For Empanelled contractor of Nasik Region Only

UNION BANK OF INDIA

REGIONAL OFFICE
NASHIK
PH.0253-2317771 / 2 / 3

SUBJECT: Electrical work of for branch at NASIRABAD

PERIOD OF COMPLETION = 60 DAYS ONLY

ISSUE OF TENDERS FROM:- 30/4/2022 ON **SATURDAY** TO **9/5/2022 on MONDAY**

LAST DATE OF SUBMISSION:-**9/5/2022 on MONDAY**UPTO 3.00 p.m.

TENDER OPENING DATE:- **10/5/2022 on TUESDAY**at 4.00 p.m.

PRICE OF THE TENDER DOCUMENT RS._00_BY WAY OF PAY ORDER

PROJECT ARCHITECT … AR.MANOJ BHANDARI,NASHIK

PLACE OF SUBMISSION: UNION BANK OF INDIA
FIRST FLOOR,THE CAPITAL BUILDING,SHARANPUR ROAD,
NASHIK
PH.0253-2317771 / 2 / 3

TENDER ISSUED TO: M/S_____

TENDER NOTICE

Subject: Electrical work of branch at .NASIRABAD,

1. Sealed item rate tenders are invited by M/s Union Bank of India, Regional Office, Nasik.

2. The work to be completed within 60 days / week from 7th day of the date of acceptance of work order placed by M/s Union Bank of India.

3. The tenderers are required to complete form of tender, price the schedule of quantities and sign each page of tender documents before submission. The completed set is to be enclosed in a sealed envelope addressed to :

   Dy. General Manager
   Nasik,Regional Office,Nasik

   Tenders will be received up to **9/5/2022 on MONDAY**up to 3.00 PM

4. No tender will be received after the expiry of the time notified for receiving tenders under any circumstances whatsoever.

   The tenders will be opened at **10/5/2022 on TUESDAY**at 4.00 PM at above address.

5. Tender shall remain valid for acceptance for a period of 90 days from the notified last date of tender submission.

6. The Bank reserves the right to reject any or all tender received without assignment of any reasons thereof.

7. The tender rate against each item of work / price indicated in the schedule of quantities and rates / price should be indicated both in words and figures. In case of any discrepancy, the rates indicated in words would prevail.

8. The rates quoted against each item of work / price should be for the complete finished item of work and include all labour, material, taxes, overhead, duties, etc. Any statutory change in the tax structure after opening of the tender shall be reimbursed by the Bank as per actual.

9. Each tender shall be accompanied by Earnest Money of RS 5,000/- in the form of Pay Order / Demand Draft in favor of Union Bank of India, payable at _Nasik_____. Tenders without Earnest Money shall be summarily rejected.

10. The earnest money deposited shall not carry any interest and will be refunded to the unsuccessful tenderers. Earnest money paid by the successful contractor will be retained by the Bank till completion of the work.
11. Earnest money paid by contractor shall be forfeited by the Bank if contractor fails to undertake the job if he is communicated about acceptance of his rates.

12. All tenders in which any of the prescribed conditions are not fulfilled or incomplete in any respect are liable to be rejected.

13. This tender notice shall form part of the contract documents.

For Union Bank Of India
Dy. General Manager

GENERAL CONDITIONS OF CONTRACT

Subject :- Electrical work of branch at NASIRABAD,

General Instructions to Contractor

1 Inspection of sites: The contractor shall visit and examine the site and satisfy as to the nature and correct dimensions of work and facilities for obtaining material and shall obtain generally his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding or incorrect information on any of these points on the ground of insufficient description will be allowed. All expenses incurred by the contractors in connection with obtaining information for submitting this tender including his visit to site and efforts in compiling the tender shall be borne by the tenderer ad no claims for reimbursement thereof shall be entertained.

2 Safety Regulations: The contractor shall take all the necessary precautions while working and to safeguard adjacent property, Bank's property, Bank's employees, and traffic persons

3 Compliance to local laws:The contractor shall conform to the provisions of any Act of the Legislature relating to the work and to the Regulation of Bye Laws of any authority. He shall also obtain the permission of the Municipality or any other Authorities if required under the existing rules.

4 Site cleaning: All the rates quoted are inclusive of removal of rubbish / debris collected during the progress of work, rejected material and clearance of site before and after the work is completed. Not more than one truck load shall be stored that to for not more than 3 days. The contractor shall arrange to remove the same immediately. If the contractor is failing to remove the same and the expenses shall be recovered from the contractor and he will not dispute for the expenses so incurred.

5 Vouchers / bills: Contractor shall upon the request of the Bank furnish bills, invoices, accounts, receipts and other vouchers for all materials brought on site to prove that the material purchased are as mentioned in the specification.

6 Contractor's responsibility: The work will from time to time be examined by Bank's Architect / Engineer, but such examination shall not in any way exonerate the contractor from the obligation to remedying any defects which may be observed at any stage of the work or after the same is completed.

7 Dismissal from work: The contractor shall upon the written request of the Bank's Architect / Engineer immediately dismiss from the work any person employed by him thereon, who may in the opinion of the authority be incompetent or misconduct himself and such person shall not be again employed on the work, without the permission of the bank.

8 Order of work, etc.: Bank reserves the right to fix the order in which the various items of work involved are to be executed. However, the contractor shall be responsible for the completion of the entire job within the item limit specified failing which liquidated damages as mentioned in clause No.49 shall be recovered from the contractor.

9 Commencement of work:The work must be started within 7 days upon accepting the work order and the programme for carrying out the various jobs shall be drawn out in consultation with the Bank's Architect / Engineer. Adequate labour force shall be provided to complete the work within the specified period. Proper security aspects should be taken care of by adequate vigilance in view of the importance of the building. Default in compliance with the programmes so finalised shall entail operation of liquidated damages as stated.

10 Subletting the work: The contractor shall not directly or indirectly sublet the work to

other party without written permission from the bank.

11 Quantities of works are provisional: The quantities mentioned in schedule are provisional and likely to increase / decrease to any extent or may be omitted thus altering the aggregate value of the contract. No claim for loss of profit / business shall be entertained on this account

12 Distribution of work: The Bank reserve the right to distribute the work for which quotation have been called, among more than one parties, if found necessary. No claim in this respect shall be considered and the contractor agrees to cooperate with other agencies appointed by the bank.

13 Third party damage: The contractor shall be responsible for all injury to persons, animals, building, building structure, any damage to road, streets, footpaths and shall rectify it at its own cost.

14 Insurance cover:All the workers of the contractor as well as his sub-contractor must be properly covered by an Insurance Policy under Workman's Compensation Act and Fatal Accidents Act. The contractor at his own expenses arrange to effect and maintain until the virtual completion of the contract, insurance policy in the joint name of the Bank and the contractor against this risk to be retained by the Bank until the virtual completion of the work, and indemnify the Bank from all the liabilities arising out of such events. In case of delay, contractor shall arrange to extend insurance policy till work is completed.

