireless Microphone Minimum Specification Required-Working Range-91m (300ft) Line of Sight Audio Frequency Response- 50 to 15,000 Hz, Total Harmonic Distortion-Ref. $\pm 33$ kHz deviation with 1 kHz tone 0.5%, typical Dynamic Range 100 dB, A-weighted, typical, Gain Adjustment Range- 10 dB RF Transmitter Output- 10 mW, typical varies by region, Power Requirements- 2 LR6 AA batteries, 1.5V, alkaline RF Sensitivity -105 dBm for 12 dB SINAD, typical	Each	4	13500	54000.00
5.1.6	Supply, laying, commissioning and testing standard ISI advanced high speed HDMI cable 1.4V with nylon mesh 22 AWG & suppression core - 20 mtr length including all labours and materials as required.	Each	12	3375	40500.00
5.1.7	Supply, laying, commissioning and testing standard ISI advanced high speed HDMI cable 1.4V with nylon mesh 22AWG & suppression core in 10 mtr. length (Male/Female) including all labours and materials as required.	Each	6	2050	12300.00
5.1.8	Supply, laying, commissioning and testing standard ISI advanced high speed VGA cable suppression core-20 mtr length including all labours and materials as required.	Each	12	2025	24300.00
5.1.9	Supply, laying, commissioning and testing Standard ISI advanced high speed VGA cable suppression - 10 mtr length including all labours and materials as required.	Each	6	1200	7200.00
5.1.10	Supply, installation, commissioning and testing (2X4) I/O or (2X1) I/O or (1X4) I/O, HDMI Switcher. (Multi Media Switcher) for 2 no's Conference room including all labours and materials as required.	Each	2	12600	25200.00
5.1.11	Supply, installation, commissioning and testing (2X4) I/O or (2X1) I/O or (1X4) I/O, VGA Switcher. (Multi Media Switcher) for 2 nos. Conference room including all labours and materials as required.	Each	2	9400	18800.00

5.1.12	Supply, installation, commissioning and testing (2X4) I/O or (2X1) I/O or (1X4) I/O, AV/ Switcher (Multi Media Switcher) for 2 nos. Conference room including all labours and materials as required.	Each	2	2350	4700.00
5.1.13	Supply, installation, commissioning and testing of pop-up boxes ISI Brand 1DATA/1VOICE/1HDMI/1VGA/1AV/2Sw acket for conference room including all labours and materials.	Each	4	12350	49400.00
5.1.14	Supply, installation, commissioning and testing of Ceiling Speaker - Input power-15w RMS, Power Taps- 15/10/5w on 100v, Freq. Resp. - 55-16000Hz, Speaker- 8" SPL (1w/1m) - 93dB, including all labours and materials as required.	Each	20	2825	56500.00
5.1.15	Supply, installation, commissioning and testing of Boundary Microphone available in cardioid type. Designed for a wide range of applications, conferencing, installed sound, surveillance. Type Electret Condenser, Frequency Response 40 to 20,000Hz Polar Pattern Half-Cardioid. Sensitivity (at 1,000Hz) -60±3dB* (1mV)* 0dB=1V/μbar, Attenuation Switch -10dB, Low Frequency Roll-off 80Hz Impedance 220Ω, Max. SPL For 1% T.H.D. 140 dB, Signal To Noise Ratio 70dB, Current Consumption ≤3mA, Power Supply 9-52 VDC phantom power, Output Connector XLR-M type(power module), including all labour and materials.	Each	32	22000	704000.00
5.1.16	Supply, installation, commissioning, testing of Studio Master 4 Input Amplifier Minimum Specification Required Wide range of output power 240 Watts OR better Maximum Power Consumption: 800 VA OR Less Phantom power supply 16 V via 1.2 k-ohm (mic.) OR better Sensitivity: 200 mV OR better Impedance: 22 k-ohm OR Less Speech filter -3 dB @ 315 Hz, high-pass, 6dB/oct OR better Dynamic range: 93 dB OR More Should Follow Minimum Safety Measures acc. to EN 60065	Each	2	40375	80750.00

5.1.17	Supply, installation, commissioning, testing of Digital Professional Mixer live 18 + 4 unbalance Channels Minimum Specification Required with AD/DA Card Must have High-Performance 16+2 input small format analogue mixers with on board effects OR better Must have 2-in/2-out USB audio playback and recording OR better Must have Switchable Hi-Z inputs for guitars, basses and other instruments Must have Hi-Pass Filters (low-cut) and 48V Phantom Power on all mic channels Must have Internal universal power supply	Each	2	59350	118700.00
5.1.18	Supply, laying and testing of Speaker Cable with Casing All cables feature Electrolytic Tough Pitch (ETP) virgin copper, including all labours and materials as required.	Mtr.	400	650	260000.00
5.1.19	Supply, installation of Connectors (Male + Female) Required for Microphones for Complete Room for 2 no's conference room, including all labours and materials as required.	Each	2	3000	6000.00
5.1.20	Scope of Work for qualified Bidder for Supply, Installation, Testing, commissioning and interfacing of Audio Equipment's for 2 nos. conference room including all labours and materials as required.	Each	2	10000	20000.00
5.1.21	<b>(A) Supply and testing of Portable PA Amplifier:</b> - Power Output: 160W Max., 120W RMS at 10% THD, 105W RMS at 5% THD, 95W RMS at 2% THD Output Regulation: $\leq 2$ dB, no load to full load at 1kHz. Input Channels: 5 $\times$ Mic 0.65mV/4.7k $\Omega$ , 2 $\times$ Aux 100mV/470 k $\Omega$ . Frequency Response: 50-15,000Hz $\pm 3$ dB. Signal to Noise Ratio: 60dB. Tone Controls: Bass: $\pm 8$ dB at 100Hz, Treble: $\pm 8$ dB at 10kHz. Output: Preamp 200mV/600 $\Omega$ , Line 1V/1k $\Omega$ . Speaker Outputs: 4 $\Omega$ , 8 $\Omega$ , 16 $\Omega$ , 70V & 100V. Digital Player: MP3 Player with USB, SD and MMC Card Reader. Power Supply: AC: 220-240V 50/60Hz DC: 12V (12V Car Battery). Power Consumption: AC: 250VA DC: 5.5A. Weight: 11-15 kg	Each	1	12000	12000.00
5.1.22	<b>(B) Supply and testing of PA Speaker Systems:</b> - Input Power: 50W Max. Power Taps:30/20/10W at 100V; Frequency Response: 55-16,000 Hz Low Frequency Speaker: 2 x 8", $\varnothing 0.75$ " Voice Coil; SPL at (1W/1m): 96dB; Max. Rated SPL:113dB. Nominal Impedance: 16 $\Omega$ / 333/500/1k $\Omega$ . Input Connectors: Two nos. of Terminal Strip in parallel. Weight: 8-10 kg.	Each	2	4000	8000.00

5.1.23	<p><b>Supply and testing of Wireless Microphone with Receiver:</b> RF Output Power: 15mW (max.) Modulation Mode: FM (F3E); Microphone Element: Dynamic, Cardioid Dynamic Range: 100dB; Spurious Emission: &lt; 45dB Maximum Deviation: <math>\hat{A}\pm</math> 25kHz; Frequency Response: 50-15,000Hz Antenna: Internal dipole; Current Consumption:&lt; 60mA Battery Life: 6-8 hrs. with 9V battery; Controls: Microphone On/Mute/Off Switch Indication: Red &amp; Green LED for indicating microphones On Dimensions: <math>\hat{A}\sim</math>52 <math>\hat{A}</math>— L242 mm; Weight: 0.20kg. (w/o battery)</p> <p><b>Receiver:</b> Frequency Stability: <math>\hat{A}\pm</math> 0.005% Quartz Crystal Controlled Receiving Method: Non-diversity; Audio Output: Channel 1: 0-55mV/1k, Channel 2: 0-55mV/1k; Channel 1+2: 0-55mV/1k Signal To Noise Ratio: &gt; 100dB; Distortion:&lt; 0.5% Frequency Response: 50-15,000Hz Maximum Deviation: <math>A\pm</math> 25kHz;Antenna:Telescopic Power Requirement: AC: 220-240V 50/60hz for AC adaptor Controls: Power On/Off switch, Audio Output Volume Control</p> <p>Indications: Red LED for Power ON Green LED for RF Reception for Channel-1, Green LED for RF Reception for Chanel-2</p>	Set	1	4000	4000.00
5.1.24	Supply, termination and testing of Copper wire for speaker	Mtr.	40	30	1200.00

## **PART-02**

### **TECHNICAL SPECIFICATIONS**

**TECHNICAL SPECIFICATION FOR SUPPLY,  
INSTALLATION, TESTING & COMMISSIONING OF  
ELECTRICAL, AIR CONDITIONING, FIRE ALARM  
WORK & OTHER ALLIED SERVICES FOR MMRC  
(NEW OFFICE), E-BLOCK BKC, BANDRA KURLA  
COMPLEX, BANDRA EAST, MUMBAI-400 051  
(MAHARASHTRA)**

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# Annexure-1

## ELECTRICAL SPECIFICATIONS

### Annexure -1: Electrical Specifications

#### A). FOR INTERNAL ELECTRICAL WORKS

- i The fans & fittings to be supplied by the contractor shall be procured & brought to site not before 3 months from “finishing” works so that, these fans & fittings are not damaged & do not lose their manufacturer’s warrantee.
- ii MCCBs shall have  $I_{cs} = I_{cu}$ .

- iii The department reserves the right to inspect the Panel Boards / Rising Main at the manufacturer's premises for which the contractor should give 15 days' advance notice.

**B). FOR MCCB**

- i. MCCB shall confirm to the latest IS: 13947-1993/IEC: 947-1989. The Service Short Circuit Breaking Capacity (ICS at 415 VAC) should be as specified.
- ii. MCCB shall be Current Limiting and comprise of Quick Make - Break switching mechanism preferably Double Break Contact system are extinguishing device and the tripping unit contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload adjustment. All MCCBs rated 200 Amps and above shall have adjustable Micro processor based releases for O/C, S/C and E/F having compatibility with processor. All MCCBs shall be fitted with rotary operating handle & door interlock assembly.
- iii. The trip command shall over ride all other commands. MCCBs shall employ maintenance free double break contact system to minimize the let thru energy and capable of achieving discrimination up to the full short circuit capacity. The manufacturer shall provide both the discrimination tables and let thru' energy curves. The MCCB shall not be restricted to Line / Load connections.
- iv. The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to disconnection as per the IS/TEC indicating the true position of all the contacts. In case of 4 poles MCCB the neutral shall be defined and capable of offering protection. All the MCCB shall be provided with vertical operation.
- v. MCCB in the MV Control Panel Board / MV distribution feeder pillars shall confirm the following specifications.
- vi. MCCBs should be extra current limiting type with trip time of less than 10 m. sec under short circuit conditions. The current limiting should be achieved by means of repulsion principal. The MCCBs as specified in BOQ should be 3 poles or 4 poles fixed type.
- vii. The MCCBs shall comply with the requirements of IEC 60947-2/ IS13947 – Part 2.
- viii. MCCB should have utilization category A.
- ix. The MCCBs should have a Service short circuit breaking capacity (Ics) equal to 50 kA rms, at 415 volts 50 Hz AC.
- x. Same MCCB should be suitable for AC as well as DC application.
- xi. MCCB shall have spreader links as standard feature.
- xii. A fixing of internal accessories should be as per site and user friendly.
- xiii. All MCCBs should be fitted with the Rotary handle operating mechanism with door interlock assembly. The Rotary operating mechanism shall be of robust design; MCCB mounted with a minimum number of linkages to ensure maximum reliability.

- xiv. All rotary mechanism should be with door interlock (with defeat feature) & padlock facility.
- xv. All protection releases for MCCBs up to 200 A should be tamper proof.
- xvi. All protection releases shall have the adjustable current settings for individual Poles.
- xvii. Over load protection – 80% to 100 % of In.
- xviii. Adjustable protection settings on short circuit from 3 to 6 Ir.
- xix. Earth fault protection module shall have with every MCCBs and the protection settings.
- xx. Adjustable Pick up settings from 10% to 50% of In.
- xxi. Adjustable delay settings from 100 m sec. to 200 m sec.
- xxii. Should be suitable and common for 3 Phase 3 wire and 3 phase 4 wire systems.
- xxiii. Should be adding on type and site mountable.
- xxiv. All protection releases should have in built thermal memory, in built true RMS sensing, Sensitive to heating effects of harmonics and improper termination.
- xxv. MCCB should be suitable for both Cu and Al termination.
- xxvi. MCCBs shall be CE marked

### **C) PAINTING OF STEEL WORK (FACTORY FABRICATION WORK)**

The steel used for fabrication of electrical / mechanical equipment should be painted with Powder-coated paint as per the detailed specifications given below:

- i. Degreasing: All the steel components, to be painted, should be effectively cleaned by alkaline degreasing.
- ii. Pickling: Oxide scale rust formation is to be removed in a hot bath of sulphuric acid. Pitting of the surface is to be prevented by the use of pickling in habitués.
- iii. Cold rinsing: The parts are then to be washed with cold water to remove all traces of acidic solution.
- iv. Phosphate: In order to attain durable paint coating the metal surface is to be given phosphate treatment by development a phosphate layer on the surface. Preferably hot grenadine solution is to be used in the phosphate plant.
- v. *Passivating*: This process is to be carried out by using dedicate solution.
- vi. Drying: The treated parts should be dried in a hot chamber in dust free atmosphere to ensure that they are absolutely clear and dry before the paint is applied.
- vii. Primer Coating: The treated and dried parts are to be sprayed with high corrosion resistance primer.

- viii. Stove Drying: The primer coating is to be packed in an electrically heated, air circulated area type storing over.
- ix. Finishing Coat: The final finishing coat shall be powder coating of approved shade.

**D). FOR ELECTRIC POLES:**

- i. The Agency shall arrange for inspection and testing for the poles in the manufacturer premises before dispatch of material with entire satisfaction of Engineer in charge.
- ii. The materials shall be under guarantee for a minimum period of one-year from the date of erection of poles for unsatisfactory performance or break down due to defective materials, design, manufacturing and bad workmanship.
- iii. Agency/firm should intimate the Engineer in charge in respect of inspection of materials at Manufacturer site well in advance.
- iv. The MS pipe used for fabrication of pole shall be ISI marked and should conform relevant IS Specification.
- v. Photocopy of license issued in favour of the firm by BIS for manufacturing steel tubular pole as per IS: 2713 should be submitted.

**E) FOR LED LUMINAIRES:**

- i. The Agency shall supply LED Light/ street light luminaries with IESNA certification i.e. LM80 and individual lens for each LED to control gear and with cast aluminium housing with ingress protection IP 65.
- ii. The Agency shall have to submit catalogue / details of product with guaranteed wattage and burning hours' information.
- iii. The Agency shall have to give replacement warranty of 01 year or as per OEM.

**F) FOR LT PANEL or FEEDER PILLAR:**

- i. The Agency shall supply Feeder Pillar as per CPRI approved specifications and certification.
- ii. The Feeder Pillar should be made of minimum 2.0 mm or as per specify in technical specifications in panel annexure thick CRCA sheet pre-paint treated, phosphatized and powder coated by approved Siemens grey paint with ingress protection IP 55. The Feeder pillar to be manufactured such that rain water and other outer atmosphere to be protected.
- iii. The mounting switch gears and meter module shall be ISI marked.

## **Additional specifications for electrical work**

### **1. Power Distribution and Wiring**

#### **1.1 Introduction**

The Electric Power will be received and distributed in a building, through following means: -

- i. Cabling and Switch gear to receive power.  
The building is divided into convenient number of parts, each part served by a rising main system to distribute power vertically/ horizontally.
- ii. Power flows from rising main through tap-off box to floor main board to final DBs and then to wiring.
- iii. While rising main takes care of general lighting and power outlet load of the building, other loads like lift, pumps sets, AC Plants, other motor loads are fed by independent cables of suitable capacity fed from properly designed essential/ non-essential LT panels with suitably design switch gear having necessary control and safety features.
- iv. Therefore, the distribution/wiring system essentially consist of provision of cables, switchgear, rising main, bus ducting, earthing, laying of pipes/ conduits etc. (in surface or recess) based on proper detail design to decide on various sizes/

capacities of these components and various controls and safeties involved, to provide an efficient, reliable, safe and adequate electrical distribution and wiring system.

## **1.2 System of distribution and wiring:**

- i. The wiring shall be done from a distribution system through main and/ or branch distribution boards. The system design and location of boards will be properly worked out.
- ii. Each main distribution board and branch distribution board shall be controlled by an incoming circuit breaker/ linked switch with fuse. Each outgoing circuit shall be controlled by a circuit breaker/ switch with fuse.
- iii. For non-residential buildings, as far as possible, DBs shall be separate for light and power.
- iv. Only MCCB/MCB fuse type DBs shall be used. Re-wirable type fuses shall not be used.
- v. Three phase DBs shall be used for final circuit distribution as per actual requirement.
- vi. 'Power' wiring shall be kept separate and distinct from light wiring, from the level of circuits, i.e., beyond the branch distribution boards. Conduits for light / power wiring shall be separate.
- vii. Essential/ non-essential/UPS distribution each will have a complete independent and separate distribution system starting from the main, switch board up to final wiring for each system. As for Example, conduit carrying non- essential wiring shall not have essential or UPS wiring. Wiring for Essential and UPS supply will have their own conduits system. No mixing of wiring is allowed
- viii. Generally, no switchboard will have more than on source of incoming supply. More than one incoming supply will be allowed only at main board with proper safety and interlocking so that only one source can be switched on at a time.
- ix. Each MDB/DB/Switch Board will have reasonable spare outgoing ways for future expansion.
- x. 03 phase load needs to be properly balanced as per standard guidelines.

## **1.3. Wiring:**

### **1.3.1 Sub-main & Circuit Wiring:**

#### **a) Sub-main Wiring:**

Sub-main Wiring shall mean the wiring from one main/ distribution switchboard to another.

#### **b) Circuit Wiring:**

Circuit wiring shall mean the wiring from the distribution board to 1<sup>st</sup> tapping point inside the switch box, from where point wiring starts.

### **1.3.2 Measurement of sub-main and circuit wiring:**

- i. Circuit and sub-main wiring shall be measured on linear basis along the run of the wiring. The measurement shall include all lengths from end to end of conduit or channel as the case may be, exclusive the interconnection inside the switch board etc. The increase on account of diversion or slackness shall not be included in the measurement.
- ii. The length of circuit wiring with two wires shall be measured in nos or from the distribution board to the nearest switch box from which the point wiring starts as per bill of quantities. Looping of switch boxes also will be counted towards circuit wiring, measured along the length of conduit/ channel.
- iii. When wires of different circuits are grouped in a single conduit/ channel, the same shall be measured on linear basis depending on the actual number and sizes of wires run.
- iv. Protective (loop earthing) conductors, which are run along the circuit wiring and the sub-main wiring, shall be measured on linear basis and paid for separately.

**Note:** Conduit carrying sub-main will not carry circuit/point wiring. Similarly, conduit carrying circuit wiring will not carry sub-main/point wiring. Conduit Carrying point wiring will not carry sub-main/circuit wiring.

### **1.3.3 Measurement of other wiring work:**

Except as specified above for point wiring, circuit wiring and sub-main wiring, other types of wiring shall be measured separately on linear basis along the run of wiring depending on the actual number and sizes of wires run.

## **1.4 Point Wiring:**

### **1.4.1 Definition**

A point (other than the socket outlet point) shall include all work necessary in complete wiring to the following outlets from the controlling switch or MCB.

- a) Ceiling rose or connector (in case of points for ceiling/ exhaust fan points, prewired light fittings, and call bell).
- b) Ceiling rose (in case of pendants except stiff pendants).
- c) Back plate (in case of stiff pendant).
- d) Lamp holder (in case of goose neck type wall bracket, batten holders and fittings which are not prewired).

### **1.4.2 Wiring Scope:**

Following shall be deemed to be included in point wiring but not limited to:

- a) Conduit/ Channel as the case may be, accessories for the same and wiring cables between the switch box and the point outlet, loop protective earthing of each fan/light fixture.
- b) All fixing accessories such as clips, screw, Phil plug, rawl plug etc. as required.
- c) Metal or PVC switch boxes for control switches, regulator, sockets etc., recessed or surface type, and phenolic laminated sheet covers over the same.
- d) Outlet boxes, junction boxes, pull-through boxes etc. but excluding metal boxes if any, provided with switch boards for loose wires/ conduit terminations.
- e) Any special block required for neatly housing the connector in batten wiring system.
- f) Control switch or MCB, as specified.
- g) 3 pin Or 6 pin socket, ceiling rose or connector as required. (2 pin and 5 pin socket outlet shall not be permitted).
- h) Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.
- i) Bushed conduit or porcelain tubing where wiring cables pass through wall etc.

### **1.4.3 Measurement**

- a. Point Wiring (other than socket outlet points)
  - i. Unless and otherwise specified, there shall be no linear measurement for point wiring for light points, fan points, exhaust fan points and call bell points. These shall be measured on unit basis by counting, and classified as laid down in 1.4.4.

### **1.4.4 Classification:**

Points measured under 1.4.3 on unit basis shall be classified as under according to the type of building.

#### **a. Residential Buildings: -**

- i. Group 'A', for Point wiring for type I, type II and type III residential quarters and hostels.
- ii. Group 'B', for point wiring for type IV and above type of residential quarters and barracks.

#### **b. Nonresidential Buildings:**

Group 'C' for all type of non-residential buildings such as offices, hospital, laboratories, educational institutions, libraries etc.

#### **c. For any other type of Building: -**

The group under which the points are to be classified shall be decided by the concerned Chief Engineer (Elect.).

### **1.4.5 Point wiring for socket outlet points:**

- i. The light (6A) point and power (16A) point wiring shall be measured on linear basis, from the respective tapping point of live cable, namely, switch box,

another socket outlet point, or the sub distribution board as the case may be, up to the socket outlet.

- ii. The metal/PVC box with cover, switch/MCB, socket outlet and other accessories shall be measured and paid as a separate item.  
Note: There shall normally be no “on the Board” Light plug point.
- iii. The power point may be 16A/ 6 pin socket outlet, where so specified in the tender documents.

#### **1.4.6 Group Control point wiring:**

- i. In case of points with more than one point controlled by the same switch, such points shall be measured in parts i.e. (a) from the switch to the first point outlet as one point and classified according to 1.4.4, and (b) for the subsequent points, the distance from that outlet to the next one and so on, shall be treated as separate point (s) and classified according to 1.4.4.
- ii. No recovery shall be made for non-provision of more than one switch in such cases.

#### **1.4.7 Twin Controlled light point Wiring:**

- i. A light controlled by two numbers of two way switches shall be measured as two points from the fitting to the switches on either side and classified according to 1.4.4.
- ii. No recovery shall be made for non-provision of more than one ceiling rose or connector for connection to call bell in such cases.

## **2. Wiring System**

- i. Wiring shall be done only by the looping system. Phase/ live conductors shall be looped at the switch box. For point wiring, neutral wire/ earth wire looping for the 1<sup>st</sup> point shall be done in the switch box; and neutral/ earth looping of subsequent points will be made from point outlets.
- ii. In wiring, no joints in wiring will be permitted anywhere, except in switch box or point outlets, where jointing of wires will be allowed with use of suitable connector.
- iii. The wiring throughout the installation shall be such that there is no break in the neutral wire except in the form of linked switchgear.

- iv. Color coding:-

Following colour coding shall be followed in wiring:-

Phase : Red/Yellow/Blue. (Three phase wiring)  
Live : Red (single Phase Wiring)  
Neutral : Black  
Earth : Green.

- v. Termination of circuits into switch board:-

Circuit will consist of phase/ neutral/ earth wire. Circuit will terminate in a switch board (first tapping point, where from point wiring starts) in following manner:-

Phase wire terminated in phase connector.

Neutral wire terminated in neutral connector

Earth wire terminated in earth connector.

The switchboard will have phase neutral and earth terminal connector blocks to receive phase/ neutral/ earth wire.

### **3. Run of wiring:**

- i. The type of wiring shall be as specified in the tender documents namely, surface conduit/ recessed conduit, steel/ PVC, channel.
- ii. Surface wiring shall run as far as possible along the walls and ceiling, so as to be easily accessible for inspection.
- iii. Above false ceiling, in no case open wiring shall be allowed. Wiring will be done in recessed conduit or surface conduit.
- iv. In recessed conduit system, routes of conduit will be planned, so that various inspection boxes provided don't present a shabby look. Such boxes can be provided 5 mm above plaster level, and they can be covered with plaster of Paris with marking of junction boxes.
- v. Where number of electrical services like electrical wiring, telephone wiring, computer cabling, pass through corridors, it may be proper to plan such service with properly designed aluminium /PVC channels duly covered by a false ceiling, so that subsequently such services can be maintained and additional cables can be provided.
- vi. Generally, conduits for wiring will not be taken in floor slabs. When it is unavoidable special precaution to be taken to provide floor channels with provision for safety and maintenance. Alternatively, false flooring can be provided.

### **4. Passing through walls or floors:**

- i. When wiring cables are to pass through a wall, these shall be taken through a protection (steel/PVC) pipe or Porcelain tube of suitable size such that they pass through in a straight line without twist or cross in them on either side end of such holes. The ends of metallic pipe shall be neatly bushed with porcelain, PVC or other approved material.
- ii. All floor openings for carrying any wiring shall be suitably sealed after installation.

### **5. Joints in wiring:**

- i. No bare conductors in phase and/ or neutral or twisted joints in phase, neutral, and/or protective conductors in wiring shall be permitted.

- ii. There shall be no joints in the through-runs of cables. If the length of final circuit or submain is more than the length of a standard coil, thus necessitating a through joint, such joints shall be made by means of approved mechanical connectors in suitable junction boxes.
- iii. Termination of multi-stranded conductors shall be done using suitable crimping type thimbles.

## **6. Socket Outlets:**

- i. Socket outlets shall be 6A 3 pin, 16 A 3 pin or 16/6 A 6 pin. 5 pin socket outlets shall not be permitted.  
The third pin shall be connected to earth through protective (loop earthing) conductor, 2 pin or 5 pin sockets shall not be permitted to be used.
- ii. Conductors connecting electrical appliances with socket outlets shall be flexible type with an earthing conductor for connection to the earth terminal of plug and metallic body of the electrical appliance.
- iii. Sockets for the power outlets of rating above 1 KW shall be of industrial type with associated plug top and controlling MCB.
- iv. Where specified, Shutter type (interlocking type) of sockets shall be used.
- v. Every socket outlet shall be controlled by a switch or MCB, as specified. The control switch/MCB shall be connected on 'live' side of line.
- vi. 5A/6A and 15A/16A socket outlets shall be installed at the following positions, unless otherwise specified.
  - a. Non-residential Building- 23 cm above floor level.
  - b. Kitchen – 23 cm above working platform and away from the likely position of stove and sink.
  - c. Bathroom- No socket outlet is permitted for connecting a portable appliance thereo. MCB/IC switch may be provided above 2 m for fixed appliance, and at least 1 m away from shower.
  - d. Rooms in residences- 23 cm above floor level, or any other level in special cases as desired by the Engineer-in-charge.
- vii. Unless and otherwise specified, the control switches for the 6A and 16A socket outlet shall be kept along with the socket outlets.

## **7. Cables:**

- i. Copper conductor cable only will be used for submain/circuit/point wiring.
- ii. Minimum size of wiring:
 

Light Wiring	:	1.5 sq.mm.
Power Wiring	:	4.0 sq.mm.
Power circuit rated	:	More than 1 KW, Size as per calculation.
- iii. Insulation:  
Copper conductor cable shall be PVC insulated, Fire retardant, Low smoke (FRLS) type conforming to BIS Specification.
- iv. Multi stranded: Cables are permitted to be used.

## **8. Wiring Accessories:**

### **a. Control switches for point:**

- i. Control switches (single pole switch) carrying not more than 16A shall be modular type. The switch shall be 'on' when the knob is down.
- ii. Modular type switches of reputed make along with matching mounting boxes shall be used in non-residential building and residential quarters of all types. Modular type sockets, stepped type fan regulators shall be used. All such boxes, switches and accessories shall be of same make of modular switch manufacturer.
- iii. It is recommended to provide double pole MCB in proper enclosure as power out let for window type AC units, geysers etc.

### **b. Switch Box:**

- i. Switch box shall be hot dip galvanized, factory fabricated. Suitable in size for surface/ recess mounting and suitable in size for accommodating the required number of switches and accessories (where required to be used for application other than modular switches/ sockets).
- ii. Switch box also can be of non-metallic material. The technical sanctioning authority will approve specified makes of reputed quality and specifications.

### **c. Ceiling rose:**

- i. A ceiling rose shall not be used on a circuit, the voltage of which normally exceeds 250V.
- ii. Only one flexible cord shall be connected to a ceiling rose. Specially designed ceiling roses shall be used for multiple pendants.
- iii. A ceiling rose shall not embody fuse terminal as an integral part of it.

### **d. Lamp Holders:**

- i. Lamp holders may be batten, angle, and pendant or bracket holder type as required. The holder shall be made of brass and shall be rigid enough to maintain shape on application of a nominal external pressure. There should be sufficient threading for fixing the base to the lamp holder part so that they do not open out during attention to the lamp or shade.
- ii. Lamp holders for use on brackets and the like shall have not less than 1.3 cm nipple and all those for use with flexible pendant shall be provided with cord grips.
- iii. All lamp holders shall be provided with shade carriers.
- iv. Where center contact Edison Screw lamp holders are used, the outer or screw contact shall be connected to the 'middle wire', or the neutral conductor of the circuit.

### **e. Fittings:**

**Types:** The type of fittings shall be as specified in tender documents.

### **Indoor Type fittings:**

- i. Where conductors are required to be drawn through tube or channel leading to the fitting, the tube or channel must be free from sharp angles or projecting edge, and of such size as will enable them to be wired with the conductors used for the final circuit without removing the braiding or sheathing. As far as possible all such tubes or channels should be sufficient size to permit looping back.
- ii. Wires used within prewired fitting shall be flexible with PVC insulation and 14/0.193mm (minimum) copper conductors. The leads shall be terminated on built-in-terminal block, ceiling rose or connector, as required.
- iii. Fittings using discharge lamps shall be complete with power factor correction capacitors, either integrally or externally. An earth terminal with suitable marking shall be provided for each fitting for discharge lamps.
- iv. Fittings shall be installed such that the lamp is at height of 2.4m above floor level, unless otherwise directed by engineer –in-charge.
- v. Fittings made of CRCA shall be phosphatized and powder/ epoxy painted. For coastal areas and humid area like toilets, kitchen, for prolonging the life of such fittings, corrosion free materials like engineering plastic, aluminium, stainless steel etc. should be used.

### **Outdoor fittings:**

Outdoor fittings shall have suitable IP protection. It is preferable that street light fittings are of cast aluminium body of IP65, for reducing recurring maintenance cost and improved performance. Where required IP 66 fittings also can be provided for reducing maintenances frequency and cost.

Other fittings, which are not available with tested IP 65/54 protection can be properly fabricated with weatherproof feature, proper gasketing etc. As far as possible corrosion free material like cast aluminium, Stainless Steel, engineering plastics may be used for fabrication of such fittings, to prolong life such fittings there should not be any exposed wiring in such outdoor fittings.

## **9. Attachment of fittings and accessories:**

### **a. Conduit wiring system:**

- i. All accessories like switches, socket outlets, call bell push and regulators shall be fixed in flush pattern inside the switch/ regulator boxes. Accessories like ceiling roses, brackets, batten holders etc. shall be fixed on outlet boxes, if so directed by the engineer-in-charge.
- ii. aluminium alloy or cadmium plated iron screws shall be used to fix the accessories to their bases.
- iii. The switch box/ regulator box shall normally be mounted with their bottom 1.25m from floor level, unless otherwise directed by the Engineer-in-charge.

**b. Fixing to Walls and ceiling:**

- i. Wooden plugs for fixing to wall/ceiling will not be allowed. Fixing will be done with the help of PVC sleeves/Rowel plugs/ dash fasteners as required.
- ii. Drilling of holes shall be done by drilling machines only. No manual drilling of hole will be allowed.

**10. Fans, Regulators and Clamps:**

**a. Ceiling Fans(If required).**

- i. Ceiling fans including their suspension shall conform to relevant Indian Standards.
- ii. All ceiling fans shall be wired to ceiling roses or to special connector boxes, and suspended from hooks or shackles, with insulator between hooks and suspension rods. There shall be no joints in the suspension rod.
- iii. For wooden or steel joists and beams, the suspension shall consist of GI flat of size not less than 40 mm x 6 mm, secured on the sides of the joist or beams by means of two coach screw of size not less than 5 cm for each flat. Where there is space above the beam, a through- bolt of size not less than 1.5 cm dia, shall be placed above the beam from which the flats are suspended. In the Latter case, the flats shall be secured from movements by means of another bolt and nut at the bottom of the beam. A hook consisting of MS rod of size not less than 1.5 cm dia shall be inserted between the MS flat through oval holes on their sides. Alternatively, the flats may be bent in wards to hold tightly between them by means of a bolt and nut, a hook of 'S' form.
- iv. In case of 'I' beams, flats shall be shaped suitably to catch the flanges and shall be held together by means of long bolt and nut.
- v. For concrete roofs, a 12 mm dia. MS rod in the shape of 'U' with their vertical legs bent horizontally at top at least 19cm on either side, or bound to the top reinforcement of the roof shall be used.
- vi. In buildings with concrete roofs having a low ceiling height, where the fan clamp mentioned under sub clause (v) above cannot be used, or wherever specified, recessed type fan clamp inside metallic box, as shown in fig. 6 shall be used.
- vii. Canopies on top of suspension rod shall effectively hide the suspension.
- viii. The leading in wire shall be of nominal cross sectional area not less than 1.5 sq.mm. and shall be protected from abrasion.
- ix. Unless otherwise specified, all ceiling fans shall be hung 2.75m above the floor.
- x. In the case of measurement of extra down rod for ceiling fan including wiring, the same shall be measured in units of 10 cm. Any length less than 5 cm shall be ignored.
- xi. The wiring of extra down rod shall be paid as supplying and drawing cable in existing conduit.

**b. Exhaust Fans:**

- i. Exhaust fan shall conform to relevant Indian Standards.

- ii. Exhaust fan shall be erected at the places indicated by the engineer-in-charge. For fixing an exhaust fan, a circular opening shall be provided in the wall to suit the size of the frame, which shall be fixed by means of rag bolts embedded in the wall. The hole shall be neatly plastered to the original finish of the wall. The Exhaust fan shall be connected to the Exhaust fan point, which shall be wired as near to the opening as possible, by means of a flexible cord, care being taken to see that the blades rotate in the proper direction.
- iii. Exhaust fan for installation in corrosive atmosphere, shall be painted with special PVC paint or chlorinated rubber paint.
- iv. Installation of exhaust fans in kitchen, dark rooms and such other special location need careful consideration; any special provisions needed shall be specified.

**c. Regulators:**

The metallic body of regulators of ceiling fans/ exhaust fans shall be connected to earth by protective conductor.

**11. LT distribution switchgear:**

- i. Switch boards are to be located in common areas like corridors, lobby etc. and not to be located in locked room.
- ii. Switch board shall be located only in dry situation and in well-ventilated space. They shall not be placed in the vicinity of storage battery or exposed to chemical fume.
- iii. Switch boards shall not be erected above gas stove, or sinks or within 2.5 meter of any washing unit in washing rooms of laundering or in the bath rooms, toilet, or kitchen.
- iv. As far as possible main boards shall not be located in basement. Such main boards can be located in ground floor.
- v. It is preferable to locate floor main boards in rising main shafts of adequate size, with steel doors (having ventilation) or in suitable room.
- vi. Similarly DBs can be in suitable niches in corridor walls having doors.
- vii. Locating main boards under staircase or standing open in corridor is not a desirable practice, besides being highly unaesthetic.
- viii. The main Switch board, which receives power to the building, should be invariably located in a switch room, having round the clock access, for emergency attendance to switchboard.

**TABLE I**

**Maximum number of PVC insulated 650/1100V grade aluminium/ copper Conductor cable conforming to IS: 694-1990.**

Nominal cross sectional area of conductor in sq.mm	20 mm		25 mm		32 mm		38 mm		51 mm		64 mm	
	S	B	S	B	S	B	S	B	S	B	S	B

1.50	5	4	10	8	18	12	-	-	-	-	-	-
2.50	5	3	8	6	12	10	-	-	-	-	-	-
4	3	2	6	5	10	8	-	-	-	-	-	-
6	2	-	5	4	8	7	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	6	5	10	7	12	8
25	-	-	-	-	3	2	5	3	8	6	9	7
35	-	-	-	-	-	-	3	2	6	5	8	6
50	-	-	-	-	-	-	-	-	5	3	6	5
70	-	-	-	-	-	-	-	-	4	3	5	4

**Note:**

- 1) The above table shows the maximum capacity of conduits for a simultaneous drawing in cables.
- 2) The columns headed 'S' apply to runs of conduit which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed 'B' apply to runs of conduit, which deflect from the straight by an angle of more than 15 degrees.
- 3) Conduit sizes are the nominal external diameters.

## **NON-METALLIC CONDUIT WIRING SYSTEM**

### **1.1 SCOPE**

This chapter covers the detailed requirements for wiring work in non-metallic conduits. This chapter covers both surface and recess types of wiring work.

### **2.1 APPLICATION**

2.1.1 Recessed conduit work is generally suitable for all application. Surface conduit work may be adopted in places like workshops etc. and where recessed work may not be possible to be done. The type of work shall be as specified in individual works.

2.1.2 Flexible non-metallic conduits shall be used only at terminations, wherever specified.

#### **2.1.3 Special precautions**

- i. If the pipes are liable to mechanical damages, they should be adequately protected.
- ii. Non- Metallic conduit shall not be used for following application:-

- a. In concealed/ inaccessible places of combustible construction where ambient temperature exceeds 60 degrees C.
- b. In places where ambient temperature is less than 5 degrees C.
- c. For suspension of fluorescent fittings and other fixtures.
- d. In areas exposed to sunlight.

## **2.2 MATERIALS**

### **2.2.1 Conduits**

- i. All non-metallic conduit pipes and accessories shall be of suitable material complying with IS: 2509-1973 and IS: 3419- 1989 for rigid conduits and IS: 9537 (Part 5) 2000 for flexible conduits. The interior of the conduit shall be free from obstructions. The rigid conduit pipes shall be ISI marked.
- ii. The conduits shall be circular in cross- section. The conduits shall be designated by their nominal outside diameter. The dimensional details of rigid non- metallic conduit are given in Table III
- iii. No non-metallic conduit less than 20 mm in diameter shall be used
- iv. Wiring capacity:  
The maximum number of PVC insulated aluminium/ copper conductor cable of 650/1100 V grade conforming to IS: 694- 1990 that can be drawn in one conduit of various sizes is given in Table- I. Conduit size shall be selected accordingly.

### **2.2.2 Conduit accessories**

- i. The conduit wiring system shall be complete in all respect including accessories.
- ii. Rigid conduit accessories shall be normally of grip type
- iii. Flexible conduit accessories shall be of threaded type.
- iv. Bends, couplers etc. shall be solid type in recess type of works, and may be solid or inspection type as required, in surface type of works.
- v. Saddles for fixing conduits shall be heavy gauge non-metallic type with base.
- vi. The minimum width and the thickness of the ordinary clips or girder clips shall be as per Table IV.
- vii. For all sizes of conduit, the size of clamping rod shall be 4.5 mm (7 SWG) diameter.

### **2.2.3 Outlets**

- i. The Switch box shall be made of either rigid PVC molding, or Mild Steel, or cast Iron on all sides except at the front. The regulator boxes shall however be made only of mild steel or cast iron
- ii. PVC boxes shall comply with the requirements laid down in IS: 14772- 2000. These boxes shall be free from burrs, fins and internal roughness. The thickness of the walls and base of PVC boxes shall not be less than 2 mm. The clear depth of PVC boxes shall not be less than 60 m.

## **2.3 INSTALLATION**

### 2.3.1 Common aspect for both recessed and surface conduit works.

- i. The erection of conduits of each circuit shall be complete before the cables are drawn in.
- ii. Conduit joints
  - a. All joints shall be sealed/ cemented with approved cement. Damage conduit pipes/ fittings shall not be used in the work. Cut ends of conduit pipes shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductors while pulling them through such pipes.
  - b. The engineer- in- charge, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc. after they have been prepared shall be submitted for inspection before being fixed.
- iii. Bends in conduit
  - a. All bends in the system may be formed either by bending the pipes by an approved method of heating, or by inserting suitable accessories such as bends, elbows or similar fittings, or by fixing non-metallic inspection boxes, whichever is most suitable. Where necessary, solid type fittings shall be used.
  - b. Radius of bends in conduit pipes shall not be less than 7.5 cm. no length of conduit shall have more than the equivalent of four quarter bends from outlet to outlet.
  - c. Care shall be taken while bending the pipes to ensure that the conduit pipe is not injured, and that the internal diameter is not effectively reduced.
- iv. Outlets

All switches, plugs, fan regulator etc. shall be fitted in flush Patten. The fan regulators can be mounted on the switch box covers, if so stipulated in the tender specifications, or if so directed by engineer-in-charge.

### 2.3.2 Additional requirements for recessed conduit work.

- i. Making chase.
- ii. Fixing conduit in chase
  - a. The conduit pipe shall be fixed by means of staples, or by means of non-metallic saddles, placed at not more than 60 cm apart, or shall be fixed by any other approved means of fixing.
  - b. At either side of bends, saddles/staples shall be fixed at distance of 15 cm from the center of the bends.
- iii. Erection in RCC work
- iv. Fixing inspection boxes.
- v. Fixing Switch boxes and accessories.
- vi. Fish wire.

vii. Bunching of cables.

For ease of maintenance, cable carrying direct current or alternating current shall always be bunched so that the outgoing and return cables are drawn in same conduit.

### 3.0 Earthing Requirements

- i. A protective (earth) conductor shall be drawn inside the conduit in all distribution circuits to provide for earthing of non-current carrying metallic parts of the installation. These shall be terminated on the earth terminal in the switch boxes, and / or earth terminal blocks at the DB's.
- ii. Gas or water pipe shall not be used as protective conductors (earth Medium)

**TABLE- II**  
**Dimensional details of rigid non-metallic conduit**

(All dimensions in mm)

Sr. No.	Nominal outside diameter (in mm)	Maximum outside diameter (in mm)	Minimum Inside diameter (in mm)	Maximum permissible eccentricity (in mm)	Maximum permissible ovality (in mm)
1	20	20 <sup>+0.3</sup>	17.2	0.2	0.5
2	25	25 <sup>+0.3</sup>	21.6	0.2	0.5
3	32	32 <sup>+0.3</sup>	28.2	0.2	0.5
4	40	40 <sup>+0.3</sup>	35.8	0.2	0.5
5	50	50 <sup>+0.3</sup>	45.0	0.4	0.6

**TABLE- III**  
**Ordinary clips or girder clips**

Size of Conduit	Width	Thickness
1) 20mm & 25mm	19 mm	20 SWG (0.9144 mm)
2) 32mm & Above	25 mm	18 (1.219 mm) WG

**TABLE IV**

Nominal Cross	10/15 mm x 10	20/15 mm x 10	25/15 mm x 16	32 mm x 16 mm	40 mm x 25 mm	40 mm x 40 mm
---------------	---------------	---------------	---------------	---------------	---------------	---------------

<i>sectional area</i>	<i>mm</i>	<i>mm</i>	<i>mm</i>			
1.5	3	5	6	8	12	18
2.5	2	4	5	6	9	15
4	2	3	4	5	8	12
6		2	3	4	6	9
10		1	2	3	5	8
16			1	2	4	6
25				1	3	5
35					2	4
50					1	3
70					1	2

Maximum number of PVC insulated 650/1100 Volt grade aluminium/  
Copper conductor cable conforming to IS: 694-1990

#### **4.0 M.V. PANEL & D.B**

**Scope:** This covers supply/ erection/ testing and commissioning of the equipment suitable for 415 V, 3 phase, 50 Hz 4 wire system.

- i. For each equipment required IP rating and short circuit rating capacity will be specified. Governing BIS also will be specified.
- ii. All the equipment will be factory fabricated in an approved factory having modern fabrication and testing process. It shall have seven tank pretreatment process comprising of degreasing, rinsing, de-rusting, rinsing, phosphatizing, rinsing and passivation followed by power coat painting having a paint thickness of 60 microns or as specified. The powder paint will be subjected to oven-heated process. All panels will be provided with suitable gasket to make it dust/ vermin proof.

#### **4.1 SPECIFICATION OF LT CUBICAL PANEL:**

- i. Cubical panel shall be floor mounted (on a base frame) totally enclosed and extensible type. The general construction shall conform to IS: 8623/93. The design shall include all provision for safety of operation and maintenance personnel. Degree of IP protection shall be IP-42 for indoor type application and IP-54 for outdoors, unless otherwise specified in drawing IP-55 or IP 63.
- ii. The panel shall be compartmentalized type having space and arrangement for incoming cable/bus ducting, incoming switchgear/ switchgears, bus coupler, insulated and properly supported compartmentalized bus bar, outgoing compartmentalized switchgear, bus bar supports, joint shrouds, cable alleys of suitable size for cabling routing, support and terminations, interconnection between bus bars and switch gear with auxiliary bus bars/ insulated conductors/ strips etc. Also the panel will be provided with necessary instrumentation like CTs, PTs,

Ammeters, Voltmeters, Phase indicating lamps, other required instruments, wiring, fuses etc.

- iii. It shall be fabricated out of CRCA not less than 2.0 mm thick or as per specification given in panel detail for load bearing members and 1.6 mm for doors of LT panels. The frame work may be Angle Iron/ Channel/ Bolted type construction. General constructions shall employ the principle of compartmentalization and segregation of each circuit. Unless otherwise approved, incomer and bus section panels shall be separate and independent and shall not be mixed with sections required for feeders. Each section of the rear accessible type board shall have hinged access door at the rear. Operating handle of the highest unit shall be at a height not more than 1.7 mts. Overall height of the board shall not exceed 2.3 meter.

**iv. Arrangement for incoming/outgoing cable termination:**

Cable entries shall be provided either from the rear or from the front through cable alleys of suitable size. Removable gland plate to be provided for each cable entry. Cable support arrangement to be provided inside cable alley so that cables are neatly arranged and fixed. From each outgoing switch, insulated strip/ conductor of suitable size to be provide up to suitable terminal block, which will receive incoming and outgoing cable termination. It is desirable that cables are not terminated directly to switch gear, but terminated through proper terminal blocks.

**v. Specification of cable terminal block:**

Terminal block of reputed make shall be used. The housing material shall be polyamide having unbreakable and fire-retardant characteristic. All the metal parts shall be made up of copper alloy including the screws. Mounting shall be 'Din' or 'G-rail' type. Screws shall be self captive type. No protection cover is required, and the block should be touch proof.

**vi. Bus bar/ Supports/ Clearances:**

The bus bar system may comprise of a system of main/ auxiliary bus bars run in bus bar alleys.

a) Rating:

Bus bars shall be made of wrought aluminium or aluminium, alloy, or electric grade copper, conforming to relevant Indian Standard, as specified. The ratings of the bus bar shall be 100A, 200A, 300A, 400A, 500A, 600A, or 800A as specified.

b) Current density:

Bus bar shall be of sufficient cross-section so that a current density of 130A/sq.cm (800A/sq. inch) is not exceeded at nominal current rating for aluminium bus bars, and 160A/sq.cm (1000A/sq. inch) for copper bus bars. The minimum sizes of sections of bus bar are given in table VI.

c) Cross Section of bus bar:

The cross section of the neutral bus bar shall be the same as that of the phase bus bar for bus bars of capacities up to 200A; for higher capacities, the neutral bus bar must not be less than half the cross section of that of the phase bus bar.

- d) **Insulation:**  
Each bus bar shall be suitably insulated with PVC sleeves/ tapes.

The insulation of the rising mains shall be capable of withstanding the voltage of 660V of A.C.

- e) **Bus bar Supports**  
Bus bar support insulators shall be class F insulators made of non- hygroscopic, non-combustible, track resistant and high strength FRP/SMC/DMC material, and shall be of suitable size and spacing to withstand the dynamic stresses due to short circuit currents. The spacing between two insulators should not exceed 250 mm.

- f) **Bus bar Clearances:**

- I. The Minimum clearance to be maintained for enclosed indoor air insulated bus bars for medium voltage application shall be as follows:

Between	Min. Clearances
Phase to earth	26 mm
Phase to phase	32 mm

Note: for strip connection from bus bars to switch gear, the above clearances don't apply.

- II.
- a. Bus bar joints shall be thoroughly cleaned and suitable oxidizing grease shall be applied before making the joint.
  - b. High tensile bolts, plain and spring washers shall be provided to ensure good contact at the joints.
  - c. The overlap of the bus bars at the joints shall be not less than the area of cross section of the bus bars.

- g) **Bus Bar Marking:**  
Bus bars and main connections shall be marked by colour or letter as per table VII & selection of bus bar as per electrical standards.

**vii. Earthing:**

2 Nos. 20x3 mm copper strip for LT panel up to 400 Amp. Capacity or 2 Nos. 20x5 mm copper strip for LT panel of higher capacity shall be fixed all around the panel connected to 2 Nos. earth bus copper strips connected to incoming earth conductors.

**viii. Commissioning:**

After erection, LT panel will be commissioned after:

- a) Tightening of all the nuts and bolts.
- b) Closing any left out holes to ensure the entire panel is insect proof.
- c) Megger testing.
- d) Earth testing.

#### **4.1.1 SPECIFICATION OF PREWIRED DB**

As a general practice only prewired MCB/HRC type DBs shall be used, on account of their superior technical features, compared to conventional DBs, which don't allow for proper wiring space and wiring termination. Rewirable fuse type DBs shall not be used.

Prewired DBs shall have following feature:

- i. Recess/ Surface type with integral loose wire box.
- ii. Phase/ neutral/ earth terminal blocks for termination of incoming & outgoing wires.
- iii. Din channel for mounting MCB's
- iv. Arrangement for mounting incomer MCB/ RCCB/ RCBO/ MCCB as required.
- v. Copper Bus bar.
- vi. Earthing terminals.
- vii. Wiring from MCB's to phase terminal block.
- viii. Interconnection between terminal block/ incoming switches/ bus bar/ neutral terminal block/ earth terminal connector with specified size of FRLS pre insulated copper conductor cable duly fitted with copper lugs/ thimbles.
- ix. Terminal blocks should be suitable for termination of conductor/ cable of required size but minimum rated cross section of the terminal blocks should be 6 sq mm.
- x. Terminal block shall be made of flame retardant polyimide material.
- xi. Colored terminal block and FRLS wires for easy identification of RYB Phases, Neutral and Earth.
- xii. Prewired DB shall be provided with a detachable cassette for safe removal of MCBs, RCCBs. Terminal connectors from the DB without loosening the internal cable connections of phase and neutral circuits. (This is an optional feature).
- xiii. The prewired DB shall have peel able poly layer on the cover for protection from cement, plaster, paints etc during the construction period.
- xiv. Detachable plate with Knock out holes shall be provided at the top/bottom of board. Complete board shall be factory fabricated and pre-wired in factory ready for installation at site. The box and cover shall be fabricated from 1.6 mm sheet steel, properly pretreated, phosphotized with powder coated finish.
- xv. Where specified it shall be of double door construction provided with hinged cover in the front.

**Note: Prewired DB will be factory manufactured by reputed manufacturer of MCB DBs.**

**TABLE V****Aluminium/ copper bus bar sections**

Current ratings in amps. Upto	Recommended rectangular cross-section			
	Aluminium		Copper	
	No. of strips/ phase	Size in mm	No. of strips/ phase	Size in mm
100	1	20x5	1	20x3
200	1	30x5	1	25x5
300	1	50x5	1	40x5
400	1	50x6	1	50x5
500	1	75x6	1	60x5
600	1	80x6	-	-
800	1	100x6	-	-
1000	1	100x10	-	-
1200	1	125x10	-	-
1600	2	100x10	-	-
2000	2	125x10	-	-
2500	3	125x10	-	-

**Note:**

- (i) In larger bus bar of sizes above 1000 amps, the sections can be accepted in other rectangular cross-sections and numbers also, provided the total cross-sectional area offered is not less than the total cross-sectional area shown in the above table against the respective bus bar rating.
- (ii) With aluminium bus bars, only Aluminium wire/ solid bar connections shall be made for incoming/ outgoing mountings on the switchboards.
- (iii) With copper bus bars, only copper wire/ solid bar connections shall be made for incoming/ outgoing mountings on the switchboards.

**5. CABLES**

- a) Standards: - Cables shall conform to the following standards except where specifically stated otherwise.
  - - IS : 1554
  - - IS : 692
  - - IS : 7098
  - - IS : 502

- b) The cables shall be of any company which is from approved list attached with the Tender. If there is any doubt about the authenticity of the cables supplied, the Engineer in Charge will send a sample of the cable to a Government approved laboratory for testing and all expenses incurred for this purpose will have to be borne by the contractor. The Engineer in Charge may also send for verification a sample of the cable along with the test certificates and excise duty gate passes, to the Company claimed to have manufactured the cable.
- c) The cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant standard specifications and cable manufacturer's instructions.
- d) The MV cables shall be PVC insulated aluminium or copper conductor armoured cable of 1100 volts grade and as specified.  
The HV cables shall be PVC insulated aluminium conductor armoured cable of 11000 volts grade cross linked polyethelene (TROPOPHEN) with shielding and as specified.  
The telephone cables shall be PVC insulated, copper conductor armoured jelly filled and conforming to P&T Specification ITD S/WT129D.
- e) All cables shall be inspected upon receipt at site and checked for any damage during transit. The contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoidance of cable jointing. This apportioning shall be got approved by Engineer in Charge before the cables are cut to lengths.
- f) Where joints are unavoidable the location of such joints shall be got approved.
- g) Cable straight joints shall be heat shrinkable type and used only to join the cables where the manufacturer's delivery lengths of cables is less than the required length and where existing cables are to be extended as directed. Individual connectors shall be insulated by shrinkable types providing high level of Insulation eliminating the need to stagger the cores. Galvanized steel casing shall be provided for protection against mechanical damages. Sleeves shall be provided for abrasion resistance, corrosion protection and water tightness.

### **LAYING OF CABLES:**

a) Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable . great care shall be exercised in laying cables to avoid forming kinks. The relative position of the cables laid on the cable tray shall be preserved and the cables shall not cross each other at all changes in direction in horizontal and vertical planes. The cable shall be bent smooth with a radius of bend not less than 12 times the diameter of cable. Distinguishing markers shall be fixed on the cable on every floor and at ends in red, yellow and blue colours shall be wrapped just below for identification insulating tapes of appropriate voltage and the sockets for phase identification.

b) The minimum width of trench for laying single cable shall be 35 cm.

Where more than one cable is to be laid in the same trench in horizontal formation, the width of trench shall be increased such that the inter-axial spacing between the cable, except where otherwise specified shall be at least 20 Cm. There shall be clearance of at least 15 Cm between axis of cables laid in single tier formation. The total depth of trench shall not be less than 75 Cm for cables upto 1.1 KV. and not less than 110 Cm for HV cables. When more than one tier of cables in unavoidable and vertical formation of laying is adopted, depth of cables above shall be increased by 30 Cm. for each additional tier to be formed.

c) The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided. Where gradients and changes in depth are unavoidable these shall be gradual. Excavation should be done by any suitable means manual or mechanical. The excavated soil should be stacked firmly by the side of the trench such that it may not fall back into the trench. The bottom of the trench shall be level and free from stones brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 8 Cm in depth. At the time of issue of cables for laying, the cores shall be tested for continuity and insulation resistance. The cable drum be properly mounted on jacks or on a cable wheel at a suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum without failure and that the spindle is horizontal in the bearings so as to prevent the drum creeping to one side while rotating. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire cable length shall as far as possible be paved off in one stretch. However, where this is not possible, the remainder of the cable may be removed by "Flaking" i.e. by making one long loop in the reverse direction. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted slightly over the rollers beginning from one end by helpers standing about 10 metres apart and drawn straight. The cable should then be taken off the rollers by additional helpers lifting the cable and then laid in a reasonably straight line. Cable laid in trenches in a single tier formation shall have a covering of clean, dry sand of not less than 17 Cm. above the base cushion of sand before the protective cover is laid. In case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 30 Cm. shall be provided over the initial bed before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have second cushion of 30 Cm. as stated above. Unless otherwise specified, the cables shall be protected by second class bricks of not less than 20 Cm X 10 Cm (nominal size) as per CPWD building specification protection covers placed on top of the sand (bricks to be laid breadthwise) for the full length of the cable.

d) The trenches shall be back-filled with excavated earth free from stones or other sharp edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 30 Cm. Unless otherwise specified a crown of earth not less than 50 Cm in the centre and tapering towards the sides of the trench shall be left to allow for subsidence.

e) Cables inside buildings shall be laid on the cable trays, or in cable trenches or in pipes. Distinguishing markers shall be fixed on every floor. All

cables passing through wall shall run through asbestos cement pipes of adequate diameter or as directed. Parallel cables shall be spaced at least 50 Cm apart maintaining their relative position over the entire length.

f) Engraved PVC labels showing the cable destination/ start shall be affixed to the cables wherever there is change in angle of laying, type of laying , entrance and exit from building etc

### **Tests**

- All routine tests are to be carried out as stipulated in IS. Manufacturer's test certificate and excise duty gate pass must be furnished, without which the cables will not be accepted.
- The method of Measurement for cables shall be the actual measured lengths of cables laid and shall include all the necessary work such as removing the precast rcc slab, placing back the precast rcc slabs, removing and placing back the chequered plate etc

### **CABLE TRAYS, STEEL WORK, CHEQUERED PLATE, PANEL SUPPORTS ETC**

- a) The steel used shall conform to IS: 226 (latest edition). The steel should be free scale, blisters, laminations, cracked edges and defects of any sort. All steel shall be checked carefully for its straightness and any bend noticed should be removed by pressure and not by hammering. Necessary test certificates shall be furnished to Engineer in Charge if requested.
- b) The cutting of steel sections shall be by punching, shearing machine. The plates may be cut by oxy-acetylene flame and cut edge shall be properly finished smooth by file. The ends of the structural/other members shall be sawn or cropped to length and whenever directed shall be chipped off. The holes in plates, angles etc. shall be drilled and not punched or gas cut.

## **6. EARTHING**

### **SCOPE**

This chapter covers the essential requirements of earthing system components and their installation. For details not covered in these specifications IS code of practice on earthing (IS: 3043-1987) shall be referred to.

### **6.1 APPLICATION**

- (i) The electrical distribution system in the Department is with earthed neutral (i.e. neutral earthed at the transformer/ generator end). In addition to the neutral earthing, provision is made for earthing the metallic body of equipment's and non-current carrying metallic components in the sub-station, as well as in the internal/ external electrical installations.
- (ii) Earthing system is also required for lightning protection, computer installations and hospital operation theaters, etc. for functional reasons.

- (iii) Earthing requirements are laid down in Indian Electricity Rules, 1956, as amended from time to time, and in the regulations of the Electricity Supply Authority concerned. These shall be complied with.
- (iv) Application for Internal Earth insulation.
  - a) Every sub-main will have earth continuity conductor to run along with sub-main wiring. In case of 3- phase submain wiring two earth continuity conductors shall be provided.
  - b) Every circuit will have its earth continuity conductor to run along with circuit wiring. In case of 3- phase circuit two earth continuity conductors shall be provided.
  - c) Looping of earth is allowed only in case of point wiring.
  - d) When 2/3 power outlets are looped to one circuit, earth looping of these outlet is permissible.

## **6.2 TYPES OF ELECTRODES & MATERIAL**

### 6.2.1 Earth Electrodes

#### 6.2.1.1 Types

The type of earth electrode shall be any of the following, as specified.

- a) Pipe Earth Electrode.
- b) Plate earth electrode.
- c) Strip or conductor earth electrode.

#### 6.2.1.2 Electrode materials and dimensions.

- (i) The Materials and minimum sizes of earth electrodes shall be as per Table IX.
- (ii) GI pipe electrodes shall be cut tapered at the bottom, and provided with holes of 12 mm dia, drilled not less than 7.5 cm from each other up to 2 m of length from the bottom.
- (iii) The length of the buried strip or conductor earth electrode shall be not less than 15 m. This length shall suitably be increased if necessary, on the basis of the information available about soil resistance, so that the required earth resistance is obtained. Prior approval of the engineer-in charge shall be taken for any such increase in length.
- (iv) All hardware items used for connecting the earthing conductor with the electrodes shall be of GI in the case of GI pipe and GI plate earth electrodes, forged tinned brass in case of copper plate electrodes.

### 6.2.2 Earthing Conductor & sizes

- (i) The earthing conductor (protective conductor from earth electrode up to the main earthing terminal/ earth bus, as the case may be) shall be of the same material as the electrode, viz. GI or copper, and in the form of wire or strip as specified.
- (ii) The sizes of earthing conductor shall be specified, but this shall not be less than the following
  - a) 4mm dia. (8 SWG) copper wire.
  - b) 25mm x 4mm in the case of GI strip, or,
  - c) 20mm x 3mm in the case of copper strip.

6.2.3 Earthing continuity/ loop earthing conductor & sizes

- (i) The material and size of protective conductors shall be as specified Below

Size of Phase Conductor	Size of protective conductor of the same material as phase conductor
Up to 4 sq.mm.	4 sq.mm.
Above 4 sq.mm. up to 16 sq.mm. conductor	Same size as phase
Above 16 sq.mm. up to 35 sq.mm.	16 sq.mm.
Above 35 sq.mm.	Half of the phase conductor

**6.3 LOCATION FOR EARTH ELECTRODES**

- (i) Normally an earth electrode shall not be located closer than 1.5 m from any building. Care shall be taken to see that the excavation for earth electrode does not affect the foundation of the building; in such cases, electrodes may be located further away from the building, with the prior approval of the Engineer-in-Charge.
- (ii) The location of the earth electrode will be such that the soil has a reasonable chance of remaining moist as far as possible. Entrances, Pavements and roadways, should be avoided for locating earth electrodes.

**6.4 INSTALLATION**

- Electrodes

#### 6.4.1.1 Various types of electrodes

- a) Pipe electrode shall be buried in the ground vertically with its top at not less than 20 cm below the ground level. The installation shall be carried out as shown in fig. 11.
- b) In locations where the full length of pipe electrode is not possible to be installed due to meeting a water table, hard soil or rock, the electrode may be to reduce length, provided the required earth resistance result is achieved with or without additional electrodes, or any alternative method of earthing may be adopted, with the prior approval of the engineer-in-charge. Pipe electrodes may also be installed in horizontal formation in such exception cases.
  - (i) Plate electrode shall be buried in ground with its faces vertical, and its top not less than 1.5 m below the ground level. The installation shall be carried out as shown in Fig. 12.
  - (ii) When more than one electrode(Plate/Pipe) is to be installed, a separation of not less than 2 m shall be maintained between two adjacent electrodes
- c)The strip or conductor electrode shall be buried in trench not less than 0.5 m deep.
  - d) If conditions necessitate the use of more than one strip or conductor electrode, they shall be laid as widely distributed as possible, in a single straight trench where feasible, or preferably in a number of trenches radiating from one point.
  - e) If the electrode cannot be laid in a straight length, it may be laid in a zigzag manner with deviation up to 45 degrees from the axis of the strip. It can also be laid in the form of an arc with curvature more than 1 m or a Polygon.

#### 6.4.1.2 Artificial treatment of soil

When artificial treatment of soil is to be restored to, the same shall be specified in the schedule of work. The electrode shall be surrounded by charcoal/ coke and salts as indicated in Fig. 11 and 12. In such cases, excavation for earth electrode shall be increased as per the dimensions indicated in these figures.

#### 6.4.1.3 Watering arrangement

In the case of plate earth electrodes, a watering pipe 20 mm dia. Medium class pipes shall be provided and attached to the electrodes as shown in Fig. 9 and 10. A funnel with mesh shall be provided on the top of this pipe for watering the earth.

- (i) In the case of pipe electrodes, a 40 mm x 20 mm reducer shall be used for fixing the funnel with mesh.
- (ii) The watering funnel attachment shall be housed in a masonry enclosure of size not less than 30 cm x 30 cm x 30 cm.

- (iii) A cast iron/ MS frame with MS cover, 6mm thick, and having locking arrangement shall be suitably embedded in the masonry enclosure.
- Earthing conductor (Main earthing lead)
  - (i). In the case of pipe earth electrode, the earthing conductor shall be securely terminated on to the plate with two bolts, nuts, check nuts and washers.
  - (ii). In the case of pipe earth electrode, wire type earthing conductor shall be secured as indicated in fig.11 using a through bolt, nuts and washers and terminating socket.
  - (iii). A double C-clamp arrangement shall be provided for terminating tape type earthing conductor with GI watering pipe coupled to the pipe earth electrode. Galvanized "C" Shaped strips, bolts, washers, nuts and check nuts of adequate size shall be used for the purpose.
  - (iv). The earthing conductor from the electrode up to the building shall protected from mechanical injury by medium class, 15mm dia. GI pipe in the case of wire, and by 40 mm diameter, medium class GI pipe in the case of strip. The protection pipe in ground shall be buried at least 30 cm deep (to be increased to 60 cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth in due co-ordination with the building work.
  - (v). The earthing conductor shall be securely connected at the other end to the earth stud/ earth bar provided on the switch board by:
    - a) Soldered or preferably crimped lug, bolt, nut and washer in the case of wire, and
    - b) Bolt, nut and washer in case of strip conductor.

In the case of substations or alternators, the terminal shall be made on the earthing terminal of the neutral point on the equipment and/ or the earth bus, as the case may be.