15 Delay & Extension of time: All the work should be completed within the specified period in the tender. If the work is delayed due to the reasons beyond the control of the contractor, he should applying to the Bank explaining, therein the reasons for such delays, immediately and if in the opinion of Bank's authorities the delay is justified, the contractor shall be granted extension in time limit.

16 Certificate of virtual completion: As soon as the work is completed, the contractor shall inform in writing such completion to the Bank's Architect / Engineer who will inspect the work and if satisfied will issue the certificate that the work has been virtually completed and the defects liability period shall commence from the date of such certificate.

17 Defect liability period: The defects or other faults which may appear during the defect liability period which is 12 months after the virtual completion of the work, arising in the opinion of the bank due to inferior quality of material or bad workmanship not in accordance with the contract, contractor shall make good at his own cost within a reasonable time. In case of default, Bank may employ and pay other agencies to amend and make good such defects and all expenses / damages / losses shall be recoverable by Bank or may be deducted from any money due to the contractor

18 Arrangement of work: The contractor shall organise the work in such a way that the office users or the nearby public area put to no hardships and the working of the office is not affected. The contractor shall take adequate care during the progress of work to protect the office property like stationery, furniture, etc. In case of any damage, the same shall be made good by the contractor. Contractor is agreed to work after office hours for which no extra cost shall be considered.

19 Stacking of material: The contractor is not to stack any of his material recklessly so as to endanger the safety of the building and cause any nuisance to the occupants and the public.

20 Extra charges: It must be clearly understood that all the conditions of contracts are intended to be strictly enforced and that no extra charges in respect of extra work will be allowed unless they are clearly outside the spirit and meaning of the condition and unless such work shall have been ordered in writing.

21 Protection of material and work: The contractor shall be responsible for storing and watching his own material and protecting the work at his own cost. The contractor and his worker will be allowed to use lift after office hours. However, no paint drums or heavy bag

of cement / paint will be allowed to be taken into the lift. Any damage / spoiling of lift / floor / dado caused during such act will have to be made good by the contractor at his own expenditure.

22 Water supply: The contractor shall make his own arrangement for water required for the work. in case the water is available and supplied by the Bank, the charges for the same shall be recovered at the rate of 1% of value of the work executed. In case water supplied by the Bank, the contractor shall make his own arrangement for the storage, pipeline from point of tape of to the required location.

23 Electric supply: Electricity will be supplied by the Bank, the contractor shall make his own arrangement for providing points, wires lines, extension board wherever it is required in the premises, in and out.

24 Approval of samples: The contractor shall furnish well in time before work commence at his own cost, colour samples, samples of material or workmanship that may be called by Bank's Architect / Engineer for approval. Rates quoted shall cover for such preliminary work.

25 Workmanship: The work involved calls for a high standard of workmanship combined with speed. All the glass panes, door handles / hinges, electric fitting, fans, furniture records, floors etc. are to be thoroughly cleaned after work is completed. Any damage to the flooring, tiles, dado, panelling or any other part of the building, etc. shall be made good at the cost of the contractor to the entire satisfaction of the Bank. Contractor shall make all arrangements for shifting of furniture / records and keeping the same in its original position after he finishes the work on daily basis. The contractor at his own cost shall provide brown paper, polythene, tarpaulin etc. for protecting furniture / fixtures, paneling, electrical, fittings, records, etc.

26 Interpretation of documents / drawing: Except where otherwise provided in the contract all questions and disputes relating to the meaning of the specifications, design drawings and instructions herein before mentioned and as to the quality of workmanship or materials used for the work or as to any other question, claim, right, matter or thing whatsoever, in any way arising out of or relating to the contract, designs, drawings specifications, estimates, instructions, orders or these conditions or otherwise concerning the works, or the execution or failure to execute the same whether arising during the progress of the work or after the completion or abandonment thereof shall be referred to the competent authority of the Bank whose decision shall be final and binding on the contractor.

27 Use of scaffolding: The contractor shall allow the use of scaffolding erected by them to any other agency employed by the Bank during the contract period without any payment.

28 Provisional Item: If ordered by the Bank, contractor shall be required to carry out provisional items at the same conditions and rates as applicable for this contract.

29 Measurements of all concealed items: Measurements of all concealed items of work and extra item if any, shall be got recorded by the Bank's Architect / Engineer before they are checked up.

30 Measurements: All measurement tapes shall be of steel and all scaffolding and ladders that may be required for taking measurements shall be supplied by the contractor.

31 Cleaning during the work: The rates quoted shall include cleaning of ceiling roses, electric switches, boards, window panes etc. after the repairing leaving the site neat and tidy from time to time.

32 Complying I.S. specification: Unless otherwise mentioned in the contract, the latest Indian Standard Code for material specifications, method of work, mode of measurements shall be followed. The payment shall be made on the basis of actual measurement of work done to be submitted along with bill

33 Rate to include: The rates quoted by the contractor shall cover for work at any height in the premises for all finished items under this contract. The rate quoted shall be inclusive of all material cost, wastage, labour, loading, profit, taxes if any, scaffolding, transport, supervision, spot light arrangement and any other means to complete the job. Octroi, sales-tax, works contract tax or any other taxes present or future to be included in the rates so quoted. If there is a change in the tax structure / duties as per State / Central Govt. order after opening of tender, the Bank shall reimburse difference in tax as per actual.

34 Price Fluctuation: The rates quoted by the contractor shall be firm throughout the currency of contract (including extension of time if any granted) and will not be subject to any fluctuation due to variation in the cost of material or labour.

35 The successful tenderer if called upon to do so, shall obtain a letter from the approved trade manufacturer whose product is used, if found necessary by the Bank confirming that the manufacturer shall provide all the technical assistance and supervision during the execution of the work at all such places as directed and the contractor shall bear the expenses, if any, for such supervision and technical assistance supplied by the trade manufacturer.

36 Testing of materials: If at any point of time during the work, if Bank authorities desire to carry out the tests of certain materials, the contractor shall arrange for the same and submit the test report without any extra cost to the Bank.

37 The contractor shall note that they should bring to the notice of the Architect / Engineer any breakage in glass window before starting work. However, if any glass window is found to be broken during the repairing work, the same shall be replaced by the contractor at his own cost.

38 Conditional tenders: Conditional tenders are liable to be rejected.

39 Rates of non-tendered items: The successful tenderer is bound to carry out any item of work necessary for the completion of the job even though such items are not included in schedule of quantities.

40 Abandonment of work: If in any case the work required to be abandoned, the contractor shall not be entitled for any claims and he will be paid as per the actual work done till that period.