- Loop Earthing/ Earth continuity conductor
  - (i). Earth terminal of every switch board in the distribution system shall be bonded to the earth bar/ terminal of the upstream switch board by protective conductor(s)
  - (ii). Two protective conductors shall be provided for a switchboard carrying a 3-phase switchgear thereon.
  - (iii). Looping earthing of individual units will not be however necessary in the case of cubical type switchboards.
  - (iv). The earth connector in every distribution board (DB) shall be securely connected to the earth stud/ earth bar of the corresponding switch board by a protective conductor.

- (v). The earth pin of socket outlets as well as metallic body of fan regulators shall be connected to earth stud in switch boxes by protective conductor. Where the switch boxes are of non-metallic type, these shall be looped at the socket earth terminals, or at an independent screwed connector inside the switch box. Twisted earth connections shall not be accepted in any case.

## **6.5 EARTH RESISTANCE**

- (i). The earth resistance at each electrode shall be measured. No earth electrode shall have a greater ohmic resistance than 5 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be up to 8 ohms.
- (ii). Where the above stated earth resistance is not achieved, necessary improvement shall be made by additional provisions, such as additional electrode(s), different type of electrode, or artificial chemical treatment of soil etc., as may be directed by engineer-in-charge.

## **6.6 MARKING**

- (i). Earth bars/ terminals at all switch boards shall be marked permanently, either as “E” or as
- (ii). Main earthing terminal shall be marked “SAFETY EARTH – DO NOT DISCONNECT”

## **6.7 USE OF RESIDUAL CURRENT DEVICES (RCDs)**

An extract on selection and application of RCDs (also known as RCCBs) from IS: 12640- 1988 is given at Appendix G. Provision of RCD shall be specified individual cases keeping in view the type, use, importance, system of earthing and nature of electric installations to be protected by the RCCBs, requirements of the local electric supply company, etc. The sensitivity shall be 30mA, 100mA, 300mA, or 500mA, as specified.

**TABLE VI**

### **Materials and sizes of earth electrodes**

<b>Type of Electrode</b>	<b>Material</b>	<b>Size</b>
Pipe	GI medium class	40mm dia 3.45 m long (Without any joint)
Plate	(i). GI (ii). Copper	60 cm x 60 cm x 6 mm thick 60 cm x 60 cm x 3 mm thick
Strip	(i). GI (ii). Copper	100 sq.mm section 40 sq.mm section

	(iii).	
Conductor	<ul style="list-style-type: none"><li>• Copper</li></ul>	<b>1</b> mm dia (8 SWG) <b>2</b>

Note: Galvanization of GI items shall conform to Class IV of IS: 4736-1986.

## **SPECIFICATION FOR** **82.5 KVA DG SET**

### **FOR DG SETS WORKS:**

These general specifications cover the equipment and materials for the DG sets, their testing and / or inspection as may be necessary before their dispatch from their respective works, their delivery at site all preparatory works, assembling, installation and adjustments, commissioning, final testing, putting into operation and handing over of the complete system.

#### **1.1 EXTENT OF WORK:**

The work shall comprise and include of entire labour including supervision and all materials necessary to make a complete installation and such tests the department may require adjustments and commissioning etc. The term complete installation shall not only mean major items of the plant and equipments covered by specifications but all incidental sundry components necessary for complete execution and satisfactory performance of installation with all layout charts whether or not those have been mentioned in details in the tender document in connection with this contract. Minor building works necessary for installation of equipment, foundation, making of opening in walls or in floors and restoring to their original condition, finish and necessary grouting etc. as required shall be done by the contractor at his own cost and nothing extra will be paid on this account.

**The contractor has to carry out routine & preventive maintenance for 12 months from the date of handing over of the equipment** (Consumable such as filters etc. shall be provided by the Department). **Nothing extra shall be paid on this account.**

The work is turnkey project. Any item required for completion of the project but inadvertently left out shall be executed with-in the quoted rates.

#### **1.2 INSPECTION AND TESTING:**

Copies of all documents of routine and type test certificates of the equipment, carried out at the manufacturers premises shall be furnished to the Engineer-in-Charge and consignee. After completion of the work in all respect the contractor shall offer the installation for testing and operation. Installation & Testing will be carried out in accordance with CPWD specifications.

### **1.3 COMPLIANCE WITH REGULATIONS AND INDIAN STANDARDS:**

All works shall be carried out in accordance with relevant regulation, both statutory and those specified by the Indian Standards related to the works covered by this specification. In particular, the equipment and installation will comply with the following:

- a) Factories Act.
- b) Indian Electricity Rules.
- c) I.S. & BS Standards as applicable.
- d) Workmen's compensation Act.
- e) Statutory norms prescribed by local bodies.
- f) CPWD relevant laws.

Nothing in this specification shall be construed to relieve the successful tenderer of his responsibility

For the design, manufacture and installation of the equipment with all accessories in accordance with currently applicable statutory regulations and safety codes. Successful tenderer shall arrange for compliance with statutory provisions of safety regulations and departmental requirements of safety codes in respect of labour employed on the work by the tenderer, Failure to provide such safety requirement will be at liberty to make arrangement for the safety requirements at the cost of tenderer and recover the cost thereof from him.

### **1.4 INDEMNITY: N.A**

### **1.5 ERECTION TOOLS**

No Tools and tackles either for unloading or for shifting the equipments for erection purposes would be made available by the department. The successful tenderer shall make his own arrangement for all these facilities. No extra payment shall be made on account of arranging tools & Plants by the tenderer for carrying out the work at site.

### **1.6 COOPERATION WITH OTHER AGENCIES**

The successful tenderer shall co-ordinate with other Contractors/ Agencies engaged in the construction of building, if any, and exchange freely all technical information so as to make the execution of this works contract smooth. No remuneration should be claimed

from the department for such technical cooperation. If any unreasonable hindrance is caused to other Agencies and any completed portion of the work has to be dismantled and re-done for want of cooperation and coordination by the successful tenderer during the course of work, such expenditure incurred will be recovered from the successful tenderer if the restoration work to the original condition or specification of the dismantled portion of the work was not undertaken by the successful tenderer himself.

### **1.7 INSURANCE AND STORAGE**

All consignments are to be duly insured up to the destination from warehouse to warehouse at the cost of the supplier the insurance covers shall be valid till the equipment is handed over duly installed, tested and commissioned position at site of work.

### **1.8 VERIFICATION OF CORRECTNESS OF EQUIPMENT AT DESTINATION**

The contractor shall have to produce all the relevant records to certify that the genuine equipment from the manufacturers has been supplied and erected. All relevant documents such as equipment dispatch invoices / bills, Excise Gate Pass, test certificate form the manufacturer / authorized testing laboratories etc. shall be made available as required by the department for verification at any stage.

### **1.9 PAINTING**

This shall include cost of painting of entire exposed ironwork complete in the installation. All equipments shall be painted at the works before dispatch to the site. Final painting shall be carries out as per direction of Engineer-in-Charge.

### **1.10 TRAINING**

The scope of works includes on the job technical training to two / three persons at site for proper day to day maintenance & operation of the DG Sets for the beneficial use of CCMC State during the trail run of DG sets. The operating staff engaged by the CCMC/ CPWD/PWD shall be trained for "Do" & "Do Not Do" for up-keeping the DG Sets as per recommended conditions of the manufacturer.

### **1.11 MAINTENANCE**

Sufficient trained and experienced staff shall be made available by the tenderer / contractor as and when called for to meet out any exigency of work during the guarantee period of one year from the handing over of the installation. Routine and preventive maintenance of the DG Sets as per manufacturer's recommendation shall be carried out and the record of the same shall be maintained for one year from the date of taking over the installation by the department.

### **1.12 OPERATION AND TRAIL RUN**

After the satisfactory final testing as per CPWD/PWD General Specification Part-VII DG Set 2006 the contractor shall demonstrate the trouble free operation of the DG Sets for the period of three working days, if any trouble / problem noticed during the Period it shall be suo moto extended for further three days, before the department takes over for the beneficial use. It may be noted that for operation & trial run fuel shall be provided by the contractor. Nothing extra shall be payable on this account. The date of taking over the installation / acceptance shall be only after the trouble free operation as mentioned above.

### **1.13 INTERPRETING SPECIFICATIONS**

- i) In interpreting the specifications the following order of decreasing importance shall be followed in case of contradictions:
  - (a) Schedule of quantities
  - (b) Technical specifications of the MMRC
  - (c) Approved Drawing (If any)
  - (d) CPWD General Specifications for Electrical Work Part-I (Internal) 2005, Part-II (External) 1994 & part-VII (DG set) 2006 & PWD specification of electrical works 2008.
  - (e) Relevant IS or other international code in case IS code is not available.

### **1.14 WORKS TO BE CARRIED OUT BY THE DEPARTMENT:**

Unless otherwise mentioned in the tender specifications, the department shall carry out the following works. Though the DG Sets are proposed to be installed in the outdoor open space, construction of building to house the DG Sets & equipments shall be provided if required. Main Power supply in L.T. (Non-Essential) for use by the tenderer for connection with AMF panel the time of commissioning of the DG Sets testing thereof at site of work.

### **1.15 WORKS TO BE DONE BY THE CONTRACTOR:**

The work shall comprise of entire labour i/c supervision and all materials necessary to make a complete installation and such tests, adjustments and commissioning as may be required by the department. The term complete installation shall not only mean major items of the plants and requirements covered by specifications but all incidental sundry components necessary for complete execution and satisfactory performance of installation, all labour charges whether or not those have been mentioned in details in tender documents in connection with this contract. In addition to supply, installation, testing and commissioning of equipments, as per schedule of works and specifications, the following works shall be deemed to be included within the scope of work to be executed by the contractor. Nothing extra shall be paid on this account.

- I) All minor building works for the installation such as cutting and making good the damages.
- II) Construction of Plain Cement Concrete Platform and installation of DG Sets on the same and including providing necessary anti vibration mountings.

- III) All supports, insulation, conduits, cables, cable trays, etc as necessary, the external support structure required to support the equipments shall be robust enough to take care of the dynamic loads, external wind pressure etc. as per satisfaction of the Engineer-in-Charge.
- IV) Tools and plants required for handling and installation of equipments.
- V) Protection required for the equipments from rain, dust storm during transportation such as provision of polythene cover, tarpaulin, etc.
- VI) Necessary equipments for the commissioning / site testing.
- VII) Fuel, lubricating dry type and other consumable items required for testing in factory and also for testing and commissioning at site.
- VIII) Necessary control cables.
- IX) The equipment must be insured towards transit from manufacturer's place of work till installation, handing over to the department.
- X) Safe custody of material and installation till the same is taken over by the department.

**1.16 EXCLUSION OF WORKS TO BE DONE BY OTHER AGENCIES (IF REQUIRED):**

Deleted.

**1.17 CIVIL WORK TO BE DONE BY THE CONTRACTOR (INCLUDED IN THE CONTRACT)**

To carry out minor civil work, such as modification and making good the pocket/cutout in wall/ceiling for cables, Distribution Boards, Wiring, conduits, or any other work required for smooth operation & commissioning of DG Sets.

**1.18 TROPICAL LOCATION / ENVIRONMENT SITE CONDITIONS:**

The tenderer will submit the power calculation for Alternator & Diesel Engine considering de-rating factor for specified output at 50°C inside the acoustic enclosure and as per tropical location of Nagpur as per environment conditions. Next nearest size of alternator & Diesel Engine shall be proposed in case calculation not worked out as per standard capacity available with the manufacturer. De-rating data shall be provided from the manufacturer of the Alternator & Diesel Engine. The environmental conditions under which the DG Sets are to function have been spelt out working temperature inside the acoustic enclosure.

**1.19 TECHNICAL SPECIFICATIONS**

The following is the details technical specification for ENGINE, ALTERNATOR and other accessories. The tenderer are advised to go through the same minutely and what is/are not applicable for particular capacity of Engine / Alternator, the same should be brought clearly in their Tender. If any particular item is available as an optional item the same should be indicated clearly in their offer no matter if additional cost is involved. Tenderer

must indicate the Model Nos. of Engine and Alternator, Engine & Alternator shall not be accepted if the date of manufacturing of this equipment be prior to 3 months from the date of opening of Eligibility Bid. Further necessary documentary evidence shall have to be furnished for this effect from the manufacturer at the time of supply of DG Sets etc.

#### **1.20 DIESEL ENGINE:**

Diesel Engine shall be of multi cylinders, vertical type, 4- stroke cycle, water-cooled, Natural Aspiration / turbo charged, shall be able to continuously develop the required BHP excluding the power requirement of the auxiliaries. The BHP capacity of the Engine shall be selected as per ultimate capacity of the Alternator selected after consideration of de-rating factors for the design temperature of 500C (Inside design temperature of Acoustic Enclosure) & as per tropical location of site as stated above including the de-rating of the Engine for similar conditions. The Engine shall have the following well-integrated accessories for proper functioning.

- i. Necessary flexible coupling with guard or direct coupling between alternator and engine.
- ii. Air cleaner of dry type / Dry type bath type.
- iii. Provision for coolant.
- iv. Radiator complete with house, fan, fan driver, thermostat and guard.
- v. Fuel service tank suitable for as per manufacturer design with inlet, outlet connection, air-vent, drain plug integrated inside the Acoustic Enclosure / floor mounting pedestals with hose connections including dry type level indicator a per standard design of the manufacturer.
- vi. Fuel pump as required.
- vii. Necessary governor.
- viii. Starter with 12 V / 24 V D.C. Lead Acid Battery of in case of 12 V for 24 V DC system. 12 V / 24 V battery charging D.C. Alternator with voltage regulator.
- ix. Battery connection leads with thimbles.
- x. Integral control & Main wiring.
- xi. Dry type & Fuel filter.
- xii. Necessary pump for cooling water and lubricating dry type.
- xiii. Natural Aspiration / turbo- charger as per design of the manufacturer.
- xiv. Necessary flywheel with starter gear ring and flywheel housing.
- xv. Instrument panel consisting of starting switch with key, lubricating dry type temperature and pressure gauges, cooling water temperature gauges, ammeter of suitable range for battery charger, hour meter with RMP indicator.

- xvi. Necessary provision for speed adjustment and emergency shut off arrangement.
- xvii. Safety control and rip off system against low lubricating dry type pressure, high lubricating dry type and cooling water temperature and over speed.
- xviii. Effective exhaust silencer (residential type) with necessary exhaust piping work with insulation with 50 mm thick Glass wool / Mineral wool / Rock wool of density not less than 46 Kg/m<sup>2</sup> & aluminium cladding with 0.80 mm thick aluminium sheet shall be provided in full length.
- xix. Heavy-duty base frame of sturdy design made of MS steel with necessary reinforcement & lifting arrangement.

### **1.21 EXHAUST SYSTEM:**

The piping for the exhaust should have minimum backpressure consistent with other requirement. Pipes should be securely supported and provided with necessary dampers and flexible connections very near to the engine to isolate vibrations. proper exhaust piping with B-class MS pipe of size as recommended by the manufacturer shall be provided up to 7 Meters of length within the scope of item & shall be insulated with 50 mm thick Glass wool / Mineral wool / Rock wool of density not less than 46 Kg/m<sup>2</sup> & aluminium cladding with 0.80 mm thick aluminium sheet shall be provided in full length. Exhaust stack height shall be provided as per CPWD/PWD General Specifications for electrical works part-VII (DG set) 2013. Since the DG sets are to be installed in different locations, the exhaust stack height shall be within 7 Meter as mentioned in the item within the scope. Extra length beyond seven meters if required shall be paid extra. The exhaust gas limits for all power outputs shall preferably be within the limits as per IS and shall clearly be spelt out.

### **1.22 FUEL SYSTEM:**

Fuel system for the engine shall be directly injection system / gravity fed to engine driven fuel pump, where provided. The daily service tank shall be complete with necessary support, gauges, valves, vent, drain, connecting tubing to the engine and filling pump. Fuel indicator, overflow line etc. This tank should be located such that fuel level is not above fuel injector. Suitable fuel filter, which can never be by-passed, should be incorporated as per manufacturer's recommendations. The replaceable element of fuel filter shall allow only clean fuel and suitably located to permit easy servicing. The fuel tank / service tank for the DG set shall be the integral part of the acoustic enclosure or housed outside the acoustic enclosures as per standard practice of the manufacturer. The capacity of the tank shall be for 12 hours continuous running of the DG set. The capacity of the tank shall be clearly indicated in the Tender.

### **1.23 LUBRICATING DRY TYPE SYSTEM:**

Necessary lubricating dry type pump, where required, shall be installed to keep the bearing primed with necessary lubricating dry type. This pump shall normally be operative on / engine's mechanical power /D.C. supply available with the set. The lubricating dry type system shall be so designed that when the engine starts after a long shut down, tripping on low dry type pressure should be avoided. The crank case capacity, number of hours after which lubricating dry type is to be charged, type of filter

and its replacement schedule are also to be clearly mentioned in the offer. Lubricating pump wherever provided shall preferably be mounted out-side the crankcase for easy maintenance or in the dry type sump as per standard design practice of the manufacturer. Suitable sump well pan for filling and emptying the sump shall be provided.

**1.24 CYCLIC VARIATION:**

Cyclic variation of set shall be within the time limit specified in B.S.S. 649 and IS 1601/1960 as amended up to date.

**1.25 FREQUENCY VARIATION:**

Frequency variation at constant load including no load shall remain within a band of 1% of rated frequency (50 cps).

**1.26 COOLING SYSTEM**

A closed circuit, self-contained cooling system shall be provided comprising of radiator fan driven

directly by engine or by independent motor, thermostatic by pass valve etc. shall be provided. In either case i.e. whether the radiator fan is driven directly by the engine or by an independent electric motor, the net output at the Engine / Alternator load terminals shall be not less than the 250 & 200 KVA / KW capacity specified. The capacity of Alternator / Engine shall be suitably increased.

**1.27 STARTING SYSTEM:**

Starting System of the Engine shall comprise of necessary heavy-duty battery of 12V D.C. of not less than in case of 12 V starting system for 24 V DC starting system suitable for DC starter motor, axial type gear to match with the toothed ring on the flywheel. A bimetallic relay protection to protect the starter motor from excessively long cranking runs suitably integrated with the engine protection system shall be included within the scope of the work & requirements of control panel, indications and auxiliaries etc. The scope shall cover all cabling, terminals, including charging etc.

**1.28 SILENCER:**

Residential type silencer suitable for outdoor mounting shall be provided with all relevant accessories required as per manufacturer's design. The silencer shall be insulated with 50 mm thick Glass wool / Mineral wool / Rock wool of density not less than 46 Kg/m<sup>2</sup> & aluminium cladding with 0.80 mm thick aluminium sheet shall be provided in full length.

**1.29 PROTECTION EQUIPMENT FOR AUXILIARIES:**

Protection equipment for low lubricating dry type pressure, over speed shut down (through frequency relay), high lubricating dry type temperature and high coolant temperature shall be provided.

### 1.29 **BED PLATE:**

The common bedplate for mounting of engine and alternator with all ancillaries fabricated with suitable size of MS Channel or fabricated bedplate with MS Sheet as per standard practice of manufacturing shall be acceptable. Gen Set with Acoustic Enclosure shall be installed on RCC foundation (1:2:4, M-25 grade) of approximate depth of 300 mm is required so as to provide levelled surface for placement. About 150 mm foundation height should be above ground level. The length & breadth of the foundation shall be at least 250 mm more than the size of the enclosure. Gen Set shall be mounted on AVMs inside the enclosure

### 1.30 **ANTI VIBRATION MOUNTING:**

Suitable Anti-vibration mounting as per manufacturer's design shall be provided for mounting the assembly so as to prevent the transmission of vibration to the structure to the maximum extent possible.

### 1.31 **PIPING ARRANGEMENT:**

MS Pipe (medium class) of adequate size shall be used for fuel line connections. M.S. black pipes will be permitted for the exhaust and water lines. The pipe work shall be inclusive for all fittings and accessories such as valves, bends, reducers, elbows, flanges, flexible connection and all necessary hardware etc. as required. The installation shall cover clamps, supports, hangers etc, as are necessary for completing the work. Welding and/or brazing will be permitted in the installation. However, the installation shall be sectionalized with flanged connections as are necessary for easy isolation for maintenance of the MMRCs. The offer shall always-included adjustment rate on running meter basis inclusive of all accessories apart from the total quantum of work guaranteed. For the purpose of working out quantity, the length of same shall include all accessories and fittings but excludes valves, if any. Those runs forming part of the factory assembly on the engine shall however be exclusive. For vibration to be isolated, piping connected to the sets also required isolation. This is achieved by interposing with flexible pipe connections and by using isolator pipe hangers.

### 1.32 **ALTERNATOR:**

The alternator shall be rated for a continuous output of 160as per BOQ capacities at 0.8 P.F (lagging) at 415 V, three phase, voltage regulation + 1%, 50 Hz at the terminals suitable for the 4 wires system exclusive of power requirement of auxiliaries. The actual capacity of the Alternator shall be worked out considering de-rating factor for **82.5 KVA** output at 50° C and as per tropical location of Nagpur. Next nearest size of alternator & Diesel Engine shall be proposed if the calculation does not exactly match with the readily standard DG Set manufactured by the manufacturer. De-rating data shall be provided from the manufacturer of the Alternator & Diesel Engine. Capacity of the alternator should be so designed that it can take 10% overload allowed for one hour in every 12 hours of operation of the D.G. set. Speed of the alternator shall be such that it is possible to couple the engine for direct drive. Model de-rating calculation for alternator & engine for the DG Sets of 160 KVA has been worked out as per attached calculation. These calculations may be termed & taken for reference only. De-rating calculations varies manufacturer to manufacturer & tenderer shall have to submit their calculation as per data from the manufacturer. Tenderer may bring out changes in model in technical bid, if their calculation so worked out for different suitable model. The alternator will be

brushless rotating field type: screen protected with drip proof enclosure of self-excited and self-regulated. It shall be provided with suitable ball and roller bearing and fully conforming to the relevant IS. Self-excited self-regulated static excitation facility shall be incorporated in the machine design. The exciter shall be mounted on the control panel or on the alternator assembly as the case may be. Bearings at the ends shall have suitable nipples for replenishing the grease. The details of replacement intervals shall be available in the manual to be supplied with the machine. The rotor assembly should be dynamically balanced for vibration free running. The generator shall retain sufficient residual magnet so that it can build up voltage without any difficulty. The performance shall be in accordance with IS 8183 for the electrical performance. Voltage regulation from no load to rated load shall be within a band of plus or minus 1 % of rated voltage. The overload trip and earth fault trip to be adjusted in accordance with manufacturer's design. The frequency regulation from no load to full load shall be as defined by the engine governor specifications. Voltage dip for any addition of sudden load up to and including 90% load shall not exceed 20% of rated voltage and shall recover within the steady band in not more than 1.5 seconds. Similarly the frequency shall recover to the steady state frequency band within 5 seconds. Class F/H insulation shall be used for stator / rotor windings. Two numbers earth terminals, one on each side with vibration proof connections with no ferrous hard ware, galvanized or plated and passivity washers etc. of 12 mm minimum dia. shall be provided on the body of the alternator.

### **1.33 TESTS ON GENERATING SETS:**

Following tests shall be conducted on the DG Sets before these are put into operation.

- i) The routine test as per relevant IS standards at manufacture's works. Copies of such test certificates are to be enclosed.
- ii) Insulation resistance tests.
- iii) Operation checks.
- iv) Full load run test for continuous 12 hours including 10% overload allowed for 1 hour at Contractor's / OEM / Manufacture's premises in the presence of representative of Engineer-in charge.

Hourly readings for all important parameters shall be taken during the test run. These readings must be certified to be acceptable by the consultant appointed by MMRC / Manufacturers of D.G. set. All consumables like fuel, lubricating dry type, coolant etc shall be provided by the tenderer. Adjustable Electrical Load shall be arranged by the tenderer. The contractor shall intimate department for the testing dates & place at least fifteen days earlier. All expenses for conducting tests except traveling, lodging & boarding of the representative of the Engineer-in-Charge shall be paid by the contractor. In addition to the above tests in the workshop of contractor's / OEM / Manufacturer's premises, load run test for at least 6 hours shall be carried out at the site of work on available load. If, however, due to any reason the department cannot send their representative to attend the testing, the full load testing shall be done at site with artificial load to be arranged by the contractor. All the expenses to be incurred for testing i/c cost of POL/Consumables and artificial load shall have to be borne by the successful tenderer within his quoted rates. Nothing extra shall be payable.

### **1.34 AMF CONTROL PANEL:**

- i) AMF control panel shall be fabricated by the manufacturer of the DG Set / OEM as per standard manufacturing practice. However the technical specifications of the AMF panel with circuit diagram & drawings shall be submitted with the technical bid for the acceptance of the department. The control panel (in single / double module) shall be fabricated with CRCA sheet steel with 2 mm thick totally enclosed, dust, drip, vermin proof, free standing, integrated with acoustic enclosure / separate uMMRC as per manufacturer / OEM standard manufacturing practice. Hinged doors shall be provided at the rear as well as on the front to access for routine inspection / maintenance. It shall be of compartmentalized construction so as to segregate the control and power functions and AC & DC wiring except where it is functionally necessary. Degree of protection will be conforming to IP-42 of IS-2147. The sheet shall be treated for degreasing, rinsing, pickling, phosphatising & passivation through 7 tank process & finally powder coated with cement grey paint. It shall have suitable capacity aluminium bus bars. The control panel shall have provisions for cable entries with suitable glands of adequate insulation & protection.
  
- ii) MANUAL MODE: It shall be possible to start up the generator set only by the operator by pressing the start push button is kept pressed. Alternator close and trip operation shall also be operated by pressing appropriate button on the panel. However, closure of the contractor shall be feasible only after alternator has build up full voltage. Engine shut down otherwise due to faults, shall also be manual by pressing "Stop" button.
  
- iii) TEST MODE: During test mode engine, shall get the start signal even though the main supply is healthy and the alternator start building up voltage but the set shall not take load by closing of contactor for alternator. If the main failure taken place during testing mode the load shall be transferred to DG set.

### **1.35 CONSTRUCTION:**

It should have weather proof corrosion resistant modular construction fabricated with 1.6 mm thick M. S. Sheet outer and should adhere to mandatory gazette noise regulation norms. All the sheet steel components should be pre-treated with zinc phosphate prior to polyester powder coating with zinc plated or stainless steel fasteners. The container should be designed for easy access to serviceable parts. It should have glass control panel viewing window. It should have provision for illumination inside enclosure. The doors should be fitted with high quality EPDM gaskets to avoid leakage of sound. For security and safety, it should have special lockable door handles with single key and emergency stop button. Detachable cable glands shall be provided.

### **1.36 PAINTING:**

The sheet metal component should be powder coated after seven tanks pre-paint treatment. To have longer life of container it should be P.P. based powder coated (inside as well as outside). Base frame should be epoxy coated when fabricated.

### **1.37 ACOUSTIC INSULATION:**

Sound proofing of enclosure should be done with quality rock wool / glass wool / mineral wool conforming to IS: 8183 of 96 Kg. /m<sup>3</sup> density. Alternatively insulated with fire retardant foam as per standard manufacturing practice of the manufacturer. The rock wool / glass wool / mineral wool shall further be covered with fibre glass cloth / fibre tissue paper fire resistive and perforated powder coated sheet of 0.6 mm thickness. The Acoustic Enclosure shall be as per type tested design approved by laboratory for compliance of sound level of 75 dBA at 1 meter specified by Ministry of Environment & forest / CPCB. Drawing of the type tested enclosure & copy of test certificate shall be provided at the time of submission of technical bid.

### **1.38 VENTILATION AND AIR CIRCULATION:**

The ventilation system shall be designed to provide air inlet / exhaust acoustic louvers for efficient air circulation and shall have following special features.

- I) Adequate ventilation is to be provided to meet air requirement for combustion and heat removal.
- II) The temperature inside the enclosure shall not exceed 5-70 C more than the ambient temperature near air suction point.

### **1.39 EXHAUST SYSTEM:**

A high efficiency residential silencer along with its associated piping and flexible bellow is to be mounted inside the acoustic enclosure. Exhaust piping with its insulation shall be provided as per item of schedule of quantity.

### **1.40 EARTHING:**

G.I. Plate earthing for DG Set body earthing & Neutral earthing shall be provided as per CPWD

General Specifications for Electrical Work Part-I (Internal) 2005, Part-II (External) 2007 & part-VII (DG set) 2013 as per following;

- i) Two sets of G.I. earth plate system for each DG Set body earthing by two distinguished G I earth strip of size as mentioned in the BOQ if the DG Sets are to be installed at separate locations. Both DG Sets shall be earthed with the common earthing system if the sets are to be installed closely at one place.

- ii) Two sets of G.I. earth plate (two sets for each DG Set) for neutral earthing. Neutral of Each DG Set shall be connected with two distinguished G.I. earth strips with neutral bushing to be provided with the alternator or panel as the case may be.

**SPECIFICATION OF POLE AND CABLE WORKS**

Painting	The poles and cross arms shall be painted with one coat of red oxide primer before erection. One coat of Primer and two coats of Aluminium paint shall be provided after stringing of lines / erection of any mountings.
Sand Cushion	Higher thickness of sand column beyond the thickness specified shall not be paid.
Cable laying	The cable laying and relevant works involved shall be done as per IS: 1255 – 1983. The sand cushion depth shall be measured after tamping. The back filling shall be rammed for consolidation and a crown of filling material be formed above trench for future natural consolidation.
Feeder route permissions for various routes.	The works shall be done as per specifications of Maharashtra State Electricity Board its standard drawings for construction of lines approved by Electrical Inspector. The contractor scope of work includes erection of the feeder testing, commissioning all as per MSEB standard and handing over to MSEB final payment to the extent of 20% contract value will be held till handing over taking over document transferring maintenance to MSEB duly signed by authorized MSEB official is received by the owner.

## **Annexure – 2**

# **AIR CONDITIONING SYSTEMS**

### **1.0 GENERAL DESCRIPTION / BASIS OF DESIGN**

#### **1.1 SCOPE-**

The work stated in these specifications together with Consultant's drawings, cover the design, manufacture, testing performance at manufacturer's works, delivering goods at site, handling at site, installation, commissioning and carrying out

performance tests at site of the complete equipment required for the HVAC System for **MMRC upcoming project office at BKC, Bandra (E) Mumbai.**

## **1.2 BASIS OF DESIGN-**

### **BUILDING DESCRIPTION-**

The proposed building complex consists of reception area, office area, director room, conference room, dining, recreation room, cabin etc. The building is of RCC framed construction with brick masonry walls and RCC slabs, beams and columns. The height of each area may vary from sections to sections.

### **ROOF-**

The exposed roof of the building will be insulated by air conditioning contractor / insulation contractor in such a manner so as to provide an overall transmission factor of 0.12 BTU / hour – ft<sup>2</sup> / °f / or better.

### **WORK TO BE DONE BY AIR CONDITIONING CONTRACTOR-**

The successful air conditioning contractor will provide complete air conditioning consisting of Air Cooled Variable Refrigerant Volume (VRV)/ VRF system & BMS work as detailed in the tender BOQ and as specified in the technical specification. The various areas to be air conditioned and ventilated comprises of reception area, office area, director room, conference room, dining, recreation room, cabin toilets, etc. on various floor as detailed in the basis of design.

### **BASIC CONSIDERATION FOR ESTIMATION**

SITE	:	Mumbai
LATITUDE	:	18°54' NORTH
LONGITUDE	:	72°49' EAST
MEAN SEA LEVEL	:	11 Mtrs.

### **AMBIENT CONDITIONS SUMMER (April)**

DRY BULB TEMPERATURE	:	95°F (35°C)
WET BULB TEMPERATURE	:	60%
DEW POINT	:	78.93°F (26.07°C)
GRAINS / Lb	:	150.79
ENTHALPY IN BTU	:	46.56

### **SPACE DESIGN CONDITIONS ALL YEAR ROUND**

DRY BULB TEMPERATURE	:	74.0°F (23.33 °C)	WET BULB TEMPERATURE	:	63.09°F (17.27°C)
RELATIVE HUMIDITY	:	55%	DEW POINT	:	56.83°F (13.79°C)
GRAINS / Lb	:	69.13	ENTHALPY IN BTU	:	28.56

## **AREA TO BE AIR-CONDITIONED**

### AREA TO BE

AIR-CONDITIONED : As per detailed Heatload Sheet  
OCCUPANCY : As per detailed Heatload Sheet  
LIGHTING LOAD : As per detailed Heatload Sheet  
EQUIPMENT LOAD : As per detailed Heatload Sheet  
FRESH AIR QUANTITY : Fresh Air considered is as per  
As per ASHRAE 62.1-2010.

## **BUILDING DATA:**

Proposed Building construction data is as follows:

Exterior Glass/ Glazing : Single Glazed Unit  
Shading Co-efficient = 0.56 BTU/hr.ft<sup>2</sup>.°  
F U-value = 1.13 BTU/hr.ft<sup>2</sup>.°F  
Exterior Wall : U = 0.34 BTU/hr.ft<sup>2</sup>.°F

## **MECHANICAL VENTILATION SYSTEM**

Ventilation standards for toilet areas shall be as follows:

Toilets : 15 Air changes per hour

## **EXPOSED CEILING / ROOF**

THE CEILING / ROOF OF THE BUILDING WILL BE INSULATED BY AIRCONDITIONING CONTRACTOR / INSULATION CONTRACTOR IN SUCH A MANNER SO AS TO PROVIDE AN OVER ALL TRANSMISSION FACTOR OF 0.12 BTU / HOUR – FT<sup>2</sup> / °F OR BETTER.