41 The Bank reserves the right to accept / reject the lower or any or all tenders in part or in whole without assigning a reason therefor.

42 Decision of the Bank shall be final and binding on any matter connected with the work. The matter of any dispute shall be decided after mutual discussions based on the terms and conditions of this contract. However, if the matter can not be resolved then the same shall be referred to the respected, qualified person in the field agreed to both the parties and his opinion shall be binding on both the parties. However, this is precourse to any legal action in this regard.

43 Incomplete quotation: Incomplete quotations shall be summarily rejected

44 Payments: The contractor shall be paid by the Bank from time to time under interim payment on account of works executed and when the value of work equal to the approximate value named in the Appendix as 'Value of work for Interim Certificate' has been executed in accordance with this contract.

45 When the work has been virtually completed and Bank's Architects / Engineer has certified in writing that the work has been completed on the basis of detailed measurements and has made a final scrutiny and that there is no dispute items, rates, ad quantities, the contractor shall be entitled to the payment of the final bill in accordance with the final certificate which will be honored within the period specified in the Appendix as period of honouring final certificate.

46 The contractor shall be paid by the Bank within the period named in Appendix (period of honouring certificate) after such certificate has been delivered to the employer by the Bank's Architect / Engineer. Bank's Architect / Engineer has power to withhold any certificate in the work or any part thereof are not carried out to his satisfaction or the contractor fails to show the desired progress or fails to follow the instructions given or in case of breach of this contract.

47 For water proofing works on traces, bathroom, WC, Chajja, work has to be executed through the agency specialized in waterproofing. Contractor will have to submit a guarantee of 10 years on stamp papers as per the format toe be prescribed by the Bank.

48 Earnest Money Deposit of successful tenderer shall be treated as security deposit. The contractor should pay this amount to the Bank by DD or PO at the time of submission of tender. This amount shall be retained by the Bank till the work is virtually completed and all amounts relating thereto settled. Second part of security deposit shall be built through the retentions from interim and final bills of the contractor and the amount of retention shall be as stated in the Appendix.

49 When the certificate of the virtual completion is issued to the contractor the security deposit in the form of EMD and 50% of retention money shall be refunded, provided that the contractor has fulfilled all the conditions of contract and further provided that the employer has no claim for forfeiture of part or whole of the said deposit. The balance 50% of the retention money built up through retention from interim and final bills will be returned to the contractor after the expiry of defect liability period, subject to deductions for any appropriations thereof required to be made by the Bank as per conditions of the contract. The contractor should note that no interest will be allowed on his security deposit.

50 The contractor is requested to sign each page of the quotation and put rubber stamp, seal below his signature and seal the quotation in an envelope.

51 Liquidated damages: If the contractor fails to maintain the required progress or to complete the work and clear the site or before the contract or extended date period of completion, he shall without prejudice to any other right, pay as agreed compensation amount of __% of contract amount per week of delay subject to maximum of __% of contract amount as liquidated damages.

52 Records & measurements: Measurements shall be taken jointly by Bank's Architect / Engineer and contractor and shall without extra charges provide assistance with appliance, labour and other things necessary for the work and measurements will be signed and dated by both the parties on completion of measurements.

53 Safety measures: The contractor at his own cost shall provide tarpaulins on the external side of the building at the time of breaking plaster etc. to safeguard adjacent property, Bank's property, employees, traffic, etc. The contractor shall follow all the safety measures while carrying out the work. Employer that is Bank shall not be liable for any compensation due to accident, any mishap or negligence.

54 If there is delay in commencement of work for any reason, the employer that is Bank shall not be liable for any compensation.

55 If at any point of time during the progress, it is observed that the contractor is not progressing the work with due diligence, care and lagging much behind the schedule or fails to gear up the work despite instructions from Bank's Architects, the employer (Bank) reserves the right to terminate the contract with 7 days notice. In such case, the contractor shall be liable to pay the employer any extra cost involved for the completion of the said work and will not obstruct any way in completing the work through other agency. After completion of entire work the contractor shall be paid for the actual work executed by him at the quoted rates after deducting any claims, damages. In case of such termination the security deposit held by the Bank will be forfeited

56 Although the number of coats of paints / polishing / white washing are specified the

contractor will have to additional coats if the surface is not to the satisfaction of the Bank's Architect / Engineer and there shall be no extra payment on account of such coats

57 First Aid: The contractor shall be responsible for all first aid and he shall keep the site fully equipped to meet such emergency.

58 Supervision: The contractor is required to have on site during all working hours a competent supervisor (acceptable to Bank) who will be responsible for the conduct of worker and who has authority to receive and act on such instructions issued by the Architect / Engineer of Bank.

59 All work shall be carried out in a workman-like manner to the entire satisfaction of the Architect / Engineers.

60 Contractor shall follow all rules / regulations in force and should possess the license for employing labour and also follow all safety measures, labour bye law and shall be responsible for any lapse.

61 Transfer of Tender Documents: Transfer of tender documents purchased by one intending tenderer to another is not permissible.

62 Safety: The contractor shall carry out the entire work in a workman like manner having full regard for the safety of the men working at site. All safe practices shall be strictly adhered to by the workmen of the contractor like wearing helmets, safety belts when working at heights, gloves when handling sharp objects and reinforcement, eye shields during welding, safety shoes, etc. The contractor shall protect sides of openings in floor slabs, edges of slabs, stairs, stairwells etc. with barricades, warning signs / lights and educate all his workmen regarding following safe working practices. He shall provide first aid boxes at site.

In spite of following safe methods, in case of any unfortunate accident, the contractor shall indemnify the employer against any expenses or claims towards treatment or compensation.

63 A Daily Diary Register: A daily diary register (with cement and steel stock statement) will be kept in the Engineer's Office or the site office. The contractor or his representative will furnish every day at 9.00 hrs. details of work for the day proceeding and the diary will be written up every day and jointly signed by the Engineer and the Contractor or their representatives in token of its correctness.

64 Nuisance: The contractor shall not any time do cause or permit anyone to do or cause any nuisance on the site or do anything which shall cause unnecessary disturbance of inconvenience to the Employer or to the owners, tenants or occupiers of other properties near the site and to the public generally.