## **EXPOSED GLASS**

ALL EXPOSED TO BE COVERED WITH SUN CONTROL FILM / COVERED WITH THICK CURTAIN / VENETIAN BLINDS.

## **HEAT TRANSFER CO-EFFICIENT & TEMPERATURE DIFFERENCE**

### **TEMPERATURE DIFFERENCE FOR EXPOSED WINDOW GLASS**

#### **SUMMER**

ROOM TEMPERATURE : @ 74°F  
EAST : 12°F  
WEST : 163°F  
SOUTH : 12°F  
NORTH : 23°F  
SOUTHEAST : 12°F  
SOUTHWEST : 85°F

NORTHEAST	: 12°F
NORTHWEST	: 138°F
<b>TEMPERATURE DIFFERENCE FOR EXPOSED WALLS &amp; ROOF SUMMER</b>	
ROOM TEMPERATURE	: @ 74°F
EAST	: 28°F
WEST	: 22°F
SOUTH	: 26°F
NORTH	: 14°F
SOUTHEAST	: 28°F
SOUTHWEST	: 24°F
NORTHEAST	: 20°F
NORTHWEST	: 16°F
ROOF EXPOSED	: 45°F
ROOF INSULATED	: 45°F
ROOF SHADED	: 18°F
CEILING	: 16°F
FLOOR	: 16°F
PARTITION WALL	: 16°F
GLASS EXPOSED	: 21°F
GLASS PARTITION	: 16°F

**HEAT TRANSFER CO-EFFICIENT (BTU/Hr. x FT<sup>2</sup> x °F)**

FOR EXPOSED WINDOW	
GLASS FOR RADIATION	: 0.56
FOR EXPOSED WINDOW GLASS	
FOR CONDUCTION	
& CONVECTION	: 1.13
FOR EXPOSED BRICK WALL	: 0.36
FOR EXPOSED SLABS	: 0.48
FOR SHADED SLABS	: 0.48
FOR INSULATED SLABS	: 0.12
FOR CEILING	: 0.48
FOR INSULATED CEILING	: 0.12
FOR FLOOR	: 0.43
FOR INSULATED FLOOR	: 0.12
PARTITION WALL	: 0.43

**OTHER CONVERSIONS**

1 kWh	: 3410 BTU / Hr.
BYPASS FACTOR OF THE	
4 - ROW COOLING COIL	: 0.12
BYPASS FACTOR OF THE	
6-ROW COOLING COIL	: 0.04
SUPPLY DUCT HEAT GAIN	: 2.5%
FAN H.P.	: 5%

SAFETY	: 5% TOTAL ON ROOM
SENSIBLE HEAT	: 12.5%
LATENT HEAT SAFETY	: 5%
TOTAL ON ROOM HEAT	: 17.5%

PERCENTAGES INDICATED ABOVE ARE THOSE CONSIDERED FOR ARRIVING AT THE PEAK LOADS FOR EACH AIR CONDITIONED AREA.

**1.3 POWER SUPPLY-**

The Employer will make 415 V, 3 Phase 50 Hz & Neutral 50 ., 4-wire A.C. elec. power supply including earthing at the main panel available.

**1.4 DESCRIPTION OF THE WORK TO BE CARRIED OUT-**

The successful tenderer's scope shall be carrying out complete high and low side work as per BOQ. The scope of work includes Supply Installation Testing & Commissioning of VRV/VRF system. The units shall be located as per tender drawings. The electrical power required for outdoor units shall be made available at the main electrical panel supplied by you as required. This panel shall be suitable for outdoor application & confirming IP-55 construction. For Indoor units & ventilation fans single phase power required shall be provided at units from Floor Distribution Board however required control cabling between indoor and outdoor units shall be done by you. The power and water required for installation, erection and commissioning of the system shall be made available by client

**Contractor to note that the ODU for Reception and Cafeteria is separated on purpose since it will be supplied by Solar Power.**

**HEAT LOAD SUMMARY SHEET-**

The Heat Load Summary Sheet is attached.

**LIST OF DRAWINGS ENCLOSED WITH TENDER-**

1. Ground Floor Layout
2. First Floor Layout
3. Terrace Layout

					LIGH TING		FRES H	HEAT AIRLOAD			INSTA LLED	TOTAL INSTA		
GROUND FLOOR														
A WING														

1	DGM 1	87	3	11.8	0.80	0.15	26	0.66	259	COMPACT	0.66	1	0.66	0.077	0.077	
2	DGM 2	87	3	11.8	0.80	0.15	26	0.62	234	COMPACT	0.66	1	0.66	0.077	0.077	
3	DGM 3	87	3	11.8	0.80	0.15	26	0.62	234	COMPACT	0.66	1	0.66	0.077	0.077	
4	ED/HOD 1	204	10	11.8	0.80	0.15	81	1.42	416	REGULAR	1.66	1	1.66	0.052	0.052	
5	ED/HOD 2	220	10	11.8	0.80	0.15	82	1.43	419	REGULAR	1.66	1	1.66	0.052	0.052	
6	ED/HOD 3	220	10	11.8	0.80	0.15	82	1.43	419	REGULAR	1.66	1	1.66	0.052	0.052	
7	ED/HOD 4	220	10	11.8	0.80	0.15	82	1.43	419	REGULAR	1.66	1	1.66	0.052	0.052	
8	ED/HOD 5	220	10	11.8	0.80	0.15	82	1.43	419	REGULAR	1.66	1	1.66	0.052	0.052	
9	ED/HOD 6	220	10	11.8	0.80	0.15	82	1.43	419	REGULAR	1.66	1	1.66	0.052	0.052	
10	ED/HOD 7	220	10	11.8	0.80	0.15	82	1.43	419	REGULAR	1.66	1	1.66	0.052	0.052	
11	DGM 4	92	3	11.8	0.80	0.15	27	0.65	251	COMPACT	0.83	1	0.83	0.092	0.092	
12	DGM 5	92	3	11.8	0.80	0.15	27	0.65	251	COMPACT	0.83	1	0.83	0.092	0.092	
13	DGM 6	92	3	11.8	0.80	0.15	27	0.65	251	COMPACT	0.83	1	0.83	0.092	0.092	
14	DGM 7	92	3	11.8	0.80	0.15	27	0.65	251	COMPACT	0.83	1	0.83	0.092	0.092	
15	DGM 8	119	3	11.8	0.80	0.15	29	0.71	276	COMPACT	1.08	1	1.08	0.092	0.092	
16	DINING	687	28	11.8	0.80	0.20	434	5.07	1,007	REGULAR	2.66	2	5.32	0.093	0.186	
17	MEETING ROOM 01	270	15	11.8	0.80	0.50	119	2.00	560	REGULAR	2.08	1	2.08	0.066	0.066	
18	MEETING ROOM 02	270	15	11.8	0.80	0.50	119	2.00	560	REGULAR	2.08	1	2.08	0.066	0.066	
19	MEETING ROOM 03	270	15	11.8	0.80	0.50	119	2.00	560	REGULAR	2.08	1	2.08	0.066	0.066	
20	DGM 9	90	3	11.8	0.80	0.15	27	0.68	269	COMPACT	0.83	1	0.83	0.092	0.092	
21	DGM 10	90	3	11.8	0.80	0.15	27	0.68	269	COMPACT	0.83	1	0.83	0.092	0.092	
22	DGM 11	90	3	11.8	0.80	0.15	27	0.68	269	COMPACT	0.83	1	0.83	0.092	0.092	
											1.66	1	1.66	0.052	0.052	
											2.08	1	2.08	0.066	0.066	
24	WAITING AREA	204	4	11.8	0.80	0.15	42	0.75	239	COMPACT	1.08	1	1.08	0.092	0.092	
											1.66	2	3.32	0.052	0.104	
											1.33	2	2.66	0.047	0.094	
26	WAITING AREA	204	4	11.8	0.80	0.15	42	0.75	239	COMPACT	1.08	1	1.08	0.092	0.092	
27	SITTING-2	600	14	11.8	0.80	2.00	138	3.32	1,289	REGULAR	2.08	2	4.16	0.066	0.132	
28	WAITING AREA	336	4	11.8	0.80	0.15	52	0.95	319	REGULAR	1.66	1	1.66	0.052	0.052	
											2.66	1	2.66	0.093	0.093	
											2.08	1	2.08	0.093	0.093	
											1.66	2	3.32	0.052	0.104	
											1.33	2	2.66	0.047	0.094	
31	WAITING AREA	204	4	11.8	0.80	0.15	42	0.75	239	COMPACT	1.08	1	1.08	0.092	0.092	
	SUB TOTAL	8,794	260			13.55	2,577	47.74	15,52		50.83		56.81		2.875	
	ODU										54.76	HP	1	54.00	53.80	53.80
	ODU-RECEPTION &										12.53	HP	1	14.00	13.60	13.60
B WING																
32	RECEPTION	177	5	11.8	0.80	0.15	46	1.25	512	REGULAR	1.66	1	1.66	0.052	0.052	
33	CONFERENCE ROOM	326	17	11.8	0.80	0.50	136	2.22	604	REGULAR	2.66	1	2.66	0.093	0.093	
34	CABIN 1	70	3	11.8	0.80	0.15	25	0.43	127	COMPACT	0.66	1	0.66	0.077	0.077	
35	CABIN 02	70	3	11.8	0.80	0.15	25	0.43	127	COMPACT	0.66	1	0.66	0.077	0.077	
36	CABIN 03	70	3	11.8	0.80	0.15	25	0.47	151	COMPACT	0.66	1	0.66	0.077	0.077	
37	SITTING-1	1,271	22	11.8	0.80	3.20	242	4.95	1,765	REGULAR	1.66	4	6.64	0.052	0.208	
38	SITTING-2	268	8	11.8	0.80	0.90	73	1.60	581	REGULAR	2.08	1	2.08	0.066	0.066	
											3.33	2	6.66	0.187	0.374	
											2.66	2	5.32	0.093	0.186	
40	SITTING-5	557	12	11.8	0.80	1.80	121	2.67	992	REGULAR	1.66	2	3.32	0.052	0.104	
41	CAFETERIA	862	43	11.8	0.80	3.00	621	8.87	2,381	REGULAR	4.13	2	8.26	0.209	0.418	
42	CABIN	82	3	11.8	0.80	0.15	26	0.61	230	COMPACT	0.83	1	0.83	0.092	0.092	
	SUB TOTAL	5,732	173			16.95	1,845	32.91	10,50		22.65		39.41		1.824	
	ODU										37.99	HP	1	38.00	33.50	33.50

					LIGH TING		FRESH			INSTALLE D	TOT AL				
FIRST FLOOR															
A WING															
1	MD ROOM	378	11	12.8	0.80	0.50	101		888	ROUN	2.66	1	2.66	0.093	0.093
2	DIRECTOR 01	281	11	12.8	0.80	0.50	93		661	ROUN	2.08	1	2.08	0.066	0.066
3	CABIN 01	64	3	12.8	0.80	0.15	24		142	COM	0.66	1	0.66	0.077	0.077
4	CABIN 02	64	3	12.8	0.80	0.15	24		142	COM	0.66	1	0.66	0.077	0.077
5	DIRECTOR 02	256	11	12.8	0.80	0.50	91		664	ROUN	2.08	1	2.08	0.066	0.066
6	DIRECTOR 03	316	10	12.8	0.80	0.50	90		781	ROUN	2.66	1	2.66	0.093	0.093
7	CONFERENCE	580	45	12.8	0.80	0.50	338		1,22	REGU	2.66	2	5.32	0.093	0.186
8	ED/HOD 09	220	10	12.8	0.80	0.15	82		578	REGU	1.66	1	1.66	0.052	0.052
9	ED/HOD 10	220	10	12.8	0.80	0.15	82		578	REGU	1.66	1	1.66	0.052	0.052
10	ED/HOD 11	220	10	12.8	0.80	0.15	82		578	REGU	1.66	1	1.66	0.052	0.052
11	ED/HOD 12	220	10	12.8	0.80	0.15	82		578	REGU	1.66	1	1.66	0.052	0.052
12	DGM 12	90	3	12.8	0.80	0.15	27		287	COM	0.83	1	0.83	0.092	0.092
13	DGM 13	90	3	12.8	0.80	0.15	27		287	COM	0.83	1	0.83	0.092	0.092
14	DGM 14	123	3	12.8	0.80	0.15	29		345	COM	1.08	1	1.08	0.092	0.092
15	DGM 15	83	3	12.8	0.80	0.15	26		225	COM	0.83	1	0.83	0.092	0.092
16	DGM 16	83	3	12.8	0.80	0.15	26		294	COM	0.83	1	0.83	0.092	0.092
17	DGM 17	83	3	12.8	0.80	0.15	26		294	COM	0.83	1	0.83	0.092	0.092
18	ED/HOD 08	226	9	12.8	0.80	0.15	76		735	REGU	2.08	1	2.08	0.066	0.066
19	MEETING ROOM-	266	15	12.8	0.80	0.50	118		649	REGU	2.66	1	2.66	0.066	0.066
20	MEETING ROOM-	266	15	12.8	0.80	0.50	118		649	REGU	2.66	1	2.66	0.066	0.066
21	AUDIO/VISUAL	183	11	12.8	0.80	0.50	86		519	REGU	1.66	1	1.66	0.052	0.052
22	CABIN	68	3	12.8	0.80	0.15	25		197	COM	0.66	1	0.66	0.077	0.077
23	SITTING-2	651	14	12.8	0.80	2.00	142		1,36	REGU	2.08	2	4.16	0.066	0.132
24	WAITING AREA	204	4	12.8	0.80	0.15	42		298	COM	1.08	1	1.08	0.092	0.092
											1.66	2	3.32	0.092	0.184
											1.33	2	2.66	0.047	0.094
26	WAITING AREA	204	4	12.8	0.80	0.15	42		298	COM	1.08	1	1.08	0.092	0.092
27	WAITING &	570	6	12.8	0.80	0.15	83		779	REGU	1.33	2	2.66	0.047	0.094
28	RECEPTION	222	2	12.8	0.80	0.15	30		326	REGU	1.66	1	1.66	0.052	0.052
29	LOBBY	584	6	12.8	1.00	0.25	85		659	REGU	2.08	2	4.16	0.066	0.132
30	REGERATION	687	23	12.8	0.80	1.50	331		1,52	REGU	2.66	2	5.32	0.093	0.186
	SUB TOTAL	8,464	278			12.45	2,594		17,9		50.01		37.4		2.803
	ODU-UPPER									36.12	HP	1	36.0	35.90	35.90
	ODU-DOWN									26.69	HP	1	28.0	26.60	26.60
B WING															
31	CONFERENCE	300	16	12.8	0.80	0.50	127		649	REGU	2.66	1	2.66	0.093	0.093
32	CABIN	82	3	12.8	0.80	0.15	26		227	COM	0.66	1	0.66	0.077	0.077
33	SITTING-2	190	6	12.8	0.80	0.90	54		559	REGU	1.66	1	1.66	0.052	0.052
34	CABIN 01	70	3	12.8	0.80	0.15	25		153	COM	0.66	1	0.66	0.077	0.077
35	CABIN 02	70	3	12.8	0.80	0.15	25		153	COM	0.66	1	0.66	0.077	0.077
36	CABIN 03	70	3	12.8	0.80	0.15	25		153	COM	0.66	1	0.66	0.077	0.077
37	SITTING-1	1,157	23	12.8	0.80	3.35	240		2,13	REGU	2.08	4	8.32	0.066	0.264
											2.66	2	5.32	0.093	0.186
											3.33	2	6.66	0.187	0.374
39	SITTING-5	556	10	12.8	0.80	1.70	108		1,21	REGU	2.08	2	4.16	0.066	0.132
	SUB TOTAL	4,478	121			13.85	1,136		9,04		17.11		31.4		1.409
	ODU									30.28	HP	1	32.0	31.00	31.00

SR. NO.	PARTICULARS	AREA (FT <sup>2</sup> )	HEIGHT (FT)	AIR QTY. (CFM)	TYPE OF UNIT	INSTALLED CAPACITY (CFM)	NOS	TOTAL INSTALL CAPACITY (CFM)
<b>GROUND FLOOR</b>								
<b>A WING</b>								
1	TOILET-01	50	8.0	100	PROPELLER FAN	100	1	100
2	TOILET-02	55	8.0	110	PROPELLER FAN	100	1	100
3	TOILET-03	36	8.0	72	PROPELLER FAN	100	1	100
4	TOILET-04	75	8.0	150	INLINE TYPE EX.FAN	150	1	150
5	TOILET-05	75	8.0	150	INLINE TYPE EX.FAN	150	1	150
6	TOILET-06	75	8.0	150	INLINE TYPE EX.FAN	150	1	150
7	TOILET-07	295	8.0	590	PROPELLER FAN	100	6	600
	<b>SUB TOTAL</b>	<b>661</b>						
<b>B WING</b>								
27	LADIES & GENTS TOILETS	345	8.0	690	INLINE TYPE EX.FAN	700	1	700
	<b>SUB TOTAL</b>	<b>345</b>						
<b>FIRST FLOOR</b>								
<b>A WING</b>								
1	TOILET-01	45	8.0	90	PROPELLER FAN	100	1	100
2	TOILET-02	45	8.0	90	PROPELLER FAN	100	1	100
3	TOILET-03	35	8.0	70	PROPELLER FAN	100	1	100
4	TOILET-04	70	8.0	140	INLINE TYPE EX.FAN	150	1	150
5	TOILET-05	75	8.0	150	INLINE TYPE EX.FAN	150	1	150
6	TOILET-06	75	8.0	150	INLINE TYPE EX.FAN	150	1	150
7	TOILET-07	40	8.0	80	PROPELLER FAN	100	2	200
8	TOILET-08	40	8.0	80	PROPELLER FAN	100	1	100
9	TOILET-09	295	8.0	590	PROPELLER FAN	100	6	600
	<b>SUB TOTAL</b>	<b>720</b>						
<b>B WING</b>								
27	LADIES & GENTS TOILETS	345	8.0	690	INLINE TYPE EX.FAN	700	1	700
	<b>SUB TOTAL</b>	<b>345</b>						

## **2.0 SPECIFICATION OF EQUIPMENT/MATERIAL AND INSTALLATION STANDARDS**

### **2.1 VARIABLE REFRIGERANT VOLUME TYPE SYSTEM (VRV / VRF System)**

The system selected should be modular system, with number of indoors connected to centrally located outdoor units, as per detail designing given in the tender. The outdoor units for all the system shall be air cooled type and mounted on terrace of the building. Indoor units in various areas shall be as per enclosed drawings/ Bill of Quantities.

All the VRV/VRF air conditioners shall be fully factory assembled, wired, internally piped & tested. The outdoor unit shall be pre charged with first charge of **R410A** refrigerant. Additional charge shall be added as per refrigerant piping at site. All the units shall be suitable for operation with 415 V + 10%, 50 Hz + 3%, 3 Phase supply for outdoor units & 220 V + 10%, 50 Hz + 3%, 1 Phase supply for indoor units.

The VRV/VRF system shall provide stable, trouble free & safe operation, with flexibility of operating desired indoor units. The outdoor units must be capable of delivering exact capacity proportional to the number of indoor units switched on & the heat load in the air conditioned area. The proportional operation shall be achieved by varying speed of the compressor in the outdoor units.

The operation of the VRV/VRF system shall be through independent wired/ wireless remote controllers as specified. The entire system shall be integrated with intelligent building management system of leading vendors like Honeywell / Johnson Controls / Siemens etc, through BAC Net Gateway. The detailing of operation required through BMS system are detailed under specifications of BMS system.

The system shall be multi-split system with inverter driven scroll compressor for application with **R410A refrigerant** and shall be composed of ceiling type indoor units / 4-way cassette type indoor units / 2-way cassette type indoor units / wall type indoor unit / floor type indoor unit and an outdoor unit as specified in tender drawings & Bill of Quantities, with a distributed refrigeration cycle, electrical components and enclosing cabinets. Both indoor units and outdoor unit shall be properly assembled, internally piped and wired, thoroughly tested and charged with refrigerant at factory and shall be topped up at site after erection.

Additional charge of refrigerant should be supported by engineering calculation. Each refrigeration cycle shall be equipped with scroll compressor, a solenoid valve, a heat exchanger, an accumulator, and a 4- way valve and flare connection parts.

**Factory testing shall be witnessed by client's engineer / consultant. You will have to accordingly arrange for the same.**

#### **SPECIFICATION OF OUTDOOR UNITS:**

Outdoors units of the VRV/VRF system shall be compact air cooled type.

All the compressors of the outdoor units must be hermetically sealed scroll type. Each module of outdoor unit must have separate 1- $\phi$  inverter compressor, suitable to operate at heat load proportional to indoor requirement.

"Anti -Corrosive" treatment (Blue Fins) for Al fins of Condenser Coils is mandatory. The treatment should be suitable for areas of high pollution and salt laden air.

The outdoor units must be suitable for up to 150 m refrigerant piping between outdoor unit & the farthest indoor units, total piping of 300 m for all the indoor units. Allowable level difference between outdoor unit & indoor units shall be 50 m in case of outdoor unit on top & 40 m in case of outdoor unit at bottom. Allowable level difference between various indoor units connected to one out door unit shall be up to 15 m.

Back up operation, in case of failure of one of the compressors of outdoor unit, for single module outdoor units or failure of one of the modules in case of multiple module outdoor units shall be possible. The VRV/VRF outdoor unit shall always be supplying at least 33% of back up operation, of the full load capacity.

The outdoor unit shall employ system of equal run time for all the compressors, inverter or on/ off type, within each out door unit – Single Module or Multi Module.

The outdoor units shall be suitable to operate within an ambient temperature range of – 5 Deg C to 43 Deg C, in cooling mode & – 20 Deg C to 15 Deg C in heating mode.

Air cooled condenser shall have Axial Flow, upward throw fan, directly coupled to fan motors with minimum IP 55 protection. The outdoor unit condenser fan shall be able to develop external static pressure up to 6 mm of H<sub>2</sub>O.

The entire operation of outdoor units shall be through independent remotes of indoor units. No separate Start/ Stop function shall be required.

Starter for the Outdoor Unit compressor shall "Direct on Line" type. Inverter compressor of the unit shall start first & at the minimum frequency, to reduce

The inrush current during starting. Refrigerant control in the outdoor unit shall be through Electronic Expansion Valve. Complete refrigerant circuit, oil balancing/ equalizing circuit shall be factory assembled & tested.

The compressor(s) shall be hermetically sealed scroll and designed for continuous operation even at high ambient temperatures of Mumbai. All condensing unit should have a combination of fixed speed and invertors driven scroll compressor. All invertors driven scroll compressor should have protection for electronic circuits and elimination of electromagnetic sound, which may interfere with the control function of the machine. The unit shall have safety device such as high-pressure switch, fan motor safety thermostat, invertors overload protector, fusible plugs and fuses for trouble free operation of the unit. The condenser shall be air -cooled, made of Cu. tubes with extended Aluminium fins. The condenser coil shall be multi-pass, cross-finned tube type, equipped with highly efficient Aluminium fins, mechanically bonded to oxygen free copper tubes. The coil shall be cleaned, dehydrated and tested or leakage at the factory. The Cabinets shall be fabricated out of heavy gauge steel, properly formed for close fit and structural rigidity. All access panels shall be so constructed as to be quickly and easily removable. All outside surface shall be finished with powder coating for protection against humid weather. The condenser fans shall be stepped control depending on no. of compressor operational & ambient condition, driven and designed to achieve low condensing temperatures & operate continuously and silently. One out-door unit should be capable to be connected up-to 16 nos. various indoor unit. All out-door units shall have BMS compatible communicable controller.

Noise level of outdoor units shall not exceed 63 dB (A) at a distance of 1.5 m from the unit.

The outdoor units shall confirm to Technological Guideline for Harmonic Suppression – JAEG 9702-1995. High Harmonic Environmental Target Level for Power Distribution system shall be 5%.

Outdoor units shall be complete with following safety devices:

- High pressure switch
- Fan driver overload protector
- Over current relay
- Inverter Overload Protector
- Fusible Plug

Unit shall be supplied with

- Installation manual
- Operation Manual
- Connection Pipes
- Clamps

Units shall be available in configuration 5 HP, 8 HP upto 48 HP, within increments of 2 HP as specified in tender drawings & Bill of Quantities.

## **SPECIFICATIONS FOR INDOOR UNITS**

The cooling coils shall be made of Copper Tubing having extended Aluminium fins. The evaporator coil shall be multi-pass, cross finned tube type, equipped with highly efficient Aluminium fins, and mechanically bonded to seamless, oxygen free copper tubes. The coil shall be cleaned, dehydrated and tested for leakage at factory. The cooling coils circuit shall be fed with liquid refrigerant through the expansion device and distributor. The indoor unit shall have two-speed fan motor. The blower shall be statically and dynamically balanced and designed for silent operation at required airflow rates against required static pressure. The filters shall be washable synthetic media type arranged for convenient cleaning and replacement. The drain pan shall be fabricated out of heavy sheet steel, insulated with 1/4" expanded polyethylene sheet. The casing shall be of heavy gauge G.I., duly powder coated for weather protection. All indoor units to be supplied with EU-3 i.e. 20 micron filters.

### **CASSETTE TYPE INDOOR UNITS**

- 1. Regular Cassette Unit**
- 2. Compact Cassette Unit**

These units shall be installed between the bottom of finished slab & top of false ceiling. The maximum allowable height for the cassette type units shall be 250 mm.

The unit must have in built drain pump, suitable for vertical lift of 750 mm. The unit casing shall be Galvanized Steel Plate.

Unit must be insulated with sound absorbing thermal insulation material, Polyurethane foam. The noise level of unit at the highest operating level shall not exceed 42 dB(A), at a vertical distance of 1.5 m from the grille of the unit.

Unit shall have provision of connecting fresh air without any special chamber & without increasing the total height of the unit (250 mm maximum). The unit shall be supplied with suitable decorative panel.

The unit shall be supplied with Resin Net filter with Mold Resistance. The filter shall be easy to remove, clean & reinstall.

The unit will be connected in series to a suitable out door unit & it must be possible to operate the unit independently, through corded/ cordless remote specified in the "Bill of quantities". The unit will be further connected to Intelligent Building Management System (To be supplied by other vendors) & it shall be possible to operate the unit through this IBMS system.

The unit shall be supplied with following from the factory –

Operation Manual

Installation Manual

Paper pattern for installation

Drain hose/ Clamp metal/ Washer fixing plate/ Sealing pads/ Clamps/ Screws/ Washer for hanging bracket/ Insulation for fitting

The unit must be available in following capacity –

0.8 HP, 1 HP, 1.25 HP, 1.6 HP, 2.0 HP, 2.5 HP, 3.2 HP, 4 HP, 5 HP CEILING MOUNTED DUCTED TYPE UNITS

These units shall be ceiling suspended with suitable supports to take care of operating weight of the unit, without causing any excessive vibration & noise. The cold air supplied by these units will be supplied to the area to be air conditioned, through duct system specified in the tender.

Each indoor unit must have electronic expansion valve operated by microprocessor thermostat based temperature control to deliver cooling/ heating as per the heat load of the room.

The unit casing shall be Galvanized Steel Plate.

Unit must be insulated with sound absorbing thermal insulation material, Glass Fibre. The noise level of unit at the highest operating level shall not exceed 49 dB(A), at a vertical distance of 1.5 m below the units with duct connected to the unit.

The unit must be able to develop external static pressure of 25 mm, at the specified air quantities. Unit must have Thermal Fuse for fan motor protection, in case of motor heating.

The unit will be connected in series to a suitable out door unit & it must be possible to operate the unit independently, through corded/ cordless remote specified in the bill of quantities.

The unit will be further connected to Intelligent Building Management System (To be supplied by other vendors) & it shall be possible to operate the unit through this IBMS system.

The unit shall be supplied with following from the factory –

- Operation Manual
- Installation Manual
- Paper pattern for installation
- Drain hose/ Clamp metal/ Insulation for fitting/ Sealing pads/ Clamps/ Screws

The unit must be available in following capacities –  
1.6 HP, 2.0 HP, 2.5 HP, 3.2 HP, 4 HP, 5 HP, 8 HP, 10 HP

### **WALL MOUNTED UNITS**

Wall mounted units must be compact & stylish design that does not detract from the décor of the room.

Each indoor unit must have electronic expansion valve operated by microprocessor thermostat based temperature control to deliver cooling/ heating as per the heat load of the room.

The unit must have provision of adding drain pump kit if required & specified. The drain pump must be suitable to lift drain up to 1000 mm from the bottom of the unit.

Unit must be insulated with sound absorbing thermal insulation material, Polystyrene/Polyethylene foam. The noise level of unit at the highest operating level shall not exceed 46 dB(A), at a vertical distance of 1.5 m from the grille of the unit.

The unit shall be supplied with Resin Net filter with Mold Resistance. The filter shall be easy to remove, clean & re install.

The unit grille must be washable with soap solution. It shall be possible to set minimum 5 steps of discharge angle by remote controller. It shall be possible to fit drain pipe from either side of the unit (Left or right)

The unit will be connected in series to a suitable out door unit & it must be possible to operate the unit independently, through corded/ cordless remote specified in the bill of quantities. The unit will be further connected to Intelligent Building Management System (To be supplied by other vendors) & it shall be possible to operate the unit through this IBMS system.

The unit shall be supplied with following from the factory –

Operation Manual

Installation Manual

Installation panel

Paper pattern for installation

Insulation tape/ Clamps/ Screws

The unit must be available in following capacities –

0.8 HP, 1 HP, 1.25 HP, 1.6 HP, 2.0 HP, 2.5 HP

## **CEILING MOUNTED BUILT – IN TYPE**

These units shall be ceiling suspended with suitable supports to take care of operating weight of the unit, without causing any excessive vibration & noise. The cold air supplied by these units will be supplied to the area to be air conditioned directly through duct collar & grille or, through duct system specified in the tender.

Each indoor unit must have electronic expansion valve operated by microprocessor thermostat based temperature control to deliver cooling/ heating as per the heat load of the room.

The unit casing shall be Galvanized Steel Plate.

Unit must be insulated with sound absorbing thermal insulation material, Glass Fibre. The noise level of unit at the highest operating level shall not exceed 48 dB(A), at a vertical distance of 1.5 m below the units with duct connected to the unit.

The unit must have provision to set external static pressure in three stages from max 10 mm to min 2 mm, depending on the air supply system.

The unit must include as standard equipment, maintenance free long-life filter, resin net with mold resistant.

The unit must include as standard equipment, a drain pump kit suitable to lift drain water up to 250 mm from the drain pipe opening.

Unit must have Thermal Fuse for fan motor protection, in case of motor heating.

The unit will be connected in series to a suitable out door unit & it must be possible to operate the unit independently, through corded/ cordless remote specified in the bill of quantities. The unit will be further connected to Intelligent Building Management System (To be supplied by other vendors) & it shall be possible to operate the unit through this IBMS system.

The unit shall be supplied with following from the factory

Operation Manual

Installation Manual

Paper pattern for installation

Drain hose/ Clamp metal/ Insulation for fitting/ Sealing pads/ Clamps/ Screws

The unit must be available in following capacities –

0.8 HP, 1 HP, 1.25 HP, 1.6 HP, 2.0 HP, 2.5 HP, 3.2 HP, 4 HP, 5 HP

## **FLOOR MOUNTED DUCT TYPE UNITS**

Floor mounted units must be compact & stylish design. Unit must have electronic expansion valve operated by microprocessor thermostat based temperature control to deliver cooling/heating as per the heat load of the room.

The unit must have provision of adding drain pump kit if required & specified. The drain pump must be suitable to lift drain up to 1000 mm from the bottom of the unit.

Unit must be insulated with sound absorbing thermal insulation material, Polystyrene/Polyethylene foam. The noise level of unit at the highest operating level shall not exceed 46 dB(A), at a vertical distance of 1.5 m from the grille of the unit.

The unit shall be supplied with Resin Net filter with Mold Resistance. The filter shall be easy to remove, clean & re install.

The unit will be connected in series to a suitable out door unit & it must be possible to operate the unit independently, through corded/ cordless remote specified in the bill of quantities. The unit will be further connected to Intelligent Building Management System (To be supplied by other vendors) & it shall be possible to operate the unit through this IBMS system.

The unit shall be supplied with following from the factory –

Operation Manual

Installation Manual

Installation panel

Paper pattern for installation

Insulation tape/ Clamps/ Screws

The unit must be available in following capacities –

10.0 HP, 16.0 HP, 20.0 HP

## **SPECIFICATION FOR CONTROLS SYSTEM FOR VRV/VRF AIR CONDITIONING SYSTEM**

### **WIRED REMOTE CONTROLLER**

Wired remote controller shall be supplied as specified in the “Bill of Quantities”.

The controller must have large crystal display screen, which displays complete operating status.

The digital display must allow setting of temperature with 1 Deg C interval.