65 Rights, remedies and powers:

I) Termination of contract due to contractor's default. If the contractor:

a. Abandon the contract.

b. At any time defaults in proceedings with the works with due diligence and continues to do so after a notice in writing of seven days from the Engineer or Project Architect or Employer, or

c. Commits default in complying with any of the terms and conditions of the contract and does not remedy it within 7 days after a notice in writing is given to him in that behalf of the Engineer or Project Architect or Employer.

d. Persistently disregards the instructions of the Engineer, Project Architect or contravenes any provision of the contract, or

e. Fails to remove materials from the site or to pull down and replace work after receiving from the Engineer, Project Architect notice to the effect that the said

materials or works have been rejected.

f. Fails to complete the works or items of work on or before the stipulated date (s) of completion, and does not complete them within the period specified in a notice given in writing in that behalf by the Engineer, or Project Architect of Employer, or

g. Offer or gives or agrees to give to any person in the Employer's service or to any other person on this behalf, any gift or consideration of any kind as an inducement or reward for doing or forbearing to do so for having done or forborne to do any act in relation to the obtaining or execution of this or any other contract for the Employer, or

h. Shall enter into a contract with the Employer in connection with which commission has been paid or agreed to be paid by him or to his knowledge, unless the particulars of any such commission and the terms of payment thereof have previously been disclosed in writing to the Employer / Engineer, or

i. Shall obtain a contract with the Employer as a result of ring tendering or other non-bonafide methods of competitive tendency, or

j. Being an individual, or if a firm, any partner thereof, shall at any time be adjudged insolvent or have a receiving order or order for administration of his estate made against him or shall take any proceedings for liquidation or composition (other than a voluntary liquidation fir the purpose of amalgamation or reconstruction) under any Insolvency Act for the time being in force or make any conveyance or assignment of his effects or composition or arrangement for the benefit of his creditors or support so to do, or any application be made under any Insolvency Act for the time being in force for the sequestration of his estates or if a trust deed be executed by him for benefit of his creditors, or

k. Being a company, shall pass a resolution or the court shall make an order for the liquidation of its affairs, or a appointed or circumstances shall arise which entitle the court or debenture holders to appoint a receiver or manager, or

l. Shall suffer an execution being levied on his goods and allow it to be continued for a period of 21 days, or

m. Assigns, transfers, sublets (engagement of labour on a piece work basis or of labour with materials not to be incorporated in the work, shall not be deemed to be sub-letting) or attempts to assign, transfer or sub-let the entire works, or any portion thereof without the prior written approval of the employer.

The Bank may, without prejudice to any other right or remedy which shall have accrued or shall accrue thereafter as the Employer by written notice determine the contract either as a whole or in part.

II) Upon such determination of the contract in whole or in part, the security deposit with the Employer in respect of the contract shall stand forfeited to the Employer without in any way effecting the rights of the Employer.

III) Rights of the employer after determination of the contract due to contractor's default.

The Engineer shall on such determination have powers to:

a. Take possession of the site and any materials equipment, plant, implements stores etc. thereon, and / or
b. Carry out the incomplete work by any means at the risk and cost of the contractor.

IV) On determination of the contract in full or in part, the Engineer shall determine what amount, if any, is recoverable from the contractor for completion of the works or part of the works or in case the works or part of the works is not to be completed, the loss

or damage suffered by the Employer. In determining the amount, credit shall be given to the contractor for the value of the work executed by him upto the time of cancellation or the value of contractor's materials to be present so as to record the measurements in his presence. If the contractor fails to be present in response to the notice, the recording of measurements shall be proceeded with ex-parte and the measurements as recorded shall be binding the contractor.

V) The Bank shall have the right to use contractor's plant, machinery and materials on the balance work but shall not in any way be responsible for any damage or loss of the same and the contractor shall not be entitled to any compensation thereof.

APPENDIX TO THE CONTRACT DOCUMENTS

Subject: **ELECTRICAL work for** branch at NASIRABAD

1. Defect liability period	:	12 months from the date of virtual completion of work.
2. Date of commencement	:	3 days after the contract is accepted by the contractor
3. Date of completion	:	60 days
4. Liquidated damages	:	a) 1% of contract amount per week / day of delay subject to maximum of 10% of contract amount for the works of less than 6 month completion period. b) 0.5% of contract amount per week / day of delay subject to maximum of 7.5% of contract amount for the works of which completion period is 6 months to 24 months completion period.
5. Period of honoring final certificate	:	30 days
6. Value of work for interim certificate	:	Rs.3,00,000/-
7. Period of honouring certificate	:	7 days
8. Retention money	:	4% of the bill value will be deducted as retention subject o maximum security deposit, inclusive of EMD. 50% of the retention money so held shall be refunded after virtual completion and balance 50% after defects liability period.
9. Initial security deposit including earnest money deposit already submitted.	:	Rs.5,000/-
10. Total Security deposit	:	4% of the contract amount
11. Earnest Money to be submitted	:	RS. 5000/- by way of demand draft or pay order on any Nationalised Bank drawn in favour of Union Bank of India payable at _Nasik_

FOR ELECTRICAL WORKS

SPECIAL CONDITIONS OF CONTRACT

1. COMPLETENESS OF TENDER :-

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the tender, whether such items are specifically mentioned in the tender documents or not.

2. RATES: -

The rates tendered shall be for complete items of work inclusive of Cost of material, erection, connection, testing, labour, supervision, tool & plants, storage, contingencies, breakage, wastage, execution at any level & height, all taxes (including works contract tax, if any), duties, and levies etc. and all charges for items contingent to the work, such as, packing, forwarding, insurance, freight and delivery at site for the materials to be supplied by the contractor.

3. WORKS TO BE DONE BY THE CONTRACTOR :-

The scope of internal and external electrification under this contract shall include the design, engineering, manufacture, assembly, testing, delivery, erection and commissioning of electrical system including supply of all material, labour, T&P etc for followings –

- Main Switches, Main L T Panels, meter board and external cable connection.
- 11 KV HT Panel.
- 11 KV / 0.433 KV Transformers.
- D. G. Sets with fuel tank, piping, fuel pump, exhaust piping with lagging and supports, cooling system complete.
- Sub and branch distribution boards, MCB's and RCCB's etc.
- Mains and Sub mains between various panels, meter boards and distribution boards.
- Point wiring with Conduits for all type of wiring including circuits, sub mains, light, fans, power and AC etc.
- Switches and socket outlets for light, fans, plug, power, Tel, TV, computer network etc with suitable MS/GI boxes with accessories complete.
- Earthing and Lightning Protection with earth leads/strips.
- Conduits and wiring for Telephone, EPABX, TV system, PA system, Music system and Computer networking, fire alarm, broad band etc.
- Cables and other allied works.

- Provision of emergency electrical supply and distribution for complete light, fans and other specified points are also included in the scope of work. For the purpose of emergency distribution separate DB's shall be installed for Light/fans **and fax machines & staircase** lighting at every place, so that these can be separated.

- Lighting Fixtures fans and exhaust fans. (If these are supplied by the client, then the contractor will erect the fixture as required without any extra payment beyond the contract)

- External lighting including underground cables and connection with the external cables and earthing.

- Feeder pillars with circuit breakers.

- Underground cables.

All the above work shall be complete in all respects up to the satisfaction of architect, consultant, Client and Engineer in charge as per the details mentioned in BOQ and drawings supplied time to time.

Unless and otherwise mentioned in the tender documents the following scope of works shall be done by the contractor, and therefore their cost shall be deemed to be included in their tendered cost:

a) Furnishing of all labour, skilled and unskilled, supervisory and administrative personnel, erection tools and tackles, testing equipment, implements, supplies, consumables like welding rods and gas, oil and grease, cleaning fluids, insulating tape, anti corrosive paints, jute cotton waste etc., and hardware for timely and efficient execution of the erection work.

b) Transport vehicles necessary for efficient transportation of equipment from Owner's stores to site of erection and excess materials back to owner's stores.

c) Complete assembly, erection and connection, testing and commissioning, putting into successful and satisfactory commercial operations of above equipment.

d) The items of work to be performed on all equipment and materials shall include but not limited to the following:

   (i) Receiving, unloading and transportation at site. (To Owner or Contractor's stores and from their upto actual place of erection).

   (ii) Opening, inspecting and reporting all damages and short supply items.

   (iii) Arranging to repair and/or re-order all damaged and short supply items.

   (iv) Storing at site with suitable all weather protection.

   (v) Assemblies, erection and complete Installation.

   (vi) Necessary coordination between work done by other Contractors.

   (vii) Final check-up, testing and commissioning in presence of Owner's representative.

(viii) Obtaining Owner's written acceptance of satisfactory performance.

4. INFORMATIONS REQUIRED FROM CONTRACTOR

i. Typical GA drawing of all equipment to be supplied and disposition of various fittings and loading.

ii. All Annexures of this specification duly filled in and signed by the contractor.

iii. Catalogue of all equipment and components explaining construction features.

iv. Transportation/shipping dimensions and weights, space required for handling parts for maintenance.

v. Type test certificates for all equipment on similar type of equipment.

vi. Final Single line diagram complete with cable sizes etc.

vii. Bill of Materials, Control & schematic line diagram for meter & relay panel, terminal connection/Master Terminal box diagram, wiring diagram with physical location of components for all equipment.

viii. Detailed cabling layout showing cable trench / tray layout, earthing layout.

ix. Detailed lighting layout showing position of fixtures / type of fixtures, circuiting and route of wires / cables / fixing details, DB details.

x. Protection relay settings.

xi. Cable schedule & interconnection chart.

xii. Foundation details and plan, loading details for all equipment.

xiii. Test certificates.

xiv. Instruction manuals of all major equipment.

xv. Test Procedures at sites.

xvi. Test reports of all tests carried out at site.

xvii. 'AS BUILT' drawings (2 sets of soft copies on CD and six sets of hard copies duly wound).

xviii. All layout drawings shall be made in scale of 1:50 or 1:100 unless until agreed by the Owner/ Consultant.

5. PRICES

a) The price quoted for supply items shall include all packing, crating, excise duty, sale tax / Works Contract tax, insurance, freight, loading/ unloading, handling & all other charges.

b) The price quoted for erection & commissioning shall include cost of all

consumables, taxes & duties. (if any). No additional taxes/duties shall be payable by Owner.

c) Prices quoted shall be firm and no variation shall be allowed during contract period.

d) Contractor shall furnish prices separately for spare parts for two (2) year's trouble free operation of the equipment and shall furnish the list of the same.

6. ELECTRIC POWER SUPPLY AND WATER SUPPLY :-

Unless and otherwise specified, power supply and water supply as may be required shall be arranged by the contractor for installation and testing of the equipment's at the site of work.

7. PROVISIONS AGAINST ACCIDENTS AND SAFETY MEASURES

a) All safety rules and codes as applicable to work including rules applicable as per factory inspector shall be followed during execution of above work.

b) All safety appliances and protective devices including hand gloves, aprons, helmets, shields, goggles, **safety** belts etc. shall be provided by Contractor for his personnel.

c) The Contractor shall arrange to provide guards and prominent display caution notices if access to any equipment / area is considered unsafe and hazardous.

8. SPECIFICATIONS

In the absence of specifications for any work or materials, relevant Indian Standard Specifications shall be applicable. If such codes for a particular subject have not been framed, the decision of the Employer / Consultant will be final and binding.

9. VARIATION IN QUANTITY

a) The Owner shall have right to delete or increase / decrease quantity specified in this specification as specified in preamble to Bill Of Materials.

b) Quantities indicated in Bill of Materials are based on engineering status of the project as on date. It is necessary that proper engineering is carried out by the contractor before procurement of material.

c) For procurement of any material & sequential delivery at site from point of view of erection etc. Contractor shall take prior approval from the employer.

d) All left over material for which payment has been made by the employer, has to be taken back by the contractor. The employer shall make necessary deduction from the bills of contractor.

10. SITE VISIT

It is recommended that contractor shall visit site before submission of his offer. Time and date shall be fixed with employer.

11. TOOLS FOR HANDLING AND ERECTION :-

All tools and tackles required for handling of equipment and materials at site of work as well as for their assembly and erection and also necessary test instruments shall be the responsibility of the contractor.

12. CO-ORDINATION WITH OTHER AGENCY: -

The contractor shall co-ordinate with all other agencies involved in the building work so that the building work is not hampered due to delay in his work. Recessed conduit and other works, which directly affect the progress of building work, should be given priority.

13. CARE OF BUILDINGS :-

Care shall be taken by the contractor to avoid damage to the building during execution of his part of the work. He shall be responsible for repairing all damages and restoring the same to their original finish at his cost. He shall also remove at his cost all unwanted and waste materials arising out of his work from the site, from time to time as designed by the Engineer-in-charge.

14. STRUCTURAL ALTERATIONS TO BUILDINGS :-

i. No structural member in the building shall be damaged/altered, without prior approval from the competent authority through the Engineer-in-charge.

ii. Structural provisions like openings, cutouts if any, provided by the department for the work, shall be used. Where these require modifications, or where fresh provisions are required to be made, such contingent works shall be carried out by the contractor at his cost.

iii. All such openings in floors provided by the department shall be closed by the contractor after installing the cables/conduits/rising mains etc. as the case may be, by any suitable means as approved by the Engineer-in-charge without any extra payment.

iv. All chase required in connection with the electrical works shall be provided and filled by the contractor at his own cost to the original architectural finish of the buildings.

15. WORK IN OCCUPIED BUILDINGS: -

i. When work is executed in occupied buildings, there should be minimum of inconvenience to the occupants. The work shall be programmed in consultation with the Engineer-in-charge and the occupying department. If so required, the work may have to be done even before and after working hours.

ii. The contractor shall be responsible to abide by the regulations or restrictions set in regard to entry into, and movement within the premises.

iii. The contractor shall not tamper with any of the existing installations including their switching operations or connections there to without specific approval from the Engineer-in-charge.