Remote shall be able to individually program by timer the respective times for operation start and stop within a maximum of 72 hours

Remote must be equipped with thermostat sensor in the remote controller that will make possible more comfortable room temperature control

The remote shall be able to monitor room temperature & preset temperature by microcomputer & can select cool/ heat operation mode automatically.

The remote must constantly monitor malfunctions in the system & must be equipped with a "self diagnosis function" that let know by a message immediately when a malfunction occurs.

It shall be possible to wire the remote up to 500 RMT.

### **WIRELESS REMOTE CONTROLLER**

Wireless remote controller shall be supplied as specified in the "Bill of Quantities"

The same operation modes & settings as with wired remote controllers must be possible. Compact light receiving unit to be mounted into wall or ceiling shall be included.

### **CENTRAL REMOTE CONTROLLER**

Central Remote controller shall be supplied as specified in the "Bill of Quantities"

Following functions shall be possible

- Control Max 64 Groups (128 indoor units)
- Zone control
- Malfunction code display
- All the functions available with wired remote controller
- It should be possible to wire the remote to 1000m

### **BUILDING MANAGEMENT SYSTEM (BAC NET GATEWAY)**

The VRV/VRF system supplied must be suitable for communication between VRV/VRF & intelligent building management system of other reputed vendors, like Siemens, Honeywell, Johnson Controls, through BAC Net gateway.

The BAC Net gate way shall utilize the standard communication protocol for the HVAC industry, to provide easy connection between VRV/VRF system & BMS.

The joint Matching Test shall be conducted by VRV/VRF vendor with the selected BMS vendor & entire be commissioned & balance.

Complete operation & monitoring of VRV/VRF air conditioning system shall be possible through the BMS system.

Following major functions shall be possible via BAC net interface on BMS

Monitoring	Air conditioning status monitoring Indoor unit error monitoring Indoor air inlet temperature monitoring Filter choke sign monitoring
Control, Operation & Setting	Start/ Stop control Temperature adjustment mode setting Remote control setting Temperature setting Filter sign reset
Display	Air conditioner operation setting & status Set temperature Indoor unit error Indoor air inlet temperature Filter sign

The BAC Net gate way shall be as per ASHRAE 135, Data link - IEE802.3, BACnet/IP, conformance Class 3, with RS232C port.

BAC Net gateway hard ware shall be suitable for operation between -10 Deg C to 50 Deg C & humidity range between 0% to 98% without condensation.

### **AIR CONDITIONING MANAGEMENT SYSTEM**

The VRV/VRF system supplied must be provided with PC based air conditioning management system, form the supplier of VRV/VRF equipments. The required hard ware must be selected, suitable for up to minimum 128 indoor units. The air conditioning management system, in broad terms must undertake following functions

Energy efficiency functions Control & optimization of system Operation & monitoring expanded network functions

Complete operation & monitoring of VRV/VRF air conditioning system shall be possible through this PC based system.

Following major functions shall be possible:

Monitoring	Air conditioning status monitoring Indoor unit error monitoring Indoor air inlet temperature monitoring Filter choke sign monitoring
Control, Operation & Setting	Start/ Stop control Temperature adjustment mode setting Remote control setting Temperature setting Filter sign reset
Display	Air conditioner operation setting & status Set temperature Indoor unit error Indoor air inlet temperature Filter sign
Measurement	Accurate operation time Number of switching times Power consumption (Optional with KWH meter) Room temperature Outdoor temperature
Printing	History Statistics Setting information

- The A/C management system must be able to connect to existing LANs.
- Remote monitoring of the complete HVAC system shall be possible.
- System shall be capable to take external signal like Security/ Fire for forced shut off.
- Required hardware shall be suitable for operation between -10 Deg C to 50 Dg C & humidity range, of 0% to 98%, without condensation.

**NOTE - ALL OUT-DOOR UNITS SHALL BE MOUNTED ON MS ANGLE FRAME STRUCTURE. THE MS ANGLE FRAME STRUCTURE SHALL BE PAINTED WITH EPOXY PAINT. THE SHADE OF THE PAINT SHALL BE APPROVED BY THE ARCHITECT.**

### **CONTROLS AND INTERLOCKING**

All electrical control devices should be enclosed in the indoor and outdoor units. The compressor should be protected against breakdown by a quick response over current relay, a high-pressure switch, a wrap around type oil heater and a discharge gas thermistor.

In addition to the compressor protection devices, the indoor / outdoor fan motor should be protected by an internal thermostat.

The indoor fan motor shall be directly supplied with the power source from the control circuit. The functions of these control devices shall compose an electrical sequence of manual starting and stopping, automatic continuous operation whenever the room thermostat requires, and the protection devices allow the operation.

The remote control switch should be designed to provide simple operation such as On/Off, temperature and fan speed only without trouble shooting functions.

The remote control should be BMS compatible for centralized monitoring. All units/remote control shall have COM port for required interface with BMS.

**The required software with open protocol to transfer readings on the BMS shall be in your scope.**

### **REFRIGERANT PIPING**

The indoor and outdoor units shall be connected with 16G Hard Copper refrigerant piping. All piping connections for the units should be performed inside the unit. The refrigerant piping should be insulated with EPDM Rubber foam of minimum 12 MM thick (or as recommended by manufacturer). Lastly, cover up the pipes sections with the help of 36 G Aluminium sheets on straight pipes and 28 G Al. sheet on bends, tees, valves etc.

### **DRAIN PIPING**

Condensate from the evaporator unit shall be drained through properly installed drain piping designed to prevent any accumulation of condensate in the drain pan.

Drain piping shall be made of 1.1/4" dia / 2" dia rigid PVC pipe of 6 Kg/Sq cm. pressure rating with water tight threaded connections, leading from the room unit to a suitable drain point. Complete drain piping shall be made leak proof and water tight by means of precise installation and the use of leak proof sealant/adhesives.

**Insulation of drain piping will be done by elastomeric EPDM Rubber foam / EPDM to be done with thickness recommended by manufacturer.**

## **2.2 FANS**

### **a. SCOPE**

The scope of this section comprises the supply, erection, testing and commissioning of centrifugal, in-line and propeller type fans and roof mounted units conforming to these Specifications and in accordance with the requirement of Drawings and Schedule of Quantities.

**b. TYPE**

Centrifugal, in-line propeller fans and roof mounted units shall be of the type as indicated on Drawings and identified in Schedule of Quantities.

**c. CAPACITY**

The air-moving capacity of fans shall be as shown on Drawings and in Schedule of Quantities.

**2.3 CENTRIFUGAL FAN**

Centrifugal fan shall be DWDI / SWSI Class I construction arrangement 3 (i.e. bearings on both the sides) for DWDI fans complete with access door, squirrel-cage induction motor, V-belt drive, belt guard and vibration isolators, direction of discharge / rotation, and motor position shall be as per the Approved-for-Construction shop drawings.

A. Housing shall be constructed of 14 gage sheet steel welded construction. It shall be rigidly reinforced and supported by structural angles. Split casing shall be provided on larger sizes of fans, however neoprene / asbestos packing should be provided throughout split joints to make it air-tight.

18 gauge galvanized wire mesh inlet guards of 5 cm sieves shall be provided on both inlets. Housing shall be provided with standard cleanout door with handles and neoprene gasket. Rotation arrow shall be clearly marked on the housing.

B. Fan Wheel shall be backward-curved non-over loading type. Fan wheel and housing shall be statically and dynamically balanced. For fans up to 450 mm dia., fan outlet velocity shall not exceed 550 meter/minute and maximum fan speed shall not exceed 1450 rpm. For fans above 450 mm dia., the outlet velocity will be within 700 meter/minute and maximum fan speed shall not exceed 1000 RPM. High static pressure fan speed shall be as per manufacturer.

C. Shaft shall be constructed of steel, turned, ground and polished.

D. Bearings: shall be of the sleeve / ball-bearing type mounted directly on the fan housing. Bearings shall be designed especially for quiet operation and shall be of the self-aligning, oil / grease pack pillow block type.

E. Motor: Fan motor shall be energy efficient and suitable for  $415 \pm 10\%$  volts, 50 cycles, 3 phase AC power supply, squirrel-cage, totally enclosed, fan-cooled motor, provided with class F insulation, and of approved make. Motor name plate horsepower shall exceed

brake horsepower by a minimum of 10%. Motor shall be designed especially for quiet operation and motor speed shall not exceed 1440 rpm. The fan and motor combination selected for the particular required performance shall be of the most efficient (smallest horse power), so that

Sound level is lowest.

F. Drive to fan shall be provided through belt with adjustable motor sheave and a standard belt guard. Belts shall be of the oil-resistant type.

G. Vibration Isolation: MS base shall be provided for both fan and motor, built as an integral part, and shall be mounted on a concrete foundation through resistoflex vibration isolators. The concrete foundation shall be at least 15 cm above the finished floor level, or as shown in approved-for-construction shop drawings.

## **2.4 PROPELLER FAN**

Propeller fan shall be direct-driven, three or four blade type, mounted on a steel mounting plate with orifice ring.

a. Mounting Plate shall be of steel construction, square with streamlined venture inlet (reversed for supply applications) coated with baked enamel paint. Mounting plate shall be of standard size, constructed of 12 to 16 gauge sheet steel depending upon the fan size. Orifice ring shall be correctly formed by spinning or stamping to provide easy passage of air without turbulence and to direct the air stream.

b. Fan Blades shall be constructed of aluminium or steel. Fan hub shall be of heavy welded steel construction with blades bolted to the hub. Fan blades and hub assembly shall be statically and dynamically balanced at the manufacturer's works.

c. Shaft shall be of steel, accurately ground and shall be of ample size for the load transmitted and shall not pass through first critical speed thru the full range of specified fan speeds.

d. Motor shall be standard (easily replaceable) permanent split capacitor or shaded pole for small sizes, totally enclosed with pre-lubricated sleeve or ball bearings, designed for quiet operation with a maximum speed of 1000 rpm for fans 60 cm dia. or larger and 1440 rpm for fans 45 cm dia. and smaller. Motors for larger fans shall be suitable for  $415 \pm 6\%$  volts, 50 cycles 3 phase power supply, and for smaller fans shall be suitable for  $220 \pm 6\%$  volts, 50 cycles single phase power supply. Motors shall be suitable for either horizontal or vertical service as indicated on Drawings and in Schedule of Quantities.

e. Accessories: The following accessories shall be provided with propeller fans:

- i. Wire guard on inlet side and bird screen at the outlet.
- ii. Fixed or gravity louvers built into a steel frame at the outlet.
- iii. Regulator for controlling fan speed for single phase fan motor.
- iv. Single phase preventers for 3 phase fans.

## **2.5 SHEET METAL WORK**

### **FLEXIBLE ALUMINIUM DUCTING**

The ducting shall be fully flexible, compressible and extendable made of 2 ply multi layered aluminium polyester foil bonded together by quality adhesive and reinforced with high carbon corrosion proof spring wire. The distance between spring wires shall not exceed 1". The ducting shall be strong, durable and should not go out of shape even fully extended. The ducting should be also available with insulation of desired thickness.

### **SMACNA STANDARDS**

Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standards – Metal and Flexible – Second Edition – 1995"-SMACNA)

All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I. raw material furnished with accompanying Mill Test Certificates.

Galvanizing shall be of 120gms/sq. m (total coating on both sides). 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.

### **SELECTION OF G.I. GAUGE AND TRANSVERSE CONNECTORS**

Duct Construction shall be in compliance with 1" (250 Pa) w.g. static norms as per SMACNA. All transverse connectors shall be the 4-bolt slip-on flange system standard makes of similar 4-bolt systems with built-in sealant.

The specific class of transverse connector and duct gauge for a given duct dimensions will be as per Table given below for the 1" (250 Pa) pressure class.

Non-toxic, AC-applications grade P.E. or PVC Gasketing is required between all mating flanged joints. Gasket sizes should conform to flange manufacturer's specification.

## SMACNA STANDARDS

FOR SELECTION OF FLANGE CLASS AND DUCT GAUGES AT 1200 MM SPACING

Duct Pressure in Inches / (Pascal)

Class

(in mm)	Reinforcement Class - Duct Gauge on						
upto 250	*3E-26	E-26	E-26	E-26	E-26	E-24	
251-300		E-26	E-26	E-26	E-26	E-24	E-24
					26	2	
301-350						6	
		E-26	E-26	E-26	E-26	E-26	E-22
351-400		E-26	E-26	E-26	E-26	E-26	E-22
401-450		E-26	E-26	E-26	E-26	E-26	H-20
451-500		E-26	E-26	E-26	E-24	E-24	H-20
501-550		E-26	E-26	E-26	E-24	E-24	H-20
551-600		E-26	E-26	E-26	E-24	E-24	H-20
601-650		E-26	E-26	E-26	E-24	E-24	H-20
651-700*2		E-26	E-26	E-26	E-24	H-24	H-18
701-750		E-26	E-26	E-26	E-24	H-24	J-18
751-900		E-26	E-24	H-22	H-22	H-22	J-18
901-1000		E-26	H-24	H-22	H-22	H-20	J-16
10 01-1200		E-24	H-22	H-22	H-20	J-18	
12 01-1300		*3H-24	H-20	H-20	J-18	J-18	
13 01-1500		H-24	H-	H-	J-18	J-16	NOT
			1				DESIGNED
			8				
15 01-1800		H-22	J-18	J-18	J-16		
18 01-2100		*3J-20	*3J-20	*3J-20			
2101-2400		J-18	J-18	J-18			
2401-2700	J-18						

Notes:

\*1-SMACNA – Sheet Metal & Air conditioning Contractors’ National Association Inc – “HVAC Duct Construction Standards- Metal and Flexible”- 1995, U.S.A.

\*2-Reading Guide - For duct sizes between, say, 651 mm and 700 mm, when the pressure class is 1” w.g. static, we require a standard ‘E’ class flange and duct gauge of 26. For the same size range but with static pressure at 4” w.g. a standard ‘H’ class flange with duct gauge of 24 should be used.

\*3 - The standard flange classes available are designated E, H and J. For E & H class of standard make use gasket size 10 mm wide and 4.5 mm thick. For standard J-class use 15 mm wide and 6 mm thick gasket.

## **DUCT CONSTRUCTION**

The fabricated duct dimensions should be as per approved drawings and all connecting sections are dimensionally matched to avoid any gaps.

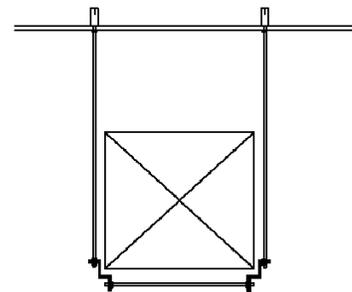
**Dimensional Tolerances:** All fabricated dimensions will be within +/- 1.0mm of specified dimension. To obtain required perpendicularity, permissible diagonal tolerances shall be +/- 1.0 mm per meter. Each and every duct pieces should be identified by color coded sticker which shows specific part numbers, job name, drawing number, duct sizes and gauge. Ducts shall be straight and smooth on the inside. Longitudinal seams shall be airtight and at corners only, which shall be either Pittsburgh or Snap Button Punch as per SMACNA practice, to ensure air tightness. Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Turning vanes or air splitters shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.

**Plenums shall be shop/** Reinforcement of ducts shall be achieved by either cross breaking or straight beading depending on length of ducts

As per SMACNA page no. 1.74, fig. 1-8 "Duct Sizes 19" (483 mm) wide and larger which have more than 10 ft<sup>2</sup> of unbraced panel shall be beaded or cross broken unless ducts will have insulation covering or acoustical liner. This requirement is applicable to 20 G (1.00 mm) or less and 3" W.G. (750 Pa) pressure or less. Ducts for 4" W.G. (1000 Pa) or more do not require beads or cross-breaks." factory fabricated panel type and assembled at site.

## **SUPPORT FOR HORIZONTAL RECTANGULAR DUCT**

	<b>Maximum Duct</b>	<b>Hanger Rod</b>	<b>Interval</b>
	Upto - 700	6 mm	2400
	701 - 1200	8 mm	2400
	1201 - 2000	10 mm	2400
	Above 2000	12 mm	2400



As an alternative, slotted galvanized brackets attached to the top two bolts of the Rolamate system may also be used as appropriate for the site condition. To provide the required thermal brake effect, Neoprene or equivalent material of suitable thickness shall be used between duct supports and duct profiles in all supply air ducts not enclosed by return air plenums.

## **INSTALLATION PRACTICE**

All ducts shall be installed as per tender drawings and in strict accordance with approved shop drawings to be prepared by the Contractor. The Contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these specifications and drawings. The work shall meet with the approval of Owner's site representative in all its parts and details.

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 there is interference/fouling with other beams, structural work, plumbing and conduits, the ducts shall be suitably modified as per actual site conditions.

Ducting over false ceilings shall be supported from the slab above, or from beams. In no case shall any duct be supported from false ceilings hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other contractor's work in the building.

Where ducts pass through brick or masonry openings, it shall be provided with 25mm thick appropriate insulation around the duct and totally covered with fire barrier mortar for complete sealing.

All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge.

## **TESTING**

After duct installation, a part of duct section (approximately 5 % of total ductwork) may be selected at random and tested for leakage. The procedure for leak testing should be followed as per SMACNA- "HVAC Air Duct Leakage Test Manual" (First Edition)

## **LOW LEAK DAMPER**

Damper shall be opposed blade type, blades shall be made of double skinned aerofoil Aluminium sections with integral gasket and assembled within a rigid extruded Aluminium alloy frame.

All linkages and supporting spindles shall be made of Aluminium or nylon, turning in Teflon bushes and linkages shall be extended for motorized operation wherever specified.

Manual dampers shall be provided with a Bakelite knob for locking the damper blades in position. Damper frames shall be sectionalized to minimize blade warping.

Air leakage through dampers when in the closed position shall not exceed 15 % of the maximum design volume flow rate at the maximum design pressure.

A fire damper shall be provided at crossing of fire rated walls. The fire dampers shall be confirming to UL-655 and other applicable fire codes. The dampers shall be operated through either fusible link or solenoid valve.

### **DAMPERS-**

All dampers shall be of 18 S.W.G. G.I sheets louver dampers of robust construction and tight fitting. The design, method of handling and control, shall be suitable for the location and service required. Dampers shall be provided with suitable links, levers and quadrants as required for their proper operation, control or setting in any desired position. Dampers and their operating devices shall be made robust, easily operable and accessible through suitable access door. Every damper shall have indication device clearly showing the damper position at all times. All the bushing will be of brass only.

A fire damper shall be provided between each air handling unit room and the rest area and at crossing of fire rated walls. The fire dampers shall be confirm to UL-655 and other applicable fire codes. The dampers shall be operated through either fusible link or solenoid valve.

### **GRILLES AND DIFFUSERS-**

All grilles (SA & RA), diffusers (SA & RA) will be made from heavy gauge extruded Aluminium sections / M.S. (As specified in the BOQ) duly powder coated to match the interior requirements of Architect / Client.

All the supply air grilles/diffusers will be provided with opposed blade volume control dampers fabricated from Al. anodized in matt black shade. The damper should be suitable for operation from front face of grille/diffuser. The grilles / diffusers must be submitted to Architect / HVAC consultant / PMC / Client for prior approval before procurement and installation.

### **INSTALLATION-**

A good quality expanded polyethylene /rubber of uniform thickness and width shall be used as gasket between flange joints. The gaskets shall be fixed by a suitable adhesive and holes made by passing a heated rod through.

1. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees or angles of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing. All the joints shall be made tight and all interior surfaces shall be smooth. Bends shall be made with radius not less than one half the width of the duct or with properly designed interior curved vanes where metal ducts or sleeves terminate in woodwork, brick or masonry openings, tight-flanged collars. Ducting over false ceiling shall be supported from the slab above or from beams.

In no case a duct shall be supported from the false ceiling hangers or to be permitted to rest on a hung ceiling.

2. All holes in concrete, masonry etc. made by contractor for fixing supports etc. shall be made good and restored to original finish by him.
3. Air handling units and fans shall be connected to duct work by inserting at air inlet and air outlet a double canvass sleeve. Each sleeve shall be minimum 100mm long, securely bolted to duct and units. Each sleeve shall be made smooth and the connecting ductwork rigidly held in the line with unit inlet or outlet.

## **TESTING-**

**All the test readings shall be furnished for peak summer and monsoon outside conditions.**

1. After completion all such system shall be tested for leakage.
2. The entire air distribution system shall be balanced to supply the air quantities as required in various zones and rooms to maintain the specified room conditions. The final readings shall be recorded and submitted to the Consultant for approval before acceptance and taking over of the entire system by the Employer.

## **PAINTING-**

Angle iron flanges, stiffeners, hangers and supports shall be painted with 2 coats of anti rust primer and those remaining uncovered shall be further painted with 2 coats of synthetic enamel paints of black color.

## **2.6 INSULATION**

### **FOR G.I. DUCTING**

### **SPECIFICATION FOR THERMAL & ACOUSTIC INSULATION**

#### **SCOPE**

The scope of this section comprises the supply and application of insulation conforming to these specifications.

#### **DUCT INSULATION**

##### **MATERIAL**

1. Insulation material shall be Closed Cell Elastomeric Nitrile Rubber
2. Density of Material shall be between 40 to 60 Kg/m<sup>3</sup>
3. Thermal conductivity of elastomeric nitrile rubber shall not exceed 0.033 W/m.K at mean temperature of 0°C
4. Insulation material shall have anti-microbial product, which is EPA (Environmental Protection Agency), USA approved, as an integral part of insulation that cannot be washed off or worn off.
5. It shall give enhanced level of protection against harmful Microbes such as bacteria, mold, mildew and fungi and should conform to following standards: Fungi Resistance – ASTM G21 and Bacterial resistance – ASTM G 22 / ASTM 2180.
6. The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O' Fire category

as per 1991 Building Regulations (England & Wales) and the Building Standards (Scotland) Regulations 1990

7. Material should be FM (Factory Mutual), USA approved.
8. Water vapor permeability shall not exceed  $1.74 \times 10^{-14}$  Kg / (m.s.Pa), i.e. Moisture Diffusion Resistance Factor or 'μ' value should be minimum 10000.

**Thickness of the insulation shall be as specified for the individual application.**

<b>THICKNESS SELECTION CHART FOR NITRILE RUBBER INSULATION Design Basis: Condensation Control</b>	
<b>OUTDOOR, ATTIC &amp; UNCONDITIONED SPACES VENTED TO OUTDOOR Design Conditions: 28.3 Deg. C &amp; 90% RH (as per ASHRAE guidelines)</b>	
<b>DUCT INSULATION</b>	<b>Required Thickness (mm)</b>
Supply Air Duct (Line Temperature 14 Deg. C)	13
Return Air Duct (Line Temperature 22 Deg. C)	9

External thermal insulation shall be provided as follow:

The thickness of the nitrile rubber shall be as shown on drawing or identified in the schedule of quantity. Following installation procedure should be adopted:

1. Duct surfaces shall be cleaned to remove all grease, oil, dirt, etc. prior to carrying out insulation work.
2. Measurement of surface dimensions shall be taken properly to cut closed cell elastomeric rubbers sheets to size with sufficient allowance in dimension.
3. Material shall be fitted under compression and no stretching of material should be allowed.
4. A thin film of adhesive shall be applied on the back of the insulating material sheet and then on to the metal surface.
5. When adhesive is tack dry, insulating material sheet shall be placed in position and pressed firmly to achieve a good bond.
6. All longitudinal and transverse joints shall be sealed as per manufacturer recommendations.
7. The adhesive shall be strictly as recommended by the manufacturer.
8. The detailed Application specifications are as per the manufacturer's recommendation.

#### **INSTALLATION OF DUCTS EXPOSED DIRECTLY TO SUNLIGHT:**

For installations exposed to sunlight, after giving 36 hours curing time for the adhesive apply manufacturer's recommended UV/Mechanical Protection. Please refer the separate detailed guidelines on UV/Mechanical Protection.

#### **ACOUSTIC INSULATION**

1. Material shall be engineered Nitrile Rubber open cell foam
2. The Random Incidence Sound Absorption Coefficient (RISAC); tested as per ISO 354, should be minimum as per enclosed chart

<b>Freq (Hz)</b>	<b>125</b>	<b>250</b>	<b>500</b>	<b>1000</b>	<b>2000</b>	<b>4000</b>	<b>NRC</b>
<b>10 mm</b>	0.03	0.04	0.14	0.04	0.88	1.00	0.35
<b>15 mm</b>	0.01	0.09	0.29	0.74	1.08	0.83	0.55
<b>20 mm</b>	0.04	0.13	0.4	0.9	1.04	0.90	0.60
<b>25 mm</b>	0.02	0.25	0.86	1.14	0.88	0.99	0.80
<b>30 mm</b>	0.07	0.32	0.99	1.16	0.93	1.08	0.85
<b>50 mm</b>	0.23	0.73	1.29	0.99	1.09	1.11	1.05

1. The material should be fibre free
2. The density of the same shall be within 140-180 Kg/m<sup>3</sup>
3. It should have Microban®\*; antimicrobial product protection, and should

pass Fungi Resistance as per ASTM G 21 and Bacterial Resistance as per ASTM E 2180.

4. The material should have a thermal conductivity not exceeding 0.047 W/m.K @ 20 Deg. C
5. The material should withstand maximum surface temperature of +850C and minimum surface temperature of -200C
6. The material should conform to Class 1 rating for surface spread of Flame in accordance to BS 476 Part 7 & UL 94 (HBF, HF 1 & HF 2) in accordance to UL 94, 1996.
7. The insulation should pass Air Erosion Resistance Test in accordance to ASTM Standard C 1071-05 (section 12.7).

Thickness of the material shall be as specified for the individual application. The insulation should be installed as per manufacturer's recommendation.

- Microban is a registered trademark of the Microban Products Company, USA.

### **DUCT ACOUSTIC LINING**

Ducts so identified and marked on Drawings and included in Schedule of Quantities shall be provided with acoustic lining of thermal insulation material for a distance of minimum 5 meters (or 30% of the duct length whichever is more).

#### **Installation Procedure**

The inside surface for the ducts shall be covered with adhesive recommended by the manufacturer. Cut Foamed sheets into required sizes apply adhesive on the foam and stick it to the duct surface

#### **(A) FALSE CEILING INSULATION**

The false ceiling shall be insulated with 50 mm thick fibreglass slab of 16 Kg. / Cu. M. density. The fibreglass slab shall be wrapped in polyethylene bags.

#### **(B) UNDERDECK INSUALTION**

1. Insulation material shall be Closed Cell 25 MM Elastomeric Nitrile Rubber.
2. Density of Material shall be between 40 to 60 Kg/m<sup>3</sup>
3. Thermal conductivity of elastomeric nitrile rubber shall not exceed 0.033 W/m.K at mean temperature of 0°C
4. Insulation material shall have anti-microbial product, which is EPA (Environmental Protection Agency), USA approved, as an integral part of insulation that cannot be washed off or worn off.
5. It shall give enhanced level of protection against harmful Microbes such

as bacteria, mold, mildew and fungi and should confirm to following standards:  
Fungi Resistance – ASTM G21 and Bacterial resistance – ASTM G22 / ASTM 2180.

6. The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7. for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O' Fire category as per 1991 Building Regulations (England & Wales) and the Building Standards (Scotland) Regulations 1990
7. Material should be FM (Factory Mutual), USA approved.
8. Water vapor permeability shall not exceed  $1.74 \times 10^{-14}$  Kg / (m.s.Pa), i.e. Moisture Diffusion Resistance Factor or ' $\mu$ ' value should be minimum 10000.

## **2.7 FRESH / EXHAUST FAN-**

Fresh / Exhaust fan will be heavy-duty industrial type, suitable for three / single-phase power supply and continuous operation with epoxy painting and direct driven motor. The fresh / exhaust air fans shall have casing as that of air handling unit.

All exhaust fans and roof extractor shall be installed as shown in drawing and shall be provided with cowl bend, in take louvers, bird screen etc.

The exhaust fan, cowl bend, in take louvers, bird screen etc. shall be measured as one unit under exhaust fan / roof extractor.

## **2.8 CROSS TALK SILENCER**

The cross-talk silencer should incorporate aerodynamic side lines with erosion protected class "O" acoustic in fills covered with perforated sheet metal. The casing should be manufactured as per DW 142 class B code and should be of galvanized sheet metal 1 mm thick to BS 2989 grade Z2 G275.

## **2.9 FLEXIBLE DUCTING**

The scope of this section comprise supply, installation, testing and commissioning of flexible ducting conforming to this specifications & in accordance with the requirements of drawings and schedule of quantities. Wherever specified uninsulated flexible duct shall be made of double lamination of Metalized Polyester film permanently bonded to a coated spring steel wire helix. Duct shall be tear & puncture resistant construction.

Wherever insulated flexible duct are specified inner core for the same should be made of double lamination of Metalized Polyester film permanently bonded to a coated spring steel wire helix. Fibre glass insulation of minimum

14 kg/cu meter density having R-value 4.2° F - Ft<sup>2</sup> - hr/Btu & 32 mm thickness shall be wrapped over the inner core & covered with strong outer jacket

cum vapour barrier made of fiberglass reinforced Metalized polyester film laminate. Care must be taken to install the entire flexible duct in fully extended position & bends made with adequate radius as per manufacturer recommended practices. Duct should confirm to Australian Fire Standard AS 4254.

### **SPECIFICATIONS FOR PAINTING WORK**

1. Cleaning the surface
2. Apply a primer coat of Red Oxide
3. Applying two coats of enamel paint of APPROVED colour code after applying cement primer for plastered surface.
4. Standard colour code.
  - a) Condensing unit : Battleship Grey.
  - b) Gauge panel : Siemens Grey
  - c) All supports /stands : Black
  - d) Ducting Concealed : Black Rust Proof
  - Exposed to Grilles Insulated /uninsulated duct : Black
  - Exposed : Fiesta Blue
  - e) Electric Panels : Steel Grey
  - e) Motor : Siemens Grey

### **MODE OF MEASUREMENT**

All painting works shall form part of the cost equipment, piping etc. No separate payment shall be advisable.

The colour of the chiller package supplied by the vendor may be accepted.

### **MODE OF MEASUREMENT**

All painting works shall form part of the cost equipment, piping etc. No separate payment shall be advisable.

## **IS. CODES**

**Following IS CODES will be applicable for the project.**

1)	IS : 659 - 1964 :	Safety Code for Air-conditioning.
2)	IS : 660 - 1963	Safety Code for Mechanical Ref.
3)	IS : 5111 - 1969 :	Code of Practice and Measurement Procedure for Testing Refrigerant Compressors.
4)	IS : 325 - 1970 :	Specifications for 3 Ph. Induction Motor. Also confirm to IS : 1231 for Foot Mounted and IS : 2223 for flange mounted motors.
5)	IS : 2147 - 1962 :	Degree of protection provided by enclosures for low voltage switch and control gears.
6)	IS : 3012 - 1965 :	Code of Practice for installation (PART-I)& Maintenance of switchgear.
7)	IS : 3016 - 1982 :	Code of Practice for Fire precautions in Welding and cutting operations.
8)	IS : 3615 - 1967 :	Glossary of terms used in Refrigeration and Air-Conditioning.

### **9) Indian Standard For Insulation Work**

1)	IS : 4671 - 1984 :	Expanded Polystyrene for Thermal insulation purposes
2)	IS : 661 - 1974	Code of Practice for Thermal Insulation of Cold Storages.
3)	IS : 7240 - 1981 :	Code of Practice for Application and finishing of Thermal Insulation
4)	IS : 7413 - 1981 :	Code of Practice for Application material at Temp. from – 80°C to 40°C. & finishing of Thermal Insulation material at Temp. from 40°C to 700°C.

5)	IS : 8183 - 1976	:	Specifications for Bonded Mineral Wool.
10)	IS : 1239	:	Pipes up-to 150 MM Dia.

11)	IS : 3589	:	Pipes above 200 MM Dia.
12)	IS : 780/ISI	:	Values of PN 1.6 rating Certificate
13)	IS :5312/ISI Certificate	:	Check Valves
14)	IS : 900	:	Installation of motor
15)	IS :4064 & 4047	:	Switch fuse unit
16)	IS : 2516	:	ACB
17)	Relevant IS	:	MCCB
18)	IS : 3069	:	Glossary of Items symbols and units relating thermal materials.
19)	IS : 702	:	Industrial bitumen.
20)	IS : 8183	:	Bonded Mineral Wool
21)	IS : 655 – 1963	:	Ducting work.
22)	IS : 277	:	For Sheet galvanising spec.
23)	IS : 3043 -1963	:	Earthing.
24)	IS : 3043	:	Earth Station.
25)	IS : 732 - 1963	:	Testing of Electrical Installation.

26)	IS : 520	:	Standard for positive displacement Refrigeration, compressor and condensing unit.
27)	IS : 2825	:	Unfired pressure vessels.
28)	IS : 4503	:	Shell and Tube type Heat Exchanger.

## **1.0 TESTING OF AIRCONDITIONING SYSTEM-**

- 1.1. Routine and types tests for various items of equipment shall be performed at the contractor's work and the test certificated furnished. Functional test shall be conducted at site.
- 1.2 The performance test to determine whether OR not the full indent of the specification is met shall be conducted by the contractor. After notification to the Employers that the installation has been completed and the system has run continuously for a period of at-least two weeks, the contractor shall conduct under the direction of the Consultants & in the presence of Employer's representatives perform such test as specified to establish the capacity of various equipment supplied and installed by the contractor.
- 1.3 The contractor shall operate test and adjust the air conditioning system units, fans, motors, all air-conditioning appliances including adjustments of regulators dampers etc.
- 1.4. All test equipment, labor, operating personnel required for this test shall be furnished by the contractor to enable the system to be put in continuous running test for a period of 3 days after all other tests and adjustments have been made. The contractor shall make arrangement of electrical power and water for testing. The performance test shall be conducted during peak summer and peak monsoon.

## **2.0 PROCEDURE**

### **2.1. Design Conditions**

The inlet and outlet conditions of Air Handling Units will be recorded for 48 hrs. (2 days) duration on hourly basis. The outside and inside Dry Bulb and Wet Bulb temperatures shall be recorded by the means of a sling psychro meter with mercury thermometers. The relative humidity shall be computed from the psychometric chart. The inside Dry Bulb temp. And relative humidity shall fall within the specified limits.

### **2.2. Capacity of the Plant**

The following aspects shall be checked before conducting the performance tests-

- i. The outside conditions shall be as close to the design values as possible. The tests shall be arranged during the peak summer and monsoon.
- ii. The internal loads of various spaces shall be close to the design values as far as possible.
- iii. The plant shall be fully loaded and the temperatures stabilized.
- iv. Hourly readings of water flow shall be recorded by a calibrated flow meter.

- v. Hourly readings of pressure, temperature, electrical current, voltage, KW, KWH and power factor shall be properly recorded.

**The capacity of the plant and various other equipments and accessories shall be ascertained as follows-**

### **3. Motor**

For all electrical motors the current, voltage and power will be recorded.

## **4.0. FUNCTIONAL TESTES**

### **4.1 Electrical Equipment**

- i. All the cables shall be tested for continuity and absence of cross phasing. Insulation resistance between the phase conductors and the earth shall be measured with the help of an 1100 megger.
- ii Motors
  - a. Insulation resistance of all motors shall be tested with a megger and the value shall not be less than 1 Meg-Ohms. If the observed value is less than 1 Meg-Ohms, the winding shall be dried out and winding shall be given a coat of approved insulating varnish.
  - b. Starting current shall be recorded every time the motor is started.
  - c. Starter operation shall be checked for single phasing by removing one of the phases.
  - d. Over load protection shall be checked by altering the starter thermal over load setting.

#### 4.2 Safety Devices and controls

[i] Interlocks for compressor motor with that of chilled water pumps. condenser water pumps and cooling tower fan shall be checked.

[ii] Flow switches in condenser water and chilled water lines shall be checked by throttling the valves.

[iii] High pressure – stat shall be checked by varying the settings of the cut out.

[iv] Low-pressure stat – shall be tested by closing the pilot solenoid valve.

[v] Anti-freeze thermostat shall be tested by varying the settings.

[vi] Oil failure switch shall be tested by varying the settings.

#### 4.3 Capacity Controls

The capacity control arrangements shall be tested by varying the load on the plant. Any other procedure recommended by the manufactures may be adopted with the prior permission of the Employers and consultants.

#### 5.0 TEST READINGS

5.1 The following readings shall be recorded hourly during the tests and capacity of the plant shall be computed.

[I]	COMPRESSOR	
1]	Suction pressure	Kg / Cm <sup>2</sup> (PSI)
2]	Suction Temperature	°C / (°F)
3]	Discharge pressure	Kg / Cm <sup>2</sup> (PSI)
4]	Discharge Temperature	°C (°F)
5]	Oil Pressure Compressor Speed Motor a] Volts b] Current c] Power factor d] Power consumption for 100%, 75%, 50% Loads	Volts Amps

<b>[II]</b>	<b>CONDENSER</b>	
1]	Refrigerant condensing temperature	°C (°F)
2]	Water flow rate	Ltr. / Sec (GPM)
3]	Entering Water Temp.	°C (°F)
4]	Leaving Water Temp.	°C (°F)
5]	Pressure drop through condenser	Kg / Cm <sup>2</sup> (PSI)
<b>[III]</b>	<b>INDOOR UNITS</b>	
1]	Air velocity	M/Hr.(FPM) <sup>2</sup>
2]	Coil Face Area	M <sup>2</sup> (SFT) <sup>3</sup>
3]	Air Quantity	Cu. M/Hr. (CFM) <sup>4</sup>
4]	Entering Air Temp. DB. Entering Air	°C (°F) <sup>5</sup>
5]	Temp. WB. Leaving Air Temp. DB.	°C (°F)
6]	Leaving Air Temp WB.	°C (°F)

### **CONTROLS, INTERLOCKS etc.**

The observations of the test shall be recorded for each item separately.

### **MODE OF MEASUREMENT**

#### **1. The following measurement code shall apply to this contract-**

##### **1.1 For Ductable / Non-Ductable VRV/VRF Unit**

The entire split unit without-door unit and in-door unit with DX coil and all Accessories, Starters, Controls, Control Panel, Control Wiring, Refrigerant Charge, Oil etc., Erection, Commissioning and Testing shall be regarded as One unit for purpose of measurement.

##### **1.1 For AHU-**

AHU with filters, fan and coil section, with motor, with base frame motor, drive and guard suitable for motor, mounting frame, vibration mounts as specified in BOQ shall from one unit of measurement. Each Motor of AHUs shall be considered as part of AHU. Installation, testing and commissioning is a part of above points.

## **1.2 For Ventilation units-**

Ventilation unit with filters, Fan and fan section, with motor, with base frame motor, drive and guard suitable for motor, mounting frame, vibration mounts as specified in BOQ shall form one unit of measurement. Installation, testing and commissioning is a part of above points.

## **2. SHEET METAL WORK-**

### **Ducting-**

- i) All sheet metal ducting work will be measured in terms of final sheet area installed in Sq. meters.
- ii) No measurement of vanes, splitters, duct dampers, deflectors, access doors etc. which are required to be installed in the duct work will be made as the same shall be deemed to be part of ducting work.
- iii) Duct fittings such as bends, elbows, tap offs, collars, transformation pieces etc. shall be treated as ordinary duct pieces with their length measured along their center line.
- iv) No duct support, stiffening, member etc. shall be measured separately. All such supports / hangers shall form part of duct work.
- v) Equipment connections such as canvas shall be deemed to be part of the ductwork and no separate measurement will be allowed.

### **Grilles-**

All grilles will be measured in terms of effective area-

Example : 600mm x 150mm grille will be measured as 0.09 Sq. meter

### **Diffusers-**

Diffusers will be measured in terms of diameter of each diffuser in centi-meter or in terms of area of diffuser.

### **Dampers-**

- i) All duct dampers shall be measured separately in terms of effective area.
- ii) Fire dampers will be measured in terms of effective area in Sq. meters.
- iii) Fresh air / exhaust air dampers will be measured as above.
- iv) No separate measurement will be made for inlet/outlet louvers, bird screen etc.

## **3. PIPING-**

- a) Piping will be measured in running length (meters)
- b) No special measurement of bends, elbows, reducer, expanders, tees, cross etc. will be made. All such fittings/accessories will be treated as normal piping.
- c) The length of piping including accessories and fittings will be measured along the center line of piping.
- d) No measurement for connectors shall be made. All connectors shall form part of piping work.
- e) No measurement of pipe supports, hanger's anchors, etc. will be made. All such items shall be deemed to form part of piping work.

#### **4. INSULATION-**

##### **Ducting Insulation-**

- i) Duct insulation will be measured on the basis of INNER LINE of insulation and not the outer line of insulation i.e. on the basis of duct surface area.  
Example: (Perimeter of duct) x 1-meter length.
- ii) No special measurement shall be made for insulation of bends, transformations pieces, tap offs, elbows etc. All such insulation shall be treated as standard duct insulation.
- iii) Insulation items shall include all accessories and finishes as specified.
- iv) No separate measurement will be made for such item.

##### **Piping Insulation-**

- i) All Piping insulation shall be in linear measure along the center of the pipe and rounded off to the nearest centimeter, over all fittings.
- ii) No separate measurement of insulation shall be made for fittings such as bends, elbows, reducers, expanders, tees, crosses, etc. All such insulation shall be linear in meters measured along the center - line of piping.
- iii) All accessories & finishes connected with insulation work shall be deemed to form part of insulation and no work shall be deemed to form part of insulation and no separate measurement will be made for such items.

##### **Equipment Insulation-**

No measurement for insulation of any equipment will be made Insulation of equipment shall be deemed to form part of the equipment.

##### **Electrical Work-**

- a) All cables shall be measured in running lengths as finally installed at site. No wastage measurement will allow.
- b) Control cable/wiring for AC system shall be treated as a lump-sum item.
- c) All measuring instruments, indicating lamps etc. shall form part of the equipment specified and no separate measurement shall be made for such items.

## 5.0 LIST OF APPROVED MAKES

Sr. No	Component	Approved Make
8.1	VARIABLE REFRIGERANT SYSTEM	mitsubishi electric / daikin / toshiba / samsung / lg / hitachi / midea
8.2	AXIAL / INLINE FAN	nicotra / punkar / flakt / comefri / ebm / abb centri-master / kruger / green
8.3	PROPELLER FAN	armonald / crompton / orient
8.4	MOTORS	ngef / crompton / seimens / bharat bijlee.
8.5	INSULATION	
	A. FIBREGLASS B. EXPANDED POLYSTYRENE C. EXPANDED POLYETHYLENE D.	fgp / up twiga / khimco beardsell / cooline nikifoam / profeel /eqvt. aeroflex / armaflex
8.6	GRILLES / DIFFUSERS	dynacraft / cosmos / caryaire / eq. approved
8.7	PRE-FILTERS	kirloskar / dyna / klenzaids / airtech.
8.8	DUCTING SHEETS	sail / nippon /
8.9	CABLES POWER CABLES	icc / cci / gloster / polycab /
	CONTROL CABLES	finolex / eqvl.appr.
8.10	CIRCUIT BREAKERS	seimens / english electric / l&t/ c & s

8.11	SWITCHES	SEIMENS / ENGLISH ELECTRIC / L&T/ C & S
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Sr. No	Component	Approved Make
8.12	STARTERS	SEIMENS / L&T / T. C.
8.13	PUSH-BUTTONS/OVERLOAD RELAY	SEIMENS / TECNIC / L&T / C & S / RASS
8.14	VOLTMETER / AMMETER	A/E - IMP
8.15	CUSHY FOOT MOUNTS	DUNLOP / EQVT. APPROVED
8.16	SIGNAL CABLES	RATRON / ASSOCIATED
8.17	POWER TRANSDUCERS	MECON / EQVT.APPRO.
8.18 8.19	P. V. C. PIPING CABLES	SUPREME / PRINCE / EQUIVALENT APPROVED (ISI)
	POWER CABLES CONTROL CABLES	ICC / CCI / GLOSTER FINOLEX / EQUI. APPROVED
8.20	COPPER PIPING	RAJCO/ MANDEV / PARASMANI

**Note – The Vendor to highlight the make of material considered while quoting.**

## **Annexure – 3**

# **FIRE FIGHTING SYSTEMS**

# **SPECIFICATIONS**

## **A. FIRE DETECTION & ALARM PANEL General**

1. The Panel shall be LPCB listed and shall comply with latest amendments of EN.
2. The panel shall be a Microprocessor based, Analogue addressable, Intelligent and networkable on fire cable, optic fibre and IP.
3. The panel shall have all necessary provisions for interfacing with BMS, smoke evacuation system, Air handling units, firefighting equipment, elevators, access control system, and other third party systems.
4. The system shall support a detector response time to meet world annunciation requirements of less than 3 to 10 seconds.

### **Main Fire Alarm Control Panel**

The control panel shall be microprocessor based networked system designed specifically for fire, emergency voice evacuation, addressable two-way emergency fire fighter communications, smoke control, integration modules for BMS or any third party control/annunciation. The control panel shall include all required hardware, software and site specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any applications can be configured, and modified. The control panel operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.

Fire Alarm panel shall be a multi-loop (exact number of loops as per schedule of quantity) panel with minimum Per loop capacity of min 225 detectors /devices put together in any combination and expandable up to two loop with capacity of more than 450 detectors / devices. It shall have a backlit 600 characters' liquid crystal display, individual coded system status LEDs, provision of internal / external printer.

The panel shall maintain a history file of the last 1000 events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries. The control panels shall also maintain a 1000 event Alarm History buffer, which consists of the 1000 most recent alarm events from the 1000 event history file.

The Loop shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU. The loop interface board shall be able to drive an LPCB twisted shielded circuit up to 4,500 feet in length. The loop Interface shall also be capable of driving an LPCB shield circuit up to 3,000 feet in length. In addition, loop wiring shall meet the listing

requirements for it to exit the building or structure.

The FAS shall have pre-signal and Positive Alarm Sequence that is the system shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. The system shall support a detector response time to meet world annunciation requirements of less than 3 to 10 seconds. To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-alarm indication shall be available at the control panel: alert and action.

The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall also support upload and download of programmed database and panel executive system program to a Personal Computer/laptop. password change screens.

The system shall provide means to obtain a variety of reports listing all event, alarm, trouble, supervisory, or security history. The system shall provide means to link one detector to up to two detectors at other addresses on the same loop in cooperative multi-detector sensing. There shall be no requirement for sequential addresses on the detectors and the alarm event shall be a result or product of all cooperating detectors chamber readings.

The Addressable Main Power Supply shall operate on 240 VAC, 50 Hz, and shall provide all necessary power for the FACP.

The FAS shall be networkable in a peer to peer style and shall be able to communicate with other network nodes. It shall be able to build a network on copper, fibre optics as well as IP.

## **B. FIRE ALARM SYSTEM DEVICES General**

1. Each device shall be LPCB Listed.
2. Addressable devices shall use simple to install and maintain decade, decimal address switches or by a soft address hand handled equipment. Devices shall be capable of being set to an address in a range of 001 to 225. Devices shall receive power and communication from the same pair of conductors of the SLC.
3. The contractors shall not install the detectors until after the construction clean-up of all trades is complete and final.
4. Initiating devices shall be installed in all areas, compartments, or locations where required by other EN codes and standards or as required by the authority having jurisdiction.
5. In the event of duplicate addressing of a device, the fire panel shall indicate this as a fault condition. However, the SLC should continue to function normally with the trouble

condition display at the Fire panel.

6. Each addressable detector & device shall respond to Fire Alarm Panel scan for information with an analog representation of measured fire related phenomena (smoke density, particles of combustion, temperature).

7. The standard base of the Detector shall be interchangeable with other Smoke / Heat / Multi-criteria Detectors.
8. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other low environmental changes that may affect their performance. The detectors shall be listed by LPCB as meeting the calibrated sensitivity test requirements of EN.
9. Addressable devices shall use simple to install and maintain hard / soft address

### **Intelligent Photoelectric Smoke Sensor**

- The Intelligent Smoke Detector is the ideal device for most application due to its excellent linear response to a wide variety of different type of smoke patterns. The unit meets the sensitivity requirement of EN 54 part 7, European Standard and approved by Loss Prevention Certificate Board (LCPB).
- Aesthetically pleasing with a low profile design, unobtrusive to complement modern building designs. The unit incorporates an intelligent processor that provides Algorithm map, Built-in A/D converter, Drift compensation, Self-Diagnosis and history log.
- The integral microprocessor analysis the signal according to the factors such as signal strength and rate of increase, then confirms these pattern with the pre-programmed fire scenarios and smoke patterns for a faster and safer response. By intelligent analysis, the smoke detection sensitivity will be automatically adjusted according to temperature change, providing a rapid response.
- Secure and speedy communication through the on board processor enables the detector to make its own decision, resulting in greater automation. The sensor and the panels utilized fuzzy logic providing an almost limitless cause and effect scenarios.
- Drift compensation, to monitor for the long term changes caused by aging, humidity, temperature, dust, etc. constant monitoring and self-adjusting, the detector updates sensitivity base line for its sensing element. Even when the detector raises a warning advising that it requires cleaning, the sensitivity remains the same as the day it was installed.
- The detector should have built in 8-bit microprocessor algorithm maps for faster response and false alarm rejection, analogue sensing, secure and speedy communication, Intelligent Linear Drift compensation, Self-diagnosis and history log, Electronic addressing, Sensing chamber for exceptional dust proof ability, Twin LED for 360° vision, Built-in remote indicator output, Low profile design.

### **Technical Specification:**

- Standard: EN54-part7
- Approval: LPCB, CE-CPD
- Protection rating: IP 23
- Operating Voltage: 24Vdc Loop voltage
- Operating Current: 5mA with remote LED indicator
- Standby Current 0.8mA
- Operating Temp: -10°C to +50°C
- Relative humidity: 95%
- Sensitivity is set within the range stipulated by LPCB standard
- Application: Indoor use
- Visual Indicator: twin LED, Red (lit steady when alarm, 3 sec interval blinking at normal state)
- Wiring: 1 pair polarized
- Dimensions: diameter 10cm; height 5cm

### **Intelligent Heat Sensor**

- This detector is extremely reliable for application in places where may have high dust levels or Smokey environments, making a normal smoke detector unsuitable, for example boiler/plant room, cars parks, kitchen, loading bays, furnace/kiln rooms. Meets the sensitivity requirement of EN 54 part 5 European Standard and approved by Loss Prevention Certificate Board (LCPB).
- Aesthetically pleasing with a low profile design, unobtrusive to complement modern building designs. The unit incorporates an intelligent processor that provides Algorithm map, Built-in A/D converter, Self-Diagnosis and history log.
- Secure and speedy communication through the on board processor enables the detector to make its own decision, resulting in greater automation. The sensor and the panels utilized fuzzy logic providing an almost limitless cause and effect scenarios.
- The integral microprocessor analysis the digital signal converted from analogue.
- Dual fixed temperature heat detector. Combining both fixed temperature and rate of rise heat detection in a single sensor. As standard the fixed temperature is set to 58°C while the rate of rise is set to 3°C in one minute.
- The detector should have built in 8-bit microprocessor, analogue sensing, secure and speedy communication, self-diagnosis and history log, field programmable electronically addressed, twin LED for 360° vision, Low profile design, built-in remote-indicat

### **Technical Specification:**

- Standard: EN54-part5
- Class: A1R detector
- Approval: LPCB, CE-CPD
- Protection rating: IP 33.
- Operating voltage: 24Vdc Loop voltage
- Operating Current: Standby Current: 0.8mA
- Alarm Current: 2mA, 5 mA; with remote LED indicator
- Operating temp: -10°C to +50°C
- Alarm Temperature: 58°C
- Relative humidity: 95%
- Sensitivity is set within the range stipulated by EN54-5 standard
- Application: Indoor use
- Detecting range: 50 sq.m. for normal area; and 20 sqm for high risk
- Visual Indicator: twin LED, Red (lit steady when alarm, 3 sec interval blinking at normal state)
- Material and colour: ABS, white
- Wiring: 1 pair non polarized
- Dimensions: diameter 10cm; height 5cm

### **Manual Call Points**

- The Manual Break Glass Call Point shall have response time of less than 1 second and shall have a very low standby current, incorporating a status LED, which flashes when, polled or is continuously lit when operated. An additional set of volt free change over contacts shall be incorporated for additional local signalling as required. The addressable code for the device shall be electronically programmed and stored in the sensor and be non-volatile. The programming of this code shall be facilitated by a digital electronic hand held device.

### **Technical Specification:**

- Standard: EN54-part 11
- Approval: LPCB, CE-CPD
- Protection rating: IP 43
- Operating voltage: Loop 24V (16V ~ 28V)
- Operating current: Standby current 0.6mA
- Alarm Current 1.8mA
- Operating temperature: -10°C to +55°C
- Relative humidity: 95%
- Application: Indoor use
- Visual Indicator: LED, Red (lit steady when alarm, 3 sec interval blinking at normal state)
- Resetting: GST key
- Front Cover: Plastic glass (optional)
- Material and colour: ABS, red
- Wiring: 1 pair non polarized
- Dimensions: 87.1mm×87.1mm×58 mm (with back-box) 87.1mm×87.1mm×23mm (Without back box) mm

## **Mounting Base**

The manual call point should be installed in compliance with all local codes having a jurisdiction in your area, BS 5389 and EN54. Surface mount and it is installed onto a standard one gang electrical box with a mounting hole that has 52mm~68mm spacing.

## **Sounder and Strobe**

- This should be a detachable, surface mounted loop powered sounder and strobe. The audio efficiency and sound distribution generate over 85 dB at 3-meter distance giving an excellent audibility from the device location. Using six highlights LED's for high intensity visual alarm to warn the people. The sounder series are convenient plug and turn installing method, two-part construction with base mounted termination allows easy installation and avoiding the wiring and connection problem associated with traditional sounder.
- The sounder should be loop powered high sound level, low power consumption High intensity LED cluster, Remote start input can be used to drive with other systems, programmable alarm mode, evacuate or alert/evacuate mode, electronically addressable, easy installation and connection, optional deep base for surface mount

## **Technical Specification:**

- Manufactured Standard: EN54-3
- Sound Level Output
  - Tone 1: Sound Level: 85dB~115dB (at 1m ahead horizontally (A weighted) Flashing Frequency:  $1.72 \times (1 \pm 20\%)$  Hz
  - Sound Pattern: 2.9KHz (150ms on /430ms off)
  - Tone 2: 85dB~115dB (at 1m ahead horizontally (A weighted)) Flashing Frequency:  $4.17 \times (1 \pm 20\%)$  Hz
  - Sound Pattern: 2.9KHz (150ms on /90ms off)
  - (Refer to sound level data below)
- Operating Current:
  - Loop: Standby-0.8mA; Alarm-9mA
- Operating Voltage: 24VDC
- Addressing: 1 or 2 using P-9910B
- Operating temp: -10°C to +50°C
- Relative humidity: 95%
- Application: Indoor use
- Protection rating: IP 33
- Material and colour: ABS, red (PANTONE 1795C)
- Wiring: 1 pair for loop
- Weight: 355g (deep base); 327g
- Dimensions:  $\phi 110\text{mm} \times 97.5\text{mm}$  (Deep Base)

$\phi 110\text{mm} \times 83\text{mm}$  (standard supplied)

## **MODULES**

### **MONITOR MODULE (FOR INPUT TO FIRE ALARM PANEL)**

The Input Device shall provide an addressable input for N.O. or N.C. contact devices such as manual water flow switches, sprinkler supervisory devices, etc. The input device shall provide a supervised initiating circuit.

An open-circuit fault shall be enunciated at the Fire Alarm panel (Subsequent alarm shall be reported.) The device shall contain an LED which blinks upon being scanned by the Fire Alarm panel. Upon determination of an alarm condition of an alarm condition, the LED shall be latched on. The operating voltage shall be in the range of 15 to 32 VDC.

### **CONTROL MODULE (FOR OUTPUT FROM FIRE ALARM PANEL)**

The control module shall provide an addressable output for a separately powered alarm indicating circuit or for a control relay. The control module shall provide a supervised indicating circuit where indicated on the plans. An open circuit fault shall be enunciated at the Fire Alarm panel.

The Output Device shall provide a control relay where indicated on the plans. The relay contacts shall be 24 V DC. The device module shall contain an LED which blinks upon being scanned by the Fire Alarm panel. Upon activation of the device, the LED shall be latched on.

### **FAULT ISOLATOR DEVICE**

A wire-to-wire short circuit fault on any circuit, before or after the circuit has been activated, shall initiate a trouble signal and shall isolate that circuit from the rest of the system. The Fault Isolator Device shall detect and isolate a short-circuited segment of a fault-tolerant loop. The device shall automatically determine a return to normal condition of the loop and restore the isolated segment. The fault isolator device shall be placed every [18 - 20] devices to limit the number lost in the event of a short-circuit.

## **Annexure – 4**

# **SOLAR SPECIFICATION**

## **Technical specifications of the 75 kW Grid Tied Solar Plant (without battery back-up)**

Engineering, Procurement & Construction (EPC) of 75 KWp, Rooftop SPV Power plants without battery back-up with five years of comprehensive maintenance contract at roof-top of Car Shades at Building at MMRC Mumbai.” The general scope under this contract includes Engineering, Procurement, Construction & design, manufacture, testing, inspection, taking approval from concern power supply company arrangement of net metering, EI sanction, packing & forwarding, transportation up to project site, loading & unloading, storage in safe custody, erection, carrying out preliminary tests at site, commissioning, performance testing, operation and maintenance for five years & handing over the equipment installed for 75 KWp SPV Power plant to Mumbai (MMRC). The illustrative schedule of requirements will be in accordance with the specifications contained in this document.

### **TECHNICAL SPECIFICATIONS.**

All the items against which no make has been mentioned must confirm to MNRE & ISI standards. The SPV Power plant shall have a total capacity of 75 kW Grid Tied (without battery backup). The power plant provides a reliable and independent power supply to loads in the building. The power plant shall have a provision to export excess power generated to building LT Supply / Grid and shall have a provision to import the power from the grid for localized use in case of load exceeding PV generation. The inverter shall be designed to convert DC power produced by SPV modules into AC power and adjust the voltage and frequency levels to suit grid voltage and frequency. The inverter shall work in parallel with either Grid supply or generator supply monitoring devices shall be provided to monitor Grid energy, solar energy and generator energy separately.

### **SOLAR PHOTOVOLTAIC MODULES**

The PV modules must confirm to the latest edition of any of the following IEC / Equivalent BIS Standard for PV module design qualification & type approval - Crystalline Silicon Terrestrial Modules IEC 61215 / IS 14286. Thin Film Terrestrial PV Modules IEC 61646 / Equivalent IS Concentrator PV Modules & Assembly IEC 62108 In addition, the Modules must confirm to IEC 61730 Part 1- requirement for construction & Part 2 –requirement for testing, for safety qualification or equivalent IS.

1. The total solar PV array capacity should not be less than 75 kWp (AS PER DESIGN) and should comprise of solar crystalline modules of appropriate power totalling to above wattage. The module type must be qualified as per IEC 61215 latest edition for crystalline silicon SPV module conversion efficiency should be equal to or greater than 15.5 %.
2. Mono/Poly crystalline Cell efficiency shall be greater than 17%.
3. The PV module shall perform satisfactorily in humidity up to 100% with temperature

between – 40°C to +85°C. Since the modules would be used in a high voltage circuit, the high voltage insulation test shall be carried out on each module and a test certificate to that effect provided.

4. Other general requirement for the PV modules and sub-systems shall be of the following: -
  - a. Raw materials (Solar Cells) and technology employed in the module production processes shall have to be certified.
  - b. The rated output power of any supplied modules shall have tolerance of + 5% as per MNRE standard specs.
  - c. The peak-power point voltage and the peak-power point current of any supplied modules and/or any module string (series connected modules) shall not vary more than 3% from the respective arithmetic means for all modules and/or for all modules strings, as the case may be.
  - d. Except where specified, the front module surface shall consist of impact resistant, low-iron and high transmission toughened glass.
  - e. The module frame, if any, shall be made of a corrosion-resistant material which shall be electrolytically compatible with the structural material used for mounting the modules.
  - f. The module shall be provided with a junction box with either provision of external screw terminal connection or sealed type and arrangement for provision of by-pass diode.
  - g. The life of the module shall be at least 25 years with performance warrantee for 25 yrs. h. The certifications for the module should be IEC 61215, 61730, UL, and SEC.
  - i. The aluminium frame shall be Press fit anodized.
  - j. Module should be made using certified Potential Induced Degradation (PID) free cells
  - k. Mono/Poly Crystalline Modules of 300 Wp or more.

**a. IDENTIFICATION AND TRACEABILITY**

Each PV module must use a RF identification tag (RFID) & SR No inside the module which must contain the following information: -

- a) Name of the manufacturer of PV Module
- b) Name of the manufacturer of Solar Cells
- c) Month & Year of manufacture (Separately for Solar Cell & Module)
- d) Country of Origin (Separately for Solar Cell & Module)
- e) I-V curve for the Module
- f) Electrical grounding (Earthing);
- g) Inter-panel/Inter-row distances with allowed tolerances; and
- h) Peak Wattage,  $I_m$ ,  $V_m$  & FF for the Module
- g) Unique Serial No. & model No. of the Module
- h) Date & Year of obtaining IEC PV module qualification Certificate
- i) Name of the test lab issuing IEC Certificate
- j) Other information on traceability of Solar Cells & Module as per ISO 9000 series.
- k) RFID tag should be fixed as per latest MNRE guide lines
- l) Only indigenously manufactured PV modules or complaint with above specifications should be used for this project.

## **ARRAY STRUCTURE:**

1. Wherever required, suitable number of PV panel structures shall be provided. Structures shall be of flat-plate design either I, Z or L sections.
2. Structural material shall be corrosion resistant and electrolytically compatible with the materials used in the module frame, its fasteners, nuts and bolts.
3. Structures shall be supplied complete with all members to be compatible for allowing easy installation at the rooftop site.
4. The structures shall be designed to allow easy replacement of any module & can be either designed to transfer point loads on the roof top as per site conditions.
5. Each structure shall have a provision to dismantle / replace quickly as per the site conditions.
6. Each panel frame structure to be so fabricated as to be fixed on the ground. The structure should be capable for withstanding a wind load of Mumbai City after grouting & installation.
7.
  - a. Immediately within 20 days from the date of order, the supplier shall specify installation details of the PV modules and the support structures with appropriate diagrams and drawings which will be finally used at the time of execution. Such details shall be essential for providing necessary base mounting plates on the car shade structure.
  - b. Details with drawings for fixing the modules;
  - c. Details with drawings of fixing the
  - d. Interconnection details inside the junction/terminal boxes;
  - e. Structure installation details and drawings;
  - f. Safety precautions to be taken.
  - g. In case of MS structure, minimum GI coating thickness should be 120 microns
  - h. Structure simulation report considering wind speed upto 180 kmph to be submitted along with quotation.

## **POWER CONDITIONING UNITS (PCU)**

Each PCUs required shall be min 25 kWp each, should convert DC power produced by SPV modules in to AC power and adjust the voltage and frequency levels to suit the local grid conditions. Common Technical Specification:

- a. Max. Recommended DC Power 25VA (Rated Active Power 25 KW) or higher
- b. Max. DC Voltage 1000(As per design) or higher as per design) MPPT Operating Range (appropriate as per DC design).
- c. Max. DC Current 2X 12(As per design) A or higher Nominal AC Output Power 25000W or higher Nominal AC Voltage 3 X 230 V
- d. Start-up Voltage 250V
- e. Dynamic MPP Efficiency >99.7%

- f. Acoustic Noise Level Less than 57 db (A)
- g. Cos phi 0.8 inductive – 0.8 capacitive
- h. Power Control MPPT with 2 or more Trackers
- i. Certifications: IEC 61727, CE, IEC62109-1, IEC62109-2

### **ELECTRICAL SAFETY, EARTHING AND PROTECTION:**

- a. Internal faults: In built protection for internal faults including excess temperature, commutation failure, and overload and cooling fan failure (if fitted) is obligatory.
- b. Isolation: Appropriate isolation is required to avoid any DC component being injected into the grid and the potential for AC components appearing at the array.
- c. Over voltage protection: Over Voltage protection against atmospheric lightening discharge to the PV array is required. Protection is to be provided against voltage fluctuations in the grid itself and internal faults in the power conditioner, operational errors and switching transients.
- d. Earth fault supervision: An integrated earth fault device shall have to be provided to detect eventual earth fault on DC side and shall send message to the supervisory system. It shall also trip the respective faulty elements from circuit.
- e. Cabling Practice: Cable connections must be made using XLPE Cu / Al cable, as per BIS standards. All cable connections must be made using suitable terminations for effective contact. The XLPECu cables must be run in Hot dipped GI trays with cover for protection and underground cables must be well protected.
- f. Fast acting semiconductor type current limiting fuses at the main bus bar to protect from the grid short circuit contribution.

### **MAXIMUM POWER POINT TRACKER (MPPT)**

Maximum power point tracker shall be integrated in the PCU to maximize energy drawn from the array. The MPPT should be microprocessor based to minimize power losses. The details of working mechanism of MPPT shall be mentioned.

### **DISCONNECTION AND ISLANDING**

Disconnection of the PV generator in the event of loss of the main grid supply is to be achieved by in built protection within the power conditioner. This may be achieved through rate of Change of current, phase angle, unbalanced voltage or reactive load variants or else. Operation outside the limits of power quality as described in the technical data sheet should cause the power conditioner to disconnect the grid. Additional parameters requiring automatic disconnection are: Neutral voltage displacement, Over-current, earth fault and reverse power in case of the above, tripping time should be less than 15 seconds. Response time in case of grid failure due to switch off or failure based shut down should be well within 1 seconds. In case of use of two PCUs suitable equipment for synchronizing the AC output of / by both the PCUs to the ACDB/Grid should be provided.

### **AUTOMATIC RECONNECTION AFTER THE GRID FAILURE IS RESTORED:**

PCU shall have the facility to reconnect the PCU automatically to the grid following restoration of grid subsequent to grid failure condition.