16. STATUTORY REGULATION AND APPROVALS :-

All electrical works shall be carried out only by those Contractors who are licensed by the concerned local authorities to execute this type of work. Only “A” Class government approved electrical contractor shall execute the job.

It shall be the responsibility of the Contractor to comply with the regulations laid down by the Indian Electricity Rules and local authorities. The Contractor shall also be responsible for obtaining all the statutory approvals/certificates for the work from the concerned Departments and these certificates shall be handed over to the Architects/Clients at the completion. All coordination with the local electric supply authorities, submitted of application, getting the desired load sanctioned shall be in the scope of contractor. The fees required to obtain the desired load sanctioned and other legal and miscellaneous charges by local electric supply authority / undertaking shall be given by the client but all follow-ups etc. shall be the contractor’s responsibility.

On completion of the work, the contractor shall obtain the certificates of final inspection and approval by the local electric supply authority and deliver these certificates to the Owner/Architects in original. The contractor shall bear all expenses and fees required to obtain these certificates without which the work shall not be taken over and shall not be considered complete..

17. STANDARDS AND CODE OF PRACTICE :-

The work shall be carried out as per the enclosed Specifications of work and the construction drawings to be issued from time to time. These specifications shall be read in conjunction with National Building Code, National Electrical Code 1985, Relevant Codes of Practices and Standards as issued by ISI and Indian Electricity Rules, CPWD specifications for electrical works (all with the latest amendments). The installation shall confirm in all respects to Indian Standard code of Practices. Following BIS codes shall be referred -

a) National Electrical Code

b) IS: 694 – 1977: PVC insulated cables for working voltage up to and including 1100 volts

c) IS: 732 -1989: Electrical wiring installation

d) IS: 1225 -1938: Installation and Maintenance of power Cables up to and including 33 KV Rating

e) IS: 1554: PVC insulated heavy-duty electrical cables.

f) IS: 1860: Installation operation and maintenance of passenger and goods elevator.

g) IS: 2309 -1989: Protection of building and allied structures against lightning.

h) IS: 3043 -1987: Earthing

i) IS: 3646 (Part-1) -1992: Interior Illumination

j) IS: 3661 (Part-2) -1967: Current rating for cable

k) IS: 3661 (Part-5) -1968: Current rating for cable

l) IS: 5216 (Part-1) -1982: Recommendations on safety procedures and practices in electrical work.

m) IS: 7098 (1 & 2): XLPE insulated cables

n) IS: 10028 (Part-1) -1985: selection, Installation and Maintenance of Transformers

o) IS: 10118 (Part-1) -1982: Selection, Installation and Maintenance of switchgear and Control gear

18. MATERIAL SAMPLES AND SHOP DRAWINGS :-

It shall also be the responsibility of the Contractor to submit without any extra charge the samples of the materials/equipment as and when asked by the Architect/Consultant. If the Contractor wishes to use an alternative make due to non-availability of the approved one, he should take the prior approval of the Architect/Consultant. Under such situations the Contractor shall show such promptness as not to hamper the progress of the work.

The Contractor shall submit for Architect/Consultant's approval the shop drawings at approved scale indicating the custom built equipment, L.T. Panels, run of cables and conduits he proposes to install.

19. ELECTRICAL DRAWINGS: -

i) The electrical drawings issued from time to time to the contractor are diagrammatic but shall be following as closely as actual construction and work will permit. The Contractor at his own expenses shall make any deviation from the drawings required to conform to the building construction. The architectural drawings shall take precedence over the electrical drawings as for as the civil and other trades works are concerned.

ii) If there is any discrepancy due to in-complete description, ambiguity or omission in the drawings and other documents relating to this Contract found by the Contractor either before starting the work or during execution or after completion, the same shall be immediately brought to the attention of the Architect/Consultant and his decision would be final and binding on the Contractor.

20. TESTING AND COMMISSIONING: -

The Contractor shall be responsible for testing and commissioning the entire electrical installation described in these specifications and relevant IS specifications and will demonstrate the operation of the systems to the entire satisfaction of the Architect/Consultant and to the Client approval.

21. GUARANTEE

At the close of work and before issue of final certificate of virtual completion by Owner / Consultant, the contractor shall furnish a written guarantee indemnifying the owner against defective materials and workmanship for a period of one year after commissioning. The contractor shall hold himself fully responsible for reinstallation or replacement of defective material free of cost to the owner.

22. COMPLETION DRAWINGS

The contractor shall submit, after the completion of the work, one set of originals and two sets of prints of the As-Fitted drawings/Completion drawings, giving the following information:

a. Run and size of conduits, inspection, junction and pull boxes.

b. Size of conductor in each circuit.

c. Location and ratings of sockets and switches controlling the light/fan and power outlets.

d. Location and details of distribution boards, mains, switches, switchgears and other particulars.

e. A complete wiring diagram as installed and schematic drawings showing all connections in the complete electrical system.

f. Location of telephone outlets, junction boxes and sizes of various conduits.

g. Location of all earthing stations, route and size of all earthing conductors etc.

h. Layout and particulars of all cables.

i. Location of all equipments with dimensions and connections.

23. INSPECTION

All equipment / material covered under this specification Is liable for inspection by the Owner/ his representative. The vendor shall inform two weeks in advance for inspection to be carried out at the manufacturer's works.

The contractor shall furnish data Sheets & other details. Additional information, if desired by the bidder can also be furnished separately.

SYSTEM DESCRIPTION

1.0 GENERAL INFORMATION

1.1 Ambient air temperature shall be taken as 50 deg. C for the purpose of designing of electrical equipment.

1.2 This specification shall be read and constructed in conjunction with the drawings and annexure to determine the scope of work.

1.3 All equipment shall be capable of continuous operation satisfactorily under the following conditions:

a) voltage variation : ± 10%
b) frequency variation : ± 5%
c) combined voltage & frequency variation : ± 10%

1.4 Nominal system supply available shall be as follows:

a) Incoming : 11 kV, 3 Ph., 50 Hz,
b) Utilization : 415V, 3 Ph., 4 wire, 50 Hz

2.0 CODES AND STANDARDS

2.1 All equipment and materials specified herein or not, shall be designed, manufactured and tested with the latest applicable standards & bureau of Indian standards.

2.2 All electrical equipment shall also conform to the latest electricity rules as regards safety and other essential provisions.

2.3 All electrical installation work shall comply with the requirements of the following Act / rules / codesas amended upto date:

a) Indian electricity act.
b) Indian electricity rules.
c) National electric code published by 818.
d) All relevant IS codes of practice.
e) Regulations published by tariff advisory committee.