## **ARRAY JUNCTION BOX, MAIN JUNCTION BOXES:**

The junction boxes are to be provided (if required as per Design) in the PV yard for termination of connecting cables. The J.B. shall be made of FRP/Powder Coated aluminium with full dust, water & vermin Proof arrangement. All wires/cables must be terminated through cable lugs. The J.Bs shall be such that input & output termination can be made through suitable cable glands.

- a. Made of FRP or cast aluminium/ copper
- b. Copper bus bars/terminal blocks housed in the junction box with suitable termination threads
- c. Conforming to IP65 standards and IEC 62208 Hinged door with EPDM rubber gasket to prevent water entry. Single compression cable glands.
- d. Provision of earthing.
- e. Suitable capacity MOVs provided within the box to protect against lightning.

## **DC DISTRIBUTION BOARD**

DC DPBs shall have sheet enclosure dust & vermin proof. The bus bars are to be made of copper of desired size. Suitable capacity MCBs be provided for controlling the DC Power output to the PCU along with necessary surge arrestors.

## **AC DISTRIBUTION PANEL BOARD**

AC Distribution Panel Board (DPB) shall control the AC power from PCU, and should Have necessary surge arrestors. Interconnection from ACDB to mains at LT Bus bar to be carried out and complete equipment along with metering to be installed in the ACDB. Requirement / specifications of DCDB and ACDB may be changed as per site conditions. An ACDB to be provided at the cable terminating point emanating from 25 KVA PCU (or more) for interconnection with grid. All switches at the, circuit breakers, connectors should confirm to IEC 60947, Part I, II and III.

## **CABLE SPECIFICATIONS:**

- a. Multi strand, annealed high conductivity copper / Aluminium conductor
- b. XLPE type 'A' pressure extruded insulation.
- c. Overall XLPE insulation for UV protection and confirm to IEC 69947
- d. Armoured cable for underground laying
- e. All cables shall conform to BIS standards (IS 694) and (IS 1554).
- f. The size of each type of cable selected shall be based on minimum voltage drop, However, the maximum drop shall be limited to 3%.
- g. All electrical cables / wires inside the building to be fixed in accordance with specifications for electrical works and as per M.S. PWD norms.
- h. Proper laying of cables has to be ensured in appropriate cable trays, pipes / trenches as per site requirement.
- i. A.C. supply cables to be terminated at the DB / LT bus bar.
- j. For laying / termination of cables, latest BIS / IEC codes / standards be followed.

### **LIGHTNING PROTECTION:**

There shall be required number of suitable lightning arrestors installed in the array field. Lightning protection shall be provided by the use of metal oxide resistors and suitable earthing such that induced transients find an alternate route to earth. Protection shall meet the safety rules as per Indian Electricity Act.

### **EARTHING PROTECTION:**

Each array structure of the PV yard should be grounded properly in addition the Lighting arrester/masts. Provision should be kept be provided inside the array field. Provision should be kept for shorting and grounding of the PV array at the time of maintenance work. All metal casing /shielding of the plant should be thoroughly grounded in accordance with Indian electricity Act./IE Rules. Earth resistance should be tested in presence of the representative of Amravati after earthing by calibrated earth tester. PCUACDB & DCDB should be earthed properly.

### **DRAWINGS & MANUALS**

Two copies of Engineering, electrical drawings and Installation and O&M manuals are to Be supplied. Bidders shall provide complete technical data sheets for each equipment giving details of the specifications along with make/makes in their bid along with basic design of the power plant and power evacuation, synchronization.

## Annexure – 5

# NETWORKING AND TELECOMMUNICATION SPECIFICATION

1) **Specifications: 37U X 800MM W X 1000MM D RACK 3 NOs**

ITEMS	Minimum Specifications / Functionalities / Capabilities
RACK	<p><b>Black Colour 42U X 800MM W X 1000MM D RACK as per</b>  Vented Top Panel with Gland Plant (Having Provision of Vented Bottom Panel with Gland Plate (Having Provision of Cable Entry) (Brush Entry), Front &amp; Rear Vertical Frames, 100MM Depth Sections, 37U Adjustable 19” Rails, Front Vented Glass Door &amp; 2 Locks, Rear Hex Perforated Split Door &amp; 2 Locks, Removable Side Panels with Bottom Vented, Set of Caster Wheels (2 with brake &amp; 2 w/a brake), 100mm Reducing Channels, Both side Power Strips &amp; 4 Wheels etc., 2 Site full perforated cable tray and Cable Brush entry in Rack Bottom</p>

2) **Specifications: UTPCAT 6a Cable (305 Mtrs Box)**

<u>Item</u>	<u>Specifications</u>	<u>Make</u>	<u>Model/Part No.</u>
<b>F/UTP COMPONENT  (CAT6A) Cable</b>	<p><b><u>Unshielded twisted pair cabling system, TIA / EIA 568-C.2 addendum Category, 6A Cabling system</u></b></p> <p>Networks should Support for Fast Ethernet and Gigabit Ethernet,10G, IEEE. 802.3/5/12, Voice, ISDN, 155 Mbps ATM, Broadband, 100 Mbps TPPMD, analog and VOIP , 23 AWG bare solid copper, CAT-6A F/UTP cabling system, 25 year systems warranty; Warranty to cover Bandwidth of the specified and installed cabling system, and the installation costs 23 AWG solid bare copper, CAT-6A F/UTP Cable, Foiled to prevent alien crosstalk, Meets EIA/TIA 568-C.2 Category 6A specifications, CM Rated, Worst Case Cable Skew: 45 nsec/100 meters MAX. @ 250MHz maximum, Characteristic Impedence: 100±15%, 1-500 MHz, Insulation polyethylene, Conductor resistance 6.65ohm / 100m maximum, Solid Cable should be compliance to RoHS. Sheath Fire resistant OR LSZH, PAIRS Colour code: Blue / White-Blue, Orange / White-Orange Green / White-Green, Brown / White – Brown</p>		

	<p><b>ELECTRICAL CHARACTERISTICS:</b>  Input Impedance (250-500 MHz): 100 +/- Polycarbonate, 94V-0 rated, IDC Contact: DC Capacitance: 5.6 nF/100 mtr. Standard Phosphor bronze 50 micron" gold, Jack contacts: Beryllium copper with thick gold and minimum thick nickel under plate, Panel: Black, powder coated steel, Approvals: UL , ETL and 3P, Termination, Pattern: TIA / EIA 568 A and B, Performance Characteristics: Attenuation, NEXT, PS NEXT, FEXT and Return Loss</p>		
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**3) Specifications: UTPCAT 6a IO (Information Outlet)**

<b>Information outlets with singlex faceplate</b>	<p><b><u>1G STP Jacks Type - Unshielded Twisted Pair, Category 6A, TIA / EIA 568-C.2</u></b>, 10G, PCB based shielded jack, Durability Modular Jack 750 mating cycles, Wire terminal 200 termination cycles, Should use standard OEM tools kit Approval UL, Housing Zinc Alloy, Wiring blocks Polycarbonate, 94V-0 rated, Jack contacts : Beryllium copper with thick gold and minimum thick nickel under plate,</p> <p>Performance Characteristics Attenuation, NEXT, PS NEXT, FEXT and Return Loss, IDC Contact: Phosphor bronze 50micron" gold: ROHS compliant  <b>Faceplate</b> 1-port, White, Material ABS / UL 94 V-0 No. of ports One with shutters, High Impact Plastic Body ABS material 86mm x 86mm with label and label covers</p>		
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**4) Specifications: UTPCAT 6a Patch Cord 3FT, 7FT,**

	<p><b><u>Type - shielded Twisted Pair STP (fully shielded twisted pair), Category 6A, TIA / EIA 568-C.2</u></b>  Patch cords shall be of multi strand copper cable with Matching coloured snag-less, elastomer polyolefin boot 50 micron" gold over nickel. Patch cord with LSZH sheath. Plug housing clear polycarbonate;</p>		
	2.8 Patch Cord Length 1 meter, 2 meters,		

	3meters, 5 meters and 10 meters. Assembled with short body RJ45 50u gold plate to minimize untwists pair length. Designed for high speed transmission and RoHS Compliant Improved PS-NEXT, ELFEXT and Return Loss performance. Back-ward-compatibility with all current Cat.5 and Cat.6 products and applications.		

**4) Specifications: Supply and Installation 12 Port SC/LC Fibre**

LIU, 12 fibre, 1 U/2U drawer style 37U" Rack mount enclosure (MM)	<p>Supply and Installation 12 Port SC/LC Fibre</p> <p>Patch Panel Multimode (loaded 1u) Front Patching Type, 1U high and rack mountable on standard 37" rack with mounting arrangements LC type supplied with fusion splicing sleeves for termination of fibre OM3, MM with termination of fibre OM3, MM with pigtail, all accessories including coupler plates pre-loaded with SC – LC couplers (OM3) for terminating fibres on the FOPP Multimode OFC Compatible</p>		
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**5) Optical Fibre Patch Cord**

Optical Fibre Patch Cord, MM, LC to LC	<p>Supply and Connectivity UP-Link Switch to Switch, Optical Fibre Patch Cord, OM3 &amp; OM4, MM, SC to LC &amp; Optical Fibre Patch Cord, OM3 &amp; OM4, MM, LC to LC</p> <p>a) 3 meter</p> <p>b) 5 meter</p>		
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	c) 10 meter d) 20 meter		
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**6) Optical Fibre Patch Cord**

Optical Fibre SFP Module	Supply and Connectivity UP-Link Switch to Switch Fibre Optic Patch Cable Cisco SFP-10G-SR Compatible 10GBASE SR SFP10 Gig SFP+ uplink module for switch (MM) end of the Multimode OFC 10 G SFP+ module will be connectivity to Cisco 24 Port L3 and 48 L2 Port Switch (For Uplink)		
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**7) Firewall with Access Point Controller**

ITEMS	Minimum Specifications / Functionalities / Capabilities
Firewall	The Supply, Installation, Configuring Enterprise Manager of Next Generation Firewall 450 User with Access Point Controller Every feature available on every appliance Firewall, VPN, ATP, IPS, email, web filtering and app control Hardware, virtualized, software or cloud based appliance Intuitive browser based interface Built-in reporting on all models Two-factor authentication with one-time password (OTP) in many areas Integrated wireless controller

**8) WIFI Access Point**

ITEMS	Minimum Specifications / Functionalities / Capabilities
Access Point	Support for the latest high-speed wireless standards including 802.11ac and 802.11n Centrally controlled wireless, No local configuration of access points required Automated channel optimization for maximum performance, Complete

threat protection for wireless clients, Quick voucher-based guest access customizable with your brand, Ì Choose from a range of access points and firewalls with integrated wireless, Supports Microsoft Lync and VoIP
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- i.) Cables shall be installed in unbroken segments from NW Point switch to individual Communication outlet locations. At each work space location cables shall be terminated in a wall mounted TIA/EIA 568A compliant communications outlet from specified manufacturers. All installed cabling runs shall be tested for flow meter compliance with specified parameters, documentation provided, and both ends of each cable run shall be labelled.

- ii) **Concealed Cabling**

All cabling shall be installed inside walls or ceiling spaces wherever possible. Within office spaces any exposed cable-run must be closed in appropriate raceway, as described below.

- 1. **Raceways**

- Cable that cannot be run inside a protected space must be enclosed in protective raceway Protective raceways must be permanently attached to underlying wall surfaces with appropriate wall anchors.

- 2. **Wall Penetrations**

- Cable penetrations of walls or floors are to be sleeved PVC conduit.

# **PUBLIC ADDRESS SYSTEM**

## **General Description**

The contractor shall supply, install, test, connect and commission a high quality fast- acting Public Address and Voice Alarm System complying strictly with BS 5839 part 8 and EN60849 and shall be TUV or Equivalent Agency approved. The Public Address and Voice Evacuation System shall comprise of Audio Matrix Units, High quality speakers, Audio rack all mounted on a 19" Rack and fully connected and integrated on the fire alarm loop. The system shall be used for Professional Sound Reproduction for all the areas where possible special events take place.

Prior to placing order for any equipment, the contractor shall submit comprehensive document comprising working drawings, catalogues and descriptive literature of components, acoustic calculation to meet with BS5839 part8 RASTI (Room Acoustic Speech Transmission Index) requirements of 0.5 on the STI scale and 0,7 on the CIS scale. The contractor shall be required to train and instruct client's personnel in the correct use, operation and supervision of the system, preferably prior to the handing over of the project.

In order to ensure whole site integration capability, the fire and voice alarm system will be awarded to a single specialist local supplier who will be responsible for the design, global operation, management and interfacing of the system. The contractor shall make sure that all power tapping of the speakers must be carried out as specified, even if the acoustic calculations indicate less power tapings. The contractor must endure minimum of 10dB above the ambient noise levels are achieved.

The system shall be fully programmed to accommodate fire alarm and voice communication zones as indicated on the drawings and schematics. The system shall be configured to allow on site modifications with the minimum of disruption using the PC based software to facilitate future changes or alterations to the buildings.

### **APPLICABLE STANDARD:**

EVAC Compliant with IEC/EN60849

Loudspeakers -Rated power IEC 60286-Part 5

Tested in accordance with BSEN60268-5

Acoustic models ready for CATT, ULYSSES & EASE Compliant with BS5839 Part 8

Battery backup/charger compliant with EN54 part 4

## **2. Scope of Work**

The scope of work under this head shall include designing supplying and installing of Public Address System. The work under this system shall consist of furnishing all materials, equipment's and appliances and labour necessary to install the said system, complete with Speakers, Amplifiers, Microphone, Zone Selection Panel for interfacing with other systems.

The PA system is designed to serve the dual purpose of making general announcement and Voice Evacuation at the time of Fire alarm activation.

### **3. System Design**

The PAVA system shall be connected on the same Fire Alarm loop with in-built isolators to protect the system in case of any cable faults. The system shall be de-centralized in nature, each distributed rack DAU (Distributed Amplifier Unit) shall have all the DSP (Digital Signal Processing), messages, amplifiers, monitoring in such a way that can work in a standalone mode in case the master rack is faulty or down.

The Man Machine Interface (MMI) shall be connected back to the control room, to monitor and control the entire PAVA system. The MMI shall be fully BS5839 part 8 and EN60849 compliant and TUV approved. The DAU shall play background / Foreground music and in case of Fire Alarm / Paging announcement, the system shall go to full power as programmed to provide the enough SPL (Sound Pressure Level) levels to comply with BS5839 part8, with minimum of 10dB above the noise levels.

All system components shall be digitally monitored including and not limited to, Messages, Amplifiers, and back up amplifiers, Speaker Circuits, Audio Matrix units, Paging Microphone, Battery Charger and the 230VAC line. Each amplifier / line circuit shall be monitored individually and shall report any faults back to the Master Audio Matrix Unit as well as the Paging Microphone.

The system shall be capable of sending messages automatically to any zone at any time interval, without affecting the music in the other areas. Each Zone and circuit speaker shall have separate amplifier, system sharing two amplifiers to multiple circuit speakers are not acceptable. There shall be one back up amplifier for every eight amplifiers, the system shall automatically change over to the back up in case of any amplifier failure, and the backup amplifiers shall be monitored as well. In case of any system component failure, the paging microphone shall override any defective unit and provide paging to the required zone. The System can provide any Cause & Effect programs after integrating with the Fire Alarm System, thus Alert/Evacuate messages can be programmed and delayed as well as played on any zone / floor as per the Cause & Effect approved by the Engineer.

The Battery Backup shall provide 24 hours of back up and 30 min of alarm operation. The power supply /charger must comply with EN54 part 4 and shall be 19" rack mounted. Battery calculation must strictly comply with BS5839 part 8 and shall be based on the amplifier size and not the speaker circuit load. The PAVA system shall be properly integrated with the fire alarm system. The integrated PAVA system shall cover all normally accessible areas including the car parks. All stair cases shall have dedicated zone riser. The system shall be capable of being used for everyday background music and public announcement duties with

the fire alarm initiated emergency announcements overriding all other facilities. Initiation of voice alarm shall take immediate priority and shall cancel all other PA operations.

In addition, a FIRE DRILL, BOMB ALERT, EARTHQUAKE ALERT and an ALL CLEAR message shall be incorporated into the operation. A fire alarm broadcast signal shall cancel any public address operation and shall override it. When a fireman's microphone is operated, this shall override any automatic voice alarm signal being transmitted to the zone selected. The Alert and Evacuate pre-recorded messages will be maintained in other zones while live voice fire announcements are being broadcast to selected loudspeaker zones.

All amplifier gain shall be monitored and measured for open, short or earth faults. The Entertainment Rack shall be located in the Control/Security Room enabling the operator to select music from the CD player, FM tuner or the double cassette deck to transmit music to selected zones or all the zones in the building from the touch screen paging microphone. A public address announcement shall override the music transmission to selected zones or all zones. Paging any zone shall not interrupt music in other zones. The Speakers shall be distributed in the entire floor and shall be configured in different zones. The announcement can be made zone wise or to all the speakers simultaneously in ALL CALL mode. Fire Alarm shall be announced immediately on receipt of Fire signal from the panel to all zones or group of Zones.

**System shall have following functions:**

Voice Evacuation and Public Address system integration includes paging system and background music system. Monitoring of microphone, controller, amplifier, fireman microphone, source modular, and amplifier changeover, AC&DC power Supply, Loudspeaker Line and Volume Control. The Amplifier shall be used only Class-D with Digital switching power technology system shall have facility for Backup amplifier for at least one backup amplifier over working Amplifier.

## **4. Amplifiers**

All amplifiers shall be power amplifier with High quality speech and Music broadcast. The power amplifiers shall have adequate continuous (RMS) power output to meet the requirement of the configuration. The unit shall be capable of delivering the rated output power with less than 0.1% harmonic distortion in the design bandwidth. The amplifier shall have a broad band frequency response of 40 Hz to 20 KHz. The output voltage and impedance shall meet with the system requirements. Amplifiers shall be protected against over loads and output shorts and a special thermal overload on the heat sink.

The Amplifier shall be Class –D Amplifier have one channel, Two Channel, Three Channel and four channels' each channel have rated power 120/240or 500W. The Amplifier shall have switch power technology for power electricity saving, Separate PFC design for highest reliability, separate power supply system for each channel, Separate cooling system, sleep mode is automatically enabled when no signal input is detected. Amplifier shall have AC 100V or 230V power supply and DC 24V input, having separate fuse for each channel. The

Amplifier shall be connected through balanced audio input and shall work on 100V Speaker Line.

#### Technical Specifications

Rated Output Voltage(RMS): 120/240/500W or 2x120/2x240/2x500

4x120/4x240/4x500W

Amplification : Class-D

Battery Voltage : 24VDC (max 10% deviation)

Frequency Response : 40Hz to 20KHz

S/N Ratio : >90 d

Total Harmonic Distortion : <0.1% @ 1kHz

Power Efficiency : >80%

Approval EN

## **5. Speakers**

1. Speakers shall be especially designed for broadcasting high quality, integrated emergency fire alarm signals and voice communications and approved by an appropriate authority for use in such situations.
2. Speakers shall be ceiling, wall mounted or Horn Speaker as shown in the schedule of work and shall be completed with mounting brackets accessories etc. Speakers shall be in metal enclosures only.
3. Speakers shall be of high efficiency providing maximum output at minimum power across 120 – 14000 Hz frequency range for Indoor Speakers. Speakers shall have a line matching transformer for direct connection to amplifiers with multiple taps.
4. Speaker external appearance shall be approved by the Architects.
5. Speakers shall be interconnected in the zone configuration.

### **5.1 6W Ceiling Mounted Speaker**

The ceiling mounted 6 W 3”speakers shall be installed as depicted in the drawing. The speakers support EASE, CATT or ULYSSES models for acoustic studies. This mean the acoustic model can be designed to simulate the sound quality and distortion prior to installation. The Speaker should be in compliance BS/EN 60065, 2003 and EMC (BS EN 61000-6-Part 1/2/3/4). The Ceiling speaker shall work on 100V line so that it can reduce line losses over long distance and allow easy parallel connection of multiple loudspeakers. The Speaker shall have multiple tapping for different application according to room size and ambient noise environment. The Speaker shall have aluminium grille and metal baffle and shall have spring clip clamp for easy installation.

#### **Technical Specifications**

Rated power	:	6 W
Tapings 100V line	:	6/3/1.5W
Operation Voltage	:	100V or 70V
Effective frequency range	:	120 ~ 14kHz (10% Variation allowed)
e) SPL @ 1W/m	:	>91 dB

- f) S.P.L. ,@Full power/ 1m, dB : >100 dB
- g) Colour : White
- h) Ceiling Cut-out : 170mm
- i) Dimensions : 200 mm x 55 mm (10% Variation allowed)

## 5.2 6W Wall Mount Speaker

The Wall mounted 6 W speakers shall be installed as depicted in the drawing. The speakers support EASE, CATT or ULYSSES models for acoustic studies. This mean the acoustic model can be designed to simulate the sound quality and distortion prior to installation. The Speaker should be in compliance BS/EN 60065, 2003 and EMC (BS EN 61000-6-Part 1/2/3/4).

The speaker shall work on 100V line so that it can reduce line losses over long distance and allow easy parallel connection of multiple loudspeakers. The Speaker shall have multiple tapping for different application according to room size and ambient noise environment. The Speaker shall have Metal grille and ABS Enclosure and shall be closed cabinet.

### Technical Specifications

- Rated power : 6 W
- Tapings 100V line : 6/3/1.5W
- Operation Voltage : 100V or 70V
- Effective frequency range : 90 ~ 18kHz (10% Variation allowed)
- e) SPL @ 1W/m : >90 dB
- f) S.P.L., @ Full power/ 1m, dB : >98 dB
- g) Colour : White
- h) Dimensions : 285mm x 200mm x 85mm

(10% Variation allowed)

### 5.3 15W Horn Speaker

The Horn speakers with 15W Output shall be installed as depicted in the drawing. The speakers support EASE, CATT or ULYSSES models for acoustic studies. This means the acoustic model can be designed to simulate the sound quality and distortion prior to installation. The Speaker should be in compliance BS/EN 60065, 2003 and EMC (BS EN 61000-6-Part 1/2/3/4). The Horn speaker shall work on 100V line so that it can reduce line losses over long distance and allow easy parallel connection of multiple loudspeakers. The Speaker shall have multiple tapping for different application according to room size and ambient noise environment. The Speaker shall have aluminium grille and metal baffle and shall have spring clip clamp for easy installation.

#### Technical Specifications

Rated power	: 15 W
Tapings 100V line	: 15W/7.5/3.75W
Operation Voltage	: 100V or 70V
Effective frequency range	: 250 ~ 8kHz (10% Variation allowed)
e) SPL @ 1W/m	: >103 dB
f) S.P.L. @ Full power/ 1m, dB	: >115 dB
g) Colour	: White
h) IP Rate	: IP 66
i) Dimensions	: 221 x 165 x 235mm (10% Variation allowed)

### 5.4 Remote Paging Microphone

1. Digital voice evacuation system remote paging microphone.
2. Each microphone of 8 zone capacity.
3. Zone expansion by connection with expansion unit.
4. System indicators of AC, DC, fault, Mic status and test.
5. 6 inputs & mic/line selection buttons.

6. 8 zone selection buttons with three-coloured indicators.
7. Reset/Cancel, All Call & Call buttons.

8. Two RJ45 ports for input and link output.
9. CAT5 or CAT6 cable communication up to 600 meters.
10. AC 230V and DC24V battery inputs.
11. Built-in monitor speaker.

## **6. Voice Alarm Controller**

1. Digital voice evacuation system all in one amplifier.
2. Specifications meet the standards of BS EN54-32 & EN608409.
3. EN54-16 standards certificate is under taken.
4. Built-in 240W & 500 8 zone class-D amplifier.
5. Integration of EVAC system, paging system, PA system & BGM system together.
6. Built-in two separate players for EVAC and alert voice message by SD card.
7. Built-in 8 zone AB speaker line low impedance supervision.
8. Built-in amplifier auto changeover into standby when fault.
9. With external amplifier input to expansion the power.
10. Capacity of connection 8 unit's remote microphone.
11. Red button EVAC message push to activate with priority except fireman mic.
12. 8 zone speaker outputs with separate zone volume control.
13. 8 zone separate indicator for EVAC, fault, music/paging & select.
14. System indicators of AC, DC, fault and indicators for EVAC, alert & fireman mic.
15. Zone capacity of 96 zones by cascaded 11 unit's router.
16. With 8 programmable control inputs and 8 programmable control outputs for voice evacuation system.
17. With Fault, EVAC outputs and Reset input for third party system integration.
18. With fireman microphone of highest priority.
19. Priority level: fireman mic, EVAC, input 1, remote microphone, timer & BGM.

20. Two combo inputs for mic/line, 4 line inputs and one REC output.
21. Two RJ45 for cascade router, two RJ45 for remote microphone input and two RJ45 for LAN/WAN/Internet network.
22. IP network module for optional to buy. The IP network
23. AC 230V and DC24V battery input. Auto switch into the battery backup when AC fails.

**Technical Specification:**

Description	8 Zone Voice Evacuation Amplifier
Rated Power Output	500W
Fireman Microphone	5Mv, 600Ω
Line 1-2 Inputs	385mV, 10kΩbalanced Combo
Line 3-6 Inputs	350mV, 10kΩ, RCA
Frequency Response	80Hz~20kHz
THD	< 1% at RMS,1KHz
S/N Ratio	>70dB
Speaker Output	100V AB 8 zone speaker outputs
REC Output	200mV
Control Input & Output	8 programmable control inputs: Max 3.3V (voltage mode) or 0V closed contact

	8 programmable control outputs: 0V closed contact Control output for fault & EVAC: 0V closed contact Reset control input: 0V closed contact
Voice Message	MP3 or WMA format, two separate players of SD card with protection cover, programmable voice message up to 255, 10 years valid
Event Record	HEX format, Hard Flash memory, events up to 1000 records, 10 years valid
Operation Environment	Operation Temp: +5°C ~ +40°C Store Temp: -20°C ~ +70°C Operation Humidity: <95%
Power Consumption	600W
Power Supply	AC230V or 115V & DC24V battery inputs, 50-60HZ
AC Fuse	250V/6.3A, slow type and restorable fuse
Dimension	484(W)×132(H)×449(D) mm
Weight	24kg

## **7. Software**

PAVA Software with following Features: Should be connected with CAT5 Cable, shall provide Zone control, status monitor, Offline Program, Event Recording, System Configuration, User Management. Software shall allow automatically playing and timing function to achieve timing programmed playing in the designated zones for unattended operation, Built-in Automatic Timing Corrector. Support Export and Import easily to save Data.

## **8. Digital AM/FM Tuner**

The digital AM/FM table top and rack mount design with aluminium alloy panel. It shall have clearly visible LDC display, microcomputer control and touch-button operation. FM/AM two band receive option, FM receiving frequency 76MHz – 108MHz, AM receiving frequency 520Hz – 1708 KHz. Radio frequency automatic search and memory function, memory up to 99 bands and a power off memory functions. Using vehicle dedicated digital radio module, integrated radio tuner module, with a small size good performance and strong anti – interference etc. Built in High fidelity wideband monitor Speaker, Sound full and clear, and a monitor with adjustable volume knob

### **Technical Specifications:**

- a) Power Supply: 220V/50Hz
- b) Power Consumption: 8W
- c) 1 Channel audio signal left and right channel output

## **9. CD/DVD Player**

The CD/DVD player shall be capable playing MP3 audio tracks from USD or DVD or CD.

### **Technical Specifications:**

- D/A converter 24 bit, 192 kHz
- Frequency response 30-20000 Hz
- Signal to noise ratio > 90
- Distortion and Noise (1kHz) > 65 dB
- Crosstalk (1kHz) > 70 dB
- Dynamic Range (1kHz) > 80 dB
- Sound System Dolby Digital
- Playback Media
  - o CD
  - o MP3-CD
  - o MP3-DVD o WMA-CD o CD-R/RW o Audio CD
- Compression format
  - o MP3
  - o Dolby Digital
  - o PCM
  - o WMA
- MP3 bit rates
  - o 32 - 320 kbps

## **10. Rack**

The equipment shall be housed in a standard rack of suitable height, with Plexiglas door or metal mesh and lock. Ventilation panels of 1U height shall be provided between each item of equipment.

Details of the proposed equipment shall be forwarded to the Consultant with performance specifications, dimensions, construction and finish for approval.

Rack should comply with ANSI/EIA RS-310-D; DIN41491; DIN41494; IEC297-2; and GB/T3047.2-92. The Rack should have DIN Rail Mounted Terminal Blocks for termination of Speaker Zone cables on the rear.

All cables coming from Speaker zones, Call Stations, Power supply should enter from Bottom. Rack should be installed at location which has minimum 600mm space from front & back for accessing it easily.

Rack should be installed in well ventilated room preferable Air conditioned. The unit should have Fans from top. The unit should have Lockable Glass door at front.

### **Dimensions**

- a) Height : as per the Quantity of PA Processor & Amplifiers
- b) Depth : 600mm Deep
- c) Width : 19"

## **11. Speaker Cables**

All cables associated with PA system shall be of following specifications:

The 2 core speaker cable will be connected to the speakers by screw terminals before which it shall be crimped using 1.5 sq. mm. bootlace lugs. Care has to be taken for avoiding any single strand of wire shall not come out of Lug & screw terminals to avoid noise & leakage.

Speaker cables used should be Multi-conductor stranded type

Flexible copper conductor of cross section 1.5 Sq. mm/2.5 Sq.mm insulated, PVCFRLS sheathed control Cable as per IS 694.

These Cables shall be laid in G.I. Conduits concealed/surface.

## **12. Call Station Cables**

Call station cables should be 4pair CAT6 STP (Shielded Twisted Pair) type, It should be crimped by RJ45 Shielded Male Connectors.

## **13. Approved Makes**

ATEIS – IDA8

BOSCH Presideo

HEINRICH DVA8/6

## **14. Testing PAVA System**

Sr. No.	Description	Visual	Test Readings	Documentation
1	All cables are tested for continuity, insulation, resistance etc.			√
2	System installation proper as per drawing	√		
3	Carry out visual checks on all speakers & Processors are free from any mechanical damage, cables, inter phase modules etc.to ensure they are properly installed.	√		
4	Check for proper termination of bootlace lugs & feruling	√		
5	Check Input A/C Supply Voltage		√	
6	Check location / spacing of loudspeakers as in drawing.	√		√
7	Check Distribution of Zones as per	√		√

	Drawing.			
8	Check full load speaker sound quality & measure Sound pressure level (SPL) in dB.	√	√	
9	Check if local loudspeakers overrides by voice messages in case of emergency evacuation.	√		√
10	If power fails, whether Voice evacuation system is working on battery supply if yes for what time		√	
11	Check if recorder messages are CLEAR, free from any noise distortion & easy to understand with Room acoustic speech transmission Index (RaSTI) value >0.5.	√	√	
12	Processor LED's and all keys are working properly	√		
13	Check for Microphone locations & the sensitivity by paging	√		√
14	Play a soft music & check sound quality	√		

## **Annexure – 6**

# **CCTV SPECIFICATIONS**

IP Based CCTV system shall be provided for the entire premises for the purpose of security surveillance, and shall be broadly divided in to

- Internal surveillance for the Monitoring the Server Aisles, Entrance to Critical Spaces, and Corridors leading to critical spaces; and also for general surveillance in the office floors.
- External Surveillance for monitoring the External Periphery of the Data Centre Building Premises, and utility areas such as the DG Area, the Fuel Unloading area, the Terrace floor with Chiller Plant area, the Main and the Material entry Gates, rear side Material and Service Gates etc.

## **1. General Specifications**

The CCTV Vendor shall supply install and commission an IP Camera based CCTV system with the objective shall be to provide High degree of Electronic surveillance system to the entire premises.

The purpose is to monitor & supervise the entire area for security purposes, as well as the record and inform officials on unwanted, untoward incidents. It is also essential to have recorded images to be stored at least for 90 days of all critical areas to facilitate investigations of a reported case.

The Hardware required for the System including servers, workstations, monitors, networking components, cables, connectors, conduits, power supplies etc. shall be in vendor's scope.

Development of independent LAN network for IP CCTV shall be Scope CCTV vendor. Further, the CCTV system shall provide the direct interface with the Access Control Systems. This shall be achieved either by offering a unified database for the IBMS, or by suitable SDK/API's middleware solution to enable the seamless transfer of data between disparate systems.

Should the Bidder need IT or Networking hardware more than what is provided for in the tender Bill of quantities, then the Bidder needs to inform the tender committee / Consultants in writing on the same along with the Tender BID and include the same in his/her bid price.

Any additions to the Take-off Quantities given in the tender, if required by the Bidder at the tender Stage shall need to be spelt out by the Bidder at the time of the Bid itself.

It is expected that the Bidder provides a system configuration wherein Main Directory shall be loaded on the Main Server hardware located in the Security/ CCTV Monitoring Room at Ground Floor; and the Failover directory shall be loaded on the failover Servers, again kept at the same location.

## **2. Power Quality at Site:**

- i. Note that AC Power Quality Available on the Site shall be 230 V AC +/- 5%, 50 Hz +/- 5%.
- ii. While there are Main UPS and Redundant UPS should be considered if required, the Electrical system shall deliver this power after switchover to the CCTV Equipment.
  - i. For the internal and external surveillance of the Data centre Premises, strategically placed video surveillance cameras shall provide continuous monitoring of all parts of the premises.
  - ii. All equipment and materials used shall be standard components that are regularly manufactured and used in the system.
  - iii. All systems and components shall have been thoroughly tested and proven in actual use.
  - iv. A minimum of 20 cameras shall be configurable with video analytics, of which, approx. 7-8 shall be for external surveillance analytics, and rest for other critical areas, reception area etc., within the premises.
  - v. Offered analytics shall have the flexibility to be deployed on any of the cameras across the complete system as per directions from the customer/consultant during the execution/operations phase of the project without any additional hardware/software requirement.

### 3. Technical Specifications:

2MP Fixed IR DOME	
Parameters	Specification
Image Sensor	1/2.8" Progressive CMOS
Maximum Resolution	1920x1080 (2MP)
Lens Type	Fixed-focal
Focal Length	f = 2.8 mm
Aperture	F1.8
Field of View	110° (Horizontal)
	64° (Vertical)
	135° (Diagonal)
Shutter Time	1/5 sec. to 1/32,000 sec.
WDR Technology	WDR
Day/Night	Removable IR-cut filter for day & night function
Minimum Illumination	0.06 Lux @ F1.8 (Colour)
	0.001 Lux @ F1.8 (B/W)
Pan/tilt/zoom Functionalities	ePTZ:
	48x digital zoom (4x on IE plug-in, 12x built in)
IR Illuminators	Built-in IR illuminators, effective up to 30 meters
	with Smart IR
	IR LED*8
On-board Storage	Slot type: MicroSD/SDHC/SDXC card slot
	Seamless Recording
Video Compression	H.264 & MJPEG
Maximum Frame Rate	30 fps @ 1920x1080
	In both compression modes
Maximum Streams	4 simultaneous streams
S/N Ratio	58Db
Dynamic Range	100Db
	Adjustable resolution, quality and bitrate, Smart

	<p>Adjustable image size, quality and bit rate, Time stamp, text overlay, flip &amp; mirror, Configurable brightness, contrast, saturation, sharpness, white balance, exposure control, gain, backlight compensation, privacy masks, Scheduled profile settings, 3D Noise Reduction, Video Rotation</p>
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Audio Capability	Two-way audio (full duplex)
Compression	G.711, G.726
Interface	Internal microphone input
	External line output
Users	Live viewing for up to 10 clients
Protocols	IPv4, IPv6, TCP/IP, HTTP, HTTPS, UPnP, RTSP/RTP/RTCP, IGMP, SMTP, FTP, DHCP, NTP, DNS, DDNS, PPPoE, CoS, QoS, SNMP, 802.1X, UDP, ICMP, ARP, SSL, TLS
Interface	10 Base-T/100 BaseTX Ethernet (RJ-45)
Video Motion Detection	Five-window video motion detection
	Video motion detection, manual trigger, digital input, periodical trigger, system boot, recording notification, camera tampering detection, audio
Alarm Events	Event notification using digital output, HTTP, SMTP, FTP and NAS server, SD Card
	File upload via HTTP, SMTP, FTP, NAS server and SD card
Connectors	RJ-45 cable connector for Network/PoE
	Audio input
	Audio output
	DC 12V power input
	Digital input*1
	Digital output*1
LED Indicator	System power and status indicator
Power Input	DC 12V
	IEEE 802.3af/at PoE Class 0
Power Consumption	Max. 9 W
Safety Certifications	CE, LVD, FCC Class B, VCCI, C-Tick

Operating Temperature	Starting Temperature: 0°C ~ 50°C (32°F~
	Working Temperature: -10°C ~ 50°C (14°F~ 122°F)

2MP 30x IR Speed Dome Outdoor PTZ Camera	
Parameters	Specification
Image sensor	1/2.8" Progressive CMOS
Maximum Resolution	60 fps @ 1080p Full HD
Lens Type	30x optical zoom, auto focus
Focal Length	4.3 ~ 129 mm
Aperture	F1.2 (Maximum)
Auto-iris	DC-Iris
Field of View	2.3° ~ 64° (Horizontal)
	1.3° ~ 36° (Vertical)
	2.6° ~ 73° (Diagonal)
Shutter Time	1/1 sec. to 1/10,000 sec.
WDR Technology	WDR
Day & Night	Yes
Minimum Illumination	0.4 lux in Color
	0.03 lux in B/W
Pan speed	0.05° – 320°/s
Pan range	360 degree
Tilt speed	0.05° – 240°/s
Tilt range	220 degree
Preset Locations	256 preset locations
Pan / Tilt / Zoom	48x digital zoom (4x on IE plug-in, 12x built in)
	Auto pan mode
	Auto patrol mode
On-board Storage	SD/SDHC/SDXC card slot
Video Compression	H265,H.264 ,MJPEG
	H.265 : 60 fps @ 1920x1080
	H.264 : 60 fps @ 1920x1080

Maximum Frame Rate	
Maximum Streams	3 simultaneous streams
S/N Ratio	Above 60 db With adjustable 2DNR & 3DNR
Dynamic Range	Above 100db
IR Illuminators	Recognition: 150M
	Detection: 200M
	Adjustable resolution, quality and constant bit rate control
Image Settings	Time stamp, text overlay, flip & mirror
	Adjustable image size, quality and bit rate
	Configurable brightness, contrast, saturation, sharpness, white balance, exposure control, gain, backlight compensation, privacy masks (Up to 24)
	Scheduled profile settings

	Defog
	External microphone input, audio output (Full
Compression	AAC
	G.711
	G.726
Interface	External microphone input
	External line output
Users	Live viewing for up to 10 clients
Network Protocols	IPv4, IPv6, TCP/IP, HTTP, HTTPS, UPnP, RTSP/RTP/RTCP, IGMP, SMTP, FTP, DHCP, NTP, DNS, DDNS, PPPoE, CoS, QoS, SNMP, 802.1X
Interface	10 Base-T / 100BaseTX Ethernet (RJ-45)
	Supported, specification available at <a href="http://www.onvif.org">www.onvif.org</a>
Video Motion Detection	Triple-window video motion detection
Auto-Tracking	Auto-tracking on moving object
Alarm Triggers	Video motion detection, manual trigger, digital input, periodical trigger, system boot, recording notification, camera tampering detection ,audio detection, advanced motion detection
Alarm Events	Event notification using digital output, HTTP, SMTP, FTP and NAS server
	File upload via HTTP, SMTP, FTP and NAS server
Connectors	RJ-45 cable connector for Network/PoE
	Audio input
	Audio output
	DC 48V
	Digital input*4
	Digital output*2
	RS485
LED Indicator	System power and status indicator

Power input	DC 48V
	95W UPoE
Casing	IK10, IP67, NEMA 4X
Safety Certifications	CE, LVD, FCC Class A, VCCI, C-Tick, UL,
Operating Temperature	Wide Temperature:
	Working Temperature: -40°C ~ 55°C

## 1. High Configuration Network Video Storage Servers

Server shall be of 19" rack mounting or any of the branded with CCTV OEM make. Quad core Intel Processor at 2.4 GHz 12M Cache, 8GB or more RAM, Microsoft Windows 2008 R2 64 bit pre-installed embedded OS. SQL Express 2008 or better as required by the application.

Minimum 12 hot swappable drive slots. 10 X 2.5TB = 25TB raw RAID 5 configured storage for 30 days of storage. Complete with one spare drive. Calculated @ H.264 Compression, 15fps @ 720p, 40 days of recording.

DVI Graphics Card to support minimum 3 multiplexed monitors, with different possibility on each of the monitor i.e. Multiplexed, Alarm, Maps, sequence or any combination. Also support Drag-n-Drop of images by using connected mouse device.

Embedded Gigabit network cards with fault tolerant configuration, Redundant Power Supply, Standard video display adapter, Minimum 3 Years Next Day Business Day on Site Warranty from OEM.

## 2. Applicable Standards

Original Equipment Manufacturer Standard

### APPROVALS

All the cameras should be

A. CE Compliant and

B. UL Listed and

C. FCCB

### **3. NETWORK FOR IP CCTV SYSTEM:**

The IP CCTV Vendor shall setup an independent IP Network for the use of IP CCTV system.

#### **EDGE SWITCHES:**

- i. All networking equipment shall be as minimum of 2 Layer and as a minimum shall support IGMP Snooping Version 2 or later. It should have minimum two 1000 baseT copper ports and minimum two slots for 1000baseT fibre modules.
- ii. The IP network shall support multicasting between all ports and shall allow for  
Multicast streams to be routed between networks.
- iii. All the edge switches should be minimum Layer-2. All Layer-2 switches must finally be brought together using 1000baseT ports to central Layer-3 switch. Connection to the servers and clients must be 1000baseT from 10/100/1000baseT ports. Connection between Layer-2 and Layer-3 switch should use fibre backbone.

- iv. Uplink port should have sufficient speed to avoid network congestion, preferably network should not be loaded more than 70% at any stage.
- v. All these Edge switches should provide IEEE 802.3af compliant PoE on all the ports simultaneously.

#### **CORE SWITCHES:**

- i. All the Main and Redundant Core switches should be minimum Layer-3.
- ii. All these Edge switches should be connected to Core switches using Gigabit or 10G connectivity depending on the load on that part of network.
- iii. All the Core switches should support and be enabled with IGMP querier.

#### **4. DIGITAL VIDEO MANAGEMENT SERVER SOFTWARE:**

- The DVM Software shall be DVM application software.
- The DVM software shall consist of an MS-SQL 2008 or better based Main and Redundant Directory Database Server, Archive Server for audio and video, Failover recording, Redundant recording, Digital Virtual Matrix, Incident Reports, Alarm Management, Scheduled backup application, reporting tools and Watchdog modules. All the related software licenses should be the part of the offered system.
- The DVM should support any of the following Video Analytics Features on user defined cameras.

Trip wire detection

Illegal parking

Loitering detection

Stolen object detection

Object left / Removal detection

Crowd Detection

Directional Motion (Adaptive Motion),

Camera Sabotage

Object Counting

## Vibration Removal

- The DVM Server shall maintain a catalogue of settings for all the client, servers, and IP cameras in the system

The DVM shall enable the client to dynamically create connections between any camera on the digital monitors (audio, video, serial ports and digital I/Os)

The DVM shall provide the client seamless operation of all cameras available in the system regardless of the actual connection to different archive servers.

- The DVM shall detect signal loss and have the capability to alert the systems administrator. The DVM Archive Server shall offer the capability to be install multiple servers' software on multiple Computer Servers to enable distributed archiving architecture on the LAN or WAN.
- The DVM Archive Server, for video and audio, shall support and manage Camera connections from IP cameras each at 25FPS PAL at custom defined resolutions.

- The offered solution shall not load more than 100 cameras per server during normal functioning of the system to ensure designed server capacity can easily accommodate all the cameras recording at minimum resolution of 1280 x 720 @ 25FPS.
- If the Bidder's solution needs additional servers to fulfil this requirement, then they shall quote for additional servers accordingly.
- The DVM shall be able to set each camera frame rate, bit rate and resolution independently from other cameras in the system, and altering these settings shall not affect the recording and display settings of other cameras.
- The DVM shall utilize multicast network communication for video monitoring.
- The DVM shall offer privileged protected privacy masking feature on all the field cameras so as only the users with specific rights can unmask the picture during live or playback. It shall also support the password protection for such mask on exported videos.
- The DVM shall not allow to login in monitoring application on multiple clients using same login ID to avoid the misuse of the subsystem.
- The DVM shall have the capability to raise the alarm in case any of the video files are being deleted from video storage location.
- Offered cameras and software should be from the same make, or should be fully integrity tested and proven in the market place, considering the high level of complexities involved in IP system and future maintenance and upgrade issues.
- Unicast based equipment shall not be considered as an approved equal for alternate system.
- The DVM shall include a federated architecture, allowing clients on the host system with the right user rights to view video sources belonging to multiple independent video management systems simultaneously as if they were on the same system.
- The DVM shall contain recording servers used for recording video feeds and for communicating with cameras and other devices. The recording servers shall process the recordings and playback the video streams.
- The DVM shall contain a management server that shall be the central manager of the system and control recording servers, cameras, devices and users. The management server shall handle the initial client login, system configuration and logging.
- The DVM shall include an alarm management function that shall provide central overview, control and scalability in any number of federated video management system installations.

- It shall be possible to generate alarms based on internal system-related events, for example motion, or archiving problems or external integrated events, for example analytics events or third-party developed plug-in events.
- Generated alarm shall appear in an alarms list in the viewing client, and it shall be possible for operators to get an overview of, and to delegate and handle alarms from the alarm list.
- The management server shall allow access to a management client from where the administrator can configure and manage all servers, cameras and users.
- The system shall allow the management server and the event server to be installed on multiple servers within a cluster of servers ensuring that another server in the cluster automatically takes over in case the first server fails.

- The DVM shall support installation and the ability to run on virtualized Windows® servers.
- The DVM shall support high availability of recording servers. A failover option shall provide standby support for recording servers with automatic synchronization to ensure maximum uptime and minimum risk of lost data.
- The DVM shall support a versatile rule system including scheduled or event-driven actions with numerous options, including support for time profiles.
  - The DVM software shall include multicast and multi-streaming support.
  - The DVM shall include automatic camera discovery.
- The DVM shall support archiving for optimizing recorded data storage through data storage solutions that must combine performance and scalability with cost efficient long-term video storage.
- The video management system shall incorporate a fully integrated video-sharing functionality for distributed viewing of video from any camera in the system on any computer with the viewing client.
- The DVM shall incorporate intuitive map functions allowing for multi-layered map environment. The map functionality shall allow for the interactive control of the complete video management system, at-a-glance overview of system integrity, and seamless drag-and-drop integration with a video wall application option.
- The DVM shall support a video wall application, which shall be flexible and hardware independent to allow for seamless integration with the management client and viewing client.
- The DVM shall support 56-bit DEA encryption and 128-, 192- and 256-bit AES encryption of video for export purposes.
- The DVM shall support full two-way audio between clients and remote devices. Two- way audio integration shall support the following features and functions:
  1. Microphone inputs to clients shall transmit audio streams to speakers attached to remote IP devices.
  2. Audio from remote IP devices equipped with microphones shall be transmitted to and recorded by the recording server. The audio shall be relayed to clients equipped with speakers.
  3. Operator audio to IP devices shall be recorded by the recording server.

- By default, each speaker and microphone shall be assigned to the same device that it is connected to the speaker and microphone shall have the capability to be assigned to other devices as well.
- The DVM software shall provide fast evidence export by exporting video in various formats, including video from multiple cameras in an encrypted native database format with an included standalone viewing client. It shall be possible to write a digital signature to the native database files containing recorded data. This shall allow the viewing client and the standalone viewing client to verify that the contents of imported and opened databases have not been tampered with and that no database files have been removed.
- The DVM shall provide full awareness of the system through a system monitoring feature that shall monitor important system components such as recording servers, failover servers and hardware devices, and shall also include system logs and show user activity through comprehensive audit logs.

- The DVM shall include support a transactional data application designed to integrate with Point of Sale (POS), or Automated Teller Machine (ATM) data and time-link video recordings with POS, or ATM transactions.
- The DVM shall support a solution that makes it possible to integrate multiple third- party video content analysis applications seamlessly into viewing client environments.
- The DVM shall include a Software Development Kit (SDK) that offers important capabilities for integrating the video management system with third party software and applications.
- The DVM shall include a standalone viewing client application to be included with video exported from the viewing client application. The standalone viewing client application shall allow recipients of the video to browse and playback the exported video without installing separate software on their computers.
- The DVM shall include support for Active Directory to allow users to be added to the system. Use of Active Directory requires that a server running Active Directory, acting as a domain controller is available on the network.
- The DVM shall be designed to support each component on the same computer for efficiency in smaller systems, or each component on separate computers for large system deployments.

## **5. DETAILED SYSTEM SPECIFICATION**

- All the vendors shall attach the point by point compliance for below specification in their technical bid.
- Offers without the compliance shall not be considered
- The product described in this specification is (IP) based Digital Video Management (DVM) System.
- The proposed solution shall not require proprietary computer, server, and network or storage hardware.
- The proposed system shall be of a manufacturer with as minimum of five (5) years of experience and offerings in the IP network video software market, the letter stating the same should be submitted by the manufacturer. OEM for the offered cameras & software shall have a direct presence in India with sales and support facilities.

- The DVM database and video storage shall use SQL database for their operations.
- Considering this system is being deployed for Tier 3 datacentre, offered DVM system shall compulsorily offer below resiliency and failover functionalities. System shall have the priority setting per camera basis with top 10% cameras nominated as “Most Critical”, another 10% as “Critical” and rest of the cameras as “Normal” cameras.
  - o Failover Management shall be a basic feature of the DVM and should be included in offer. This functionality shall ensure the availability of past, present and future recording with near seamless continuity.
  - o The system should be capable to switching between Main to Failover Server in case of a failure of any one of them; and from one recording server to the next recording server in case of failure of the former – in microseconds – to ensure near continuous surveillance capability.

- o Above failover mechanism shall be designed to achieve highest level of resiliency in the system with optimum system components.
- The DVM system shall be based on the latest in software programming technology Microsoft
- o . NET 3.5 frame work or better.
- The DVM approved IP cameras shall provide the ability to be powered by power over Ethernet (PoE) 802.3af option.
- If required, Outdoor PTZs shall be powered by redundant mode Solid State Power Supplies, which shall have inline filters and surge protection circuitry to enable safe operable power to the Cameras.
- The DVM should support any of the following Video Analytics Features on user defined cameras.

Trip wire detection

Illegal parking

Loitering detection

Stolen object detection.

Object left / Removal detection

Crowd Detection

Directional Motion (Adaptive Motion)

Camera Sabotage

Object Counting

Vibration Removal

- The DVM video storage shall be capable of storing video for a period of 90 days available for on line access – The Bidder shall budget for unlimited storage capability in the Tender Bid. By Addition of Additional Storage Space, M/s AURIC should be able to expand the archival from 90 days to beyond, without any additional charges to be paid to the Bidder.
- The DVM Storage solution shall be as minimum set at RAID-5 configuration

- o Storage system shall be of RAID5 configured Direct Attached Storage (DAS) / Storage Area Network (SAN) Systems / Internal storage system.
  
- The DVM shall be based on high quality Dual / multiple H.264 stream IP cameras.
- Any other image based video compression JPEG, MJPEG, MPEG4, Wavelet, or shall not be considered as approved equal due to the high network bandwidth associated with these types of digital video compression.
- Offered cameras and software should necessarily support ONVIF interface.
- Each Camera shall provide dual video streaming technology providing independent settings per stream.
- The DVM shall have a capacity to switch and control all the current cameras. DVM Software should be expandable to unlimited cameras in future, without any additional cost to M/s Netmagic
- The system shall allow the recording, live monitoring, playback of archived video audio, and data simultaneously

- The DVM shall provide file export tool for export the native video format with all video protections (e.g. watermark, encryption) and the ability to play this video on a standard computer.
- The native file format video player shall show the status of the video authentication as available with the original file format.
- The IP Based DVM shall provide file export tool for export of single frames of video in J-PEG and BMP file formats and for export of motion video files in AVI file format for transport and playback on computers utilizing a Windows environment.
- The Client Reserves the right to, at a later date, depending on their sourcing economies, provide the required computers for the DVM client and servers, these computers shall be of the most current state of the art technology available at the time of installation and as minimum shall be better than the minimum requirements specified by DVM system manufacturer as well as tender specifications.

#### **6. DVM Client MONITOR Application:**

- The Client Monitor application shall allow for live monitoring of video and audio.
- The Monitor shall enable view of 1 to 32 video tiles simultaneously on a single SVGA (1024x768) monitor at up to 30fps per camera.
- The Monitor shall enable view of up to 32 video tiles simultaneously on a single monitor and shall provide the ability to connect up to Four (4) monitors to a single computer supporting multiple SVGA (1024x768) monitor outputs.
- The IP based DVM shall provide as minimum on each of the VGA monitors independently the following tile views:
  - Full screen, Quad, 3x3, 4x4, 5x5, 6x5, 1 + 9 (One large and 9 small view), 1+11 (One large and 11 small view), 1+12 (One large centre tile and 12 small view), 1+15 (One large and 15 small view), And more.
- The DVM Monitor application shall allow operators to view an instant replay of any camera.
- The operator shall be able to define the amount of time he wishes to go back from a predefined list or through a custom setup period.
- The operator shall be able to control the playback with play, pause, forward, and speed buttons.
- The DVM Monitor application shall allow operators to add bookmarks to recorded clips of video or audio.

- The operator shall be able to choose and trigger an action from a list of available actions included but are not limited to:

View camera in a video tile

View camera on a Decoder (analog monitor)

View Map or procedure in a video tile

Starting/stopping PTZ patter

Go to PTZ Pre-set.

Sending alert messages

Send/receive messages through a serial data stream

- The DVM Monitor application shall be able to display all cameras attached to the system regardless of their physical location on the network.

- The DVM Monitor application shall be able to display all camera sequences created in the system.
- The DVM Monitor application shall allow for unlimited cameras sequences, which may be run independently of each other on either digital monitor tiles or analog CCTV monitors.

### **Technical Specifications for Security Systems**

- The DVM Monitor application shall allow operators to control (Pause/Play, skip forwards, skip backwards) Camera Sequences, without affecting other operators' ability to view and control the same sequence.
- The DVM Monitor application shall display all cameras, sequences and analog monitors in a logical tree.
- The DVM Monitor application operator shall be able to drag and drop a camera from a tree of available cameras into any video tile or an analog monitor icon for live viewing.
- The DVM Monitor application shall support Graphical Site Representation (Maps) functionality, where digital maps are used to represent the physical location of cameras and other devices throughout facility.
- The DVM Maps shall have the ability to contain hyperlinks to create a hierarchy of interlinked maps.
- The DVM Maps shall be able to import maps from any graphical software supporting BMP, JPEG and/or GIF image formats.
- The DVM Monitor application operator shall be able to drag and drop a camera from a map into a video tile for live viewing.
- The operator shall be able to click on an icon in a map to initiate PTZ camera pre-set, run PTZ pattern, view camera in an analog monitor or send an I/O stream.
- The DVM Monitor application shall support the procedure functionality, where procedures can be triggered to appear during a certain event and can be used to provide detail written or verbal instructions to the operator as to the actions to be taken.
- The DVM Monitor application shall support digital zoom on a fixed camera's live and recorded video streams
- The DVM Monitor application shall support digital zoom on a PTZ camera's live and recorded video streams
- The DVM client shall provide the following video analytics alarm options:

Trigger alarms or events to draw the user attention

Provide a meaningful text description of the event.

Provide OSD graphics to depict the analytics event, including the participating objects, event location, motion directions and more.

Provide the above OSD graphics on live video, archived video and JPEG images

The Client Workstation shall have dual redundant 1 G (1000Mb) network interface and shall operate on 100/1000 Ethernet networked and shall be of the most current technology available by a major brand name manufacturer of computers and servers.

### **Technical Specifications for Security Systems**

- The DVM Monitor application shall provide management and control over the system using a standard PC mouse, keyboard and CCTV Joystick controller. The vendors should provide joystick controller as an integrated part of each client workstation.
- The DVM client shall be able to use multiple CCTV keyboards to operate the entire set of cameras throughout the system, including cameras of various manufacturers' brands, including their PTZ functionalities (i.e.: one keyboard manufacturer controls another manufacturer's dome or vice-versa).
- The DVM client shall allow for a CCTV keyboard to be attachable directly to the PC running the DVM client application via its serial port.
- The DVM client CCTV Keyboard Interface shall provide full PTZ control.
- The operator shall be able to control pan-tilt-zoom, iris, focus, dome relays and dome patterns
- The DVM client software shall allow the operator to access the PTZ configuration menus with no need of additional hardware.
- This shall prioritize which operator has control over a camera vs. another operator trying to control the same camera at the same time.
- The DVM client CCTV Keyboard Interface shall provide full video matrix operations.

### **7. Integration Interface**

- DVM should provide well defined SDK/API for integration development possibilities with third party ACS, FAS, BMS system.
- Development of integration module shall be in the scope of BMS system OEM, whereas DVM vendor should provide the requisite SDK/API for the same. Cost of the same should be included in the offer.

## **Annexure – 7**

### **List of Approved Makes**

**List of approved makes is as follows:**

SR. NO.	ITEMS	MAKES (ISI MARKED)
1	PVC PIPES AND ACCESSORIES	PRECISION / DIAMOND/ AVONPLAST / GRANDLAY / AKG
2	COPPER MULTI-STRAND WIRES	POLYCAB / FINOLEX / GLOSTER / L&T / KEI / SKYSTONE / RALLISON / INDO ASIAN / HPL / TEREXEL / RR / HAVELLS /
3	SWITCHES / SOCKETS / TV, TELEPHONE SOCKET, ETC. (MODULAR)- CAT A	ANCHOR ( RIDER ), LEGRAND(MYLING)
4	SWITCHES / SOCKETS / TV, TELEPHONE SOCKET, ETC. (MODULAR)- CAT B	ANCHOR (ROMA) / LEGRAND (ARTERIER/ MIRUS/ MYLINC ) / AS PER APPROVED BY ELECT. INCHARGE.
5	MCB / ELCB / RCCB / ISOLATORS / MCCB /DISTRIBUTION BOARDS	<b>CAT A</b> : LEGRAND / HAGER / L & T / SIEMENS / ABB
		<b>CAT B</b> : STANDARD / GROUP SNEIDER / MERLIN GERIN / HPL (MOOLER) / C & S/HAGGER/LEGRAND
6	SFU / FUSE SWITCH UNIT	SCHNEIDER / SIEMENS / L & T / CROMPTON / GE / INDOASIAN / HPL/ CUTTLER HAMMER / C & S / MERLIN GERIN
7	OUTDOOR BOXES/ FLOOR BOX	CLIPSAL / HENZEL / HUNTER / SINTEX / NATIONAL/ MK
8	HRC FUSES	SCHNEIDER / GE / L & T / SIEMENS / HPL / ABB / INDOASIAN / C & S
9	INDUSTRIAL SOCKETS	CLIPSAL / LEGRAND / CROMPTON / CUTTLER HAMMER / C & S
10	FAN REGULATOR	TO MATCH WITH THE SWITCH / SOCKETS

SR. NO.	ITEMS	MAKES (ISI MARKED)
11	UG CABLES	POLYCAB / ASIAN / GLOSTER / GEMSCAB / UNIVERSAL / CCI / NICCO / FINOLEX / KEI / TEREXEL
12	CABLE GLANDS	DOWELS / BRACCO / SIEMENS / COMET / JAINCO
13	CABLE JOINTING	RAYCHEM / CCI – XYCON / CABSEAL / M SEAL
14	CEILING FANS	CROMPTON / BAJAJ / ANCHOR / ORIENT / USHA / HAVELLS / KHAITAN
15	EXHAUST / PEDESTAL FAN	CROMPTON / BAJAJ / ANCHOR / ORIENT / USHA / ALMONARD / KHAITAN
16	FIXTURE	PHILIPS / CROMPTON / BAJAJ / WIPRO (AS SPECIFIED IN BOQ)
17	TELEPHONE WIRE / CABLES	FINOLEX / TATA (LUCENT) / ITL / SKYSTONE / GRANDLAY / GEMSCAB / DELTON / NATIONAL / L&T / DELTON / POLYCAB
18	CABLE TRAY & RACEWAYS (FACTORY FABRICATED)	SLATTCO / GLOBE / RICO STEEL / INDIANA / SADHANA / LEGRAND
19	NETWORK CABLE	DIGISOL / SCHNEIDER / AVAYA/ SYSTEMEC / FINOLEX / LEGRAND
20	TRANSFORMER	CROMPTON / KIRLOSKAR / VOLTAMP / BHARAT BIJLEE / KTL / ABB / MEGAWIN / URJA( UPTO 500KVA ONLY )
21	DG SET (ASSEMBLED BY AUTHORIZED OEA / OEM)	<b>ENGINE</b> - CUMMINS / PERKINS / CATTERPILLAR / KOEL / GREAVES COTTON/LEYLAND/ KIRLOSKAR
		<b>ALTERNATOR</b> - STAMFORD / JYOTHI / CROMPTON GREAVES / KEC
22	CAPACITOR	SIEMENS / ASIAN / KHATAU JUNKAR / L & T / ABB / UNIVERSAL
23	ACB	SIEMENS / L & T / GE / ABB / SNEIDER/ C & S/LEGRAND

<b>SR. NO.</b>	<b>ITEMS</b>	<b>MAKES (ISI MARKED)</b>
24	VCB / HT SWITCH WITH CUBICLE / SF6	SIEMENS / ABB / CROMPTON / AREVA / L&T / MEGAVIN
25	CT'S / PT'S	AE / INDCOIL / KAPPA / RICCO / PRAGATI / MEGAVIN
26	APFC RELAY	L & T / GEC / EMERCON / ALSTOM
27	CONTACTOR / TIMER / STARTER	L & T / CUTTLER HAMMER / SNEIDER / SIEMENS / HPL – MOLLAR / C & S
28	TRIVECTOR METER / ENERGY METER	AE / RISHAB / C & S / TECNIC / SIEMENS / SNEIDER / L & T / INDOASIAN
29	EPABX	AVAYA / NEC / LG ARIA / SIEMENS / ALCATEL
30	TELEPHONE INSTRUMENT	BPL / TATA / SIEMENS / AVAYA / NEC
31	AMMETER / VOLTMETER / POWERFACTOR METER / FREQUENCY METER	AE / RISHAB / IMP / MECO / ABB / HPL
32	LIGHTNING PRO. SYSTEM	SYNERGY / INDELEC / STORMASTER(LPI)
33	HT / LT PANELS	SUN CONTROL / KENSON ENGINEERS / KRIS CONTROLS / ELECTCONTROL / PES / VIVID / CONTROL CENTRE / IMPERIAL / PEATON ELECTRICAL / DB ENTERPRISES
34	GI PIPES	ZENITH / TATA / JINDAL
35	ROTARY SWITCH / SELECTOR SWITCH	SIEMENS / L & T / GE / KAYCEE
36	TELEPHONE TAG BOX	ITL OR ANY EQUIVALENT APPROVED MAKE
37	UPS / INVERTER	DUBAS / DB POWER / POWER WARE / APLAB / EMERSON / APC / STREAMLINE
38	BATTERIES	EXIDE / AMARON / PANASONIC / AMARAJA
39	RMU WITH CUBICLE	SIEMENS / SNEIDER / ABB / MEGAWIN / CGL / L&T

SR. NO.	ITEMS	MAKES (ISI MARKED)
40	CHANGEOVER SWITCH	HPL / INDO ASIAN./ C& S
41	VOLTAGE STABILIZER	ORICON / V- GUARD / EVEREST
42	UNITISED COMPACT SUBSTATION	CROMPTON/MEGAWIN/ABB/TESLA
43	GI OCTAGONAL POLES	BAJAJ / ASTER / KL INDUSTRIES
46	Engine	Cummins, Catterpillar, Kirloskar,
47	Alternator	Stampford, Crompton, Kirloskar
48	Relays	A.E, Crompton, L&T
49	Contractors	Siemens, L&T, GE
50	M.S Pipes	Tata, Jindal / Bansal
51	Anti Vibrations Mountings	Dunlop, Polybond,
52	Batteries	Exide, DigMMRCe, Faruken, Standard
53	Control Cables and other Cables	Finolex, Polycab, Gloster, R.R. cable
54	Power Cable	Finolex, Polycab, Gloster, Crystal
55	MCCBs	L&T hagger /GE /Siemens /Legrand

SR. NO.	ITEMS	MAKES (ISI MARKED)
56	Ammeter/ Voltmeter (Digital) :	Conserve, L&T, HPL,AE
57	Current Transformer	As per Manufacturer design.
58	Steel Tubular Pole	Subham/Utkarsh/keidia
59	Street light fitting	Bajaj/Philips/Wipro
60	Insulators	As per Manufacturer design
61	Fire Alarm System	GST / Cooper / Esser
62	Digital Public Address System	Heinrich / BOSCH/ Aties
63	IP - CCTV Camera	Vivotek / Axis / Sony /Hikvision
64	Integrated Security Management System	Axxon Soft / Genetec
65	Servers , Workstation	DELL/HP/IBM
66	Networked Attached Storage	Promise/ IBM/HP/DELL
67	Network Switches	CISCO/ HP / DELL

SR. NO.	ITEMS	MAKES (ISI MARKED)
68	Access Controller	HID/ KABA / Lenel/ Tyco Software House
69	Access Controller Software	Idcube / KABA / Lenel/ Tyco Software House
70	PV MODULES	RENEWSYS, WAAREE, VIKRAM, SOVA, RENESOLA (CHINA), TRINA (CHINA)
71	ON GRID INVERTER (3 PH )	SMA, ZEVEER, FRONIUS, DELTA, ABB, HUWAI, GROWATT, KACO, POWER ONE
72	ON GRID INVERTER ( 1 PH ) :	SMA, ZEVEER, FRONIUS, DELTA, ABB
73	OFF GRID :	POWER ONE, SWASTIK, MG SOLAR, EMERSON