3.0 SYSTEM DESCRIPTION

3.1 GENERAL

a) One independent radial feeder is envisaged from State Electricity Board for receiving incoming supply on 11 kV.

b) Two poles structure consisting of LAs, Isolator, drop out fuses etc. or 11 KV incoming supply shall be connected to Metering Panel through 11 kV XLPE

cable. On two Pole structure 11 kV XLPE cable shall be terminated through outdoor termination.

c) 11 kV XLPE cable from two pole structure to metering Panel to shall be buried in ground

d) 11 KV Panel shall have one incomer cum outgoing (unit panel), which will feed power to the Transformer.

e) 415V L T panel shall receive power from Transformer / DG sets and shall feed power to various Blocks & Common Services as per enclosed single line diagram. The panel will be PLC controlled for automatic operation in case of power failure for DG synchronization and auto load sharing arrangements.

f) Further routing of cables and Power Distribution shall be as per Single Line Diagram.

4.0 DESIGN CRITERIA

4.1 GENERAL

a) The equipment shall be used in high voltage system having characteristics as listed in this specification.

b) The equipment shall be installed in a hot, dusty, humid and tropical atmosphere.

c) There shall be no radio interference when the equipment are operated at maximum service voltage.

d) The max. temp. in any part of the equipment at specified rating shall not exceed the permissible limits as stipulated in the relevant standards.

e) The equipment shall be capable of withstanding the dynamic and thermal stresses of listed short circuit current without any damage or deterioration.

f) All equipment, accessories and wiring shall have tropical protection, involving special treatment of metal and insulation against fungus, insects and corrosion.

g) The safety clearances of all live parts of the equipment shall be as per relevant standards.

h) All equipment/components of identical rating shall be physically and electrically interchangeable.

i) All outdoor equipment shall be suitable to mount on steel structure. Connectors shall be bimetallic conductor.

j) Wherever single core cables are terminated in any equipment, gland plate shall be of Aluminium (3-4 mm thick).

k) There shall be no straight through joints in power & control cables.

l) All cable terminations shall be with Double compression cable gland with armour holding system.

m) The lighting fixture shall have loop in & loop out facility.

4.2 D G SET

a) DG Sets are intended to provide emergency load of 415V, 3 Ph. 4 wire, 50 Hz to various loads of campus.

b) DG Sets shall be provided with Electronics governor and shall be suitable for parallel operation.

c) DG sets shall be silent type and should be provided in a suitable acoustic enclosure.

d) All controls shall be of 24V DC.

e) DG Sets shall be suitable for continuous operation.

f) DG Sets shall be started / stopped from Engine / DG Panel / Remote.

g) The height of exhaust pipes shall be in line with requirements of pollution control rules.

h) DG set shall **be radiator cooled** and shall be silent type (In acoustic enclosure).

i) Main features of DG sets shall be as follows:

i.	Rating	:	As per B.O.Q. at 0.8 PF, 415V, 3 Ph, 50 Hz.
ii.	Duty	:	Continuous
iii.	Diesel Engine cooled.	:	4 stroke, multi Cylinders, turbo charged after
iv.	Speed	:	1500 rpm
v.	Type of cooling	:	Radiator cooled
vi.	Type of alternator regulated	:	Brushless, separately-excited (PMG), self-
vii.	Starting	:	Electrical Self-Starting
viii.	Batteries	:	Lead Acid type

GENERAL & TECHNICAL

1 POINT WIRING :-

1.1. DEFINITION :-

A point (other than socket outlet point) shall include all work necessary in complete wiring to the following outlets from the controlling switch or MCB. The scope of wiring for a point shall, however, include the wiring work necessary in tapping from another point in the same distribution circuit.

i. Ceiling rose or connector (in the case of points for ceiling/exhaust fan points, pre wired light fittings and call bells).

ii. Ceiling rose (in the case of pendants except stiff pendants)

iii. Back plate (in the case of stiff pendants).

iv. Lamp holder (in the case of goose neck type wall brackets, batten holders and fittings which are not pre wired).

1.2. SCOPE :-

Following shall be deemed to included in point wiring.

i. Conduit/casing and capping as the case may be, accessories for the same and wiring cables between the switch box and the point outlet.

ii. All fixing accessories such as clips, nails, screws, Phil plug, rawl plug etc as required.

iii. Metal switch boxes for control switches, regulators, sockets etc, recessed or surface type, and phenolic laminated sheet covers over the same.

iv. Outlet boxes, junction boxes, pull-through boxes etc, but excluding metal boxes if any, provided with switchboards for loose wires/conduit terminations.

v. Any special block required for neatly housing the connector.

vi. Control switch or MCB, as specified.

vii. 3 pin or 6-pin socket, ceiling rose or connector as required.

viii. Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.

ix. Interconnecting wiring between points on the same circuit, in the same switch box or from another.

x. Protective (loop earthing) conductor from one metallic switch box to another in the distribution circuits, and for socket outlets. (The length of protective conductor run along with the circuits/sub mains is excluded from scope of points)

xi. Bushes conduit or porcelain tubing where wiring cables pass through wall etc.

1.3 MATERIAL :-

The system of wiring shall consist of ISI marked single core PVC insulated flexible copper conductor wires as per IS: 694 amended up to date.

2. MEASUREMENT :-

i. Contractor shall measure the work jointly with the site engineer and prepare measurement sheets in triplicate. Three copies of measurement sheets shall be submitted along with running account bills. Bills received without proper measurements of work shall not be considered submitted.
ii. Should the contractor neglect to measure the work, then the measurement taken by Engineer/Architect or a person approved by the Bank shall be final and binding to him. Such measurements shall be taken in accordance with the mode of measurements wherever specified or as per actual executed quantities.
iii. All authorised extra works, omissions and all variations made without the Engineer/Architect/Bank's knowledge, or subsequently sanctioned by him in writing (with the prior approval of the contractor in writing) shall be included in such measurement.
iv. All bills for the work shall be submitted in the tender price bid format.

2.1. 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.

ii. No separate measurement will be made for interconnections between points in the same distribution circuit and for the circuit protective (loop earthing) conductors between metallic switch boxes.

2.2 POINT WIRING FOR SOCKET OUTLET POINTS :-

i. The light plug (5A/6A) point and power (15A/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 box with cover, switch/MCB socket outlet and other accessories shall be measured and paid as a separate item.

iii. The power point outlet will be 15A/5A or 16A/6A six-pin socket outlet.

2.3 GROUP CONTROL POINTS WIRING :-

i. In the case of points with more than one point controlled by the same switch, such point shall be measured in parts i.e.(a) from the switch to the first point outlet as one point, and (b) for the subsequent points each shall be treated as separate point.

ii. No recovery shall be made for non-provision of more than one switch in such cases.

2.4 TWIN CONTROL LIGHT POINT WIRING: -

i. A light point controlled by two numbers of two way switches shall be measured as two points from the fitting to the switches on either side.

ii. No recovery shall be made for non-provision of more than one ceiling rose or connector in such cases.

2.5 MULTIPLE CONTROLLED CALL BELL POINTS WIRING :-

i. In the case of call bell points with a single call bell outlet, controlled from more than one place, the point shall be measured in parts i.e. (a) from the call bell outlet to one of the nearest ceiling roses meant for connection to bell push, treated as one point and (b) from that ceiling rose to the next one and so on, shall be treated as separate point(s).

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.

3. CIRCUIT AND SUBMAIN WIRING :-

3.1. CIRCUIT WIRING :-

Circuit wiring shall mean the wiring from the distribution board up to the tapping point for the nearest first point of that distribution circuit, viz. up to the nearest first switch box.

3.2. SUB MAIN WIRING :-

Sub main wiring shall mean the wiring from one main/distribution switchboard to another and from Distribution Board to Power Outlet / AC Outlet.

4. MEASUREMENT OF CIRCUIT AND SUBMAIN WIRING :-

i. Circuit and sub main wiring shall be measured on linear basis along the run of the wiring. The measurement shall include all length from end to end of conduit or casing and capping as the case may be, exclusive of interconnections inside the switchboard 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 from the distribution board to the first nearest switch box in the circuit irrespective of whether the neutral conductor is taken to switch box or not.

iii. When wires of different circuits are grouped in a single conduit/casing and capping, the same shall be measured on linear basis depending on the actual number and sizes of wires run.

iv. When circuit wires and wires of point wiring are run in the same conduit/casing and capping, circuit wiring shall be measured on linear basis depending on the actual number and sizes of wires run in the existing conduit/casing capping.

v. 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, if not included in item.

vi. 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.

5. SYSTEM OF DISTRIBUTION AND WIRINGS :-

i. Main distribution board shall be controlled by the circuit breaker. Each outgoing circuit shall be controlled by a circuit breaker on the phase or live conductor.

ii. The branch distribution board shall be controlled by a circuit breaker. Each outgoing circuit shall be provided with a MCB of specified rating on the phase or live conductor.

iii. The load of the circuits shall be divided, as far as possible, evenly between the number of ways of the distribution boards, leaving at least one spare circuit for future extension.

iv. The neutral conductors (incoming and outgoing) shall be connected to a common link (multi way connector) in the distribution board and be capable of being disconnected individually for testing purposes.

v. Wiring shall be separate for essential loads (i.e those fed through stand by supply) and non-essential loads throughout.

6. BALANCING OF CIRCUITS :-

The balancing of circuits in three wire or poly phase installations shall be arranged up to the satisfaction of the Engineer-in-charge.

7. WIRING SYSTEM :-

j. Unless and otherwise specified the wiring shall be done only by the “Looping system”. Phase or live conductors shall be looped at the switch boxes and neutral conductors at the point outlets.

ii. Lights, fans and call bells shall be wired in the ‘lighting’ circuits. 15A/16A socket outlets and other power outlets shall be wired in the ‘Power’ circuits. 5A/6A socket outlets shall also be wired in the “Lighting” circuit both in residential as well as non-residential buildings.

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. Surface wiring shall run, as far as possible, along the walls and ceiling so as to be easily accessible for inspection.

v. In no case, the open wiring shall be run above the false ceiling without the approval of Engineer-in-charge.

vi. In all types of wiring, due consideration shall be given for neatness, good appearance and safety.

8. 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 end of such holes. The ends of metallic pipe shall be neatly bushed with porcelain, PVC or other approved material.

ii. Where a wall pipe passes outside a building so as to be exposed to weather, the outer end shall be bell mouthed and turned downwards and properly bushed on the open end.

9. JOINTS IN WIRING :-

i. No bare conductor 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 sub main 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.

10. CONFORMITY TO I.E. ACT, I.E. RULES AND STANDARDS :-

i. All electrical works shall be carried out in accordance with the provisions of the Indian Electricity Act, 1910 and Indian Electricity Rules 1956 amended up to date.

ii. The work shall also conform to relevant Indian Standard codes of practice for the type of work involved.

iii. In all electrical installation works, relevant safety codes of practice shall be followed.

iv. The complete wiring installation shall confirm to IS: 732 amended up to date.

11. GENERAL REQUIREMENTS OF COMPONENTS :-

11.1 QUALITY OF MATERIALS :-

All materials and equipment supplied by the contractor shall be new. They shall be of such design, size and material as to satisfactorily function under the rated conditions of operation and to with stand the environmental conditions at site.

11.2 RATING OF COMPONENTS :-

i. All components in a wiring installation shall be of appropriate ratings of voltage, current and frequency, as required at the respective sections of the electrical installation in which they are used.

ii. All conductors, switches and accessories shall be of such size as to be capable of carrying the maximum current, which will normally flow through them, without their respective ratings being exceeded.

11.3 CONFORMITY OF STANDARDS :-

All components shall conform to relevant Indian Standard specification, wherever existing. Materials with ISI certification mark shall be preferred. However for conduits, wiring cables, piano/tumbler switches and socket outlets, ISI marked materials shall only be permitted.

11.4 INTERCHANGEABILITY: -

Similar parts of all switches, lamp holders, distribution fuse boards, switch gears, ceiling roses, brackets, pendants, fans and all other fittings of the same type shall be interchangeable in each installation.

SWITCHES & RECEPTACLES (Piano Type)

1. CONTROL SWITCHES FOR POINTS :-

i. The switch box or regulator box shall be made of metal on all sides, except on the front. In the case of cast boxes, the wall thickness shall be at least 3 mm and in case of welded mild steel sheet boxes, the wall thickness shall not be less than 1.2 mm (18 gauge) for boxes up to a size of 20 cm x 30 cm, and above this size 1.6 mm (16 gauge) thick MS boxes shall be used. The metallic boxes shall be duly painted with anticorrosive paint before erection.

ii. Where a large number of control switches and/or fan regulators are required to be installed at one place, these shall be installed in more than one outlet box adjacent to each other for ease of maintenance.

iii. An earth terminal with stud & 2 metal washers shall be provided in each MS box for termination of protective conductors and for connection to socket outlet/metallic body of fan regulator etc.

iv. Clear depth of the box shall not be less than 50 mm, and this shall be increased suitably to accommodate mounting of fan regulators in flush pattern.

v. The fan regulators can also be mounted on the switch box covers, if so directed by the Engineer-in-charge.

vi. Control switches (single pole switches) carrying not more than 16 A shall be of piano type, as specified, and the switch shall be "ON" when the nob is down.

vii. Only MCB' s shall be used for controlling industrial type socket outlets.

viii. Control switch shall be placed only in the live conductor of the circuit. No single pole switch or fuse shall be inserted in the protective (earth) conductor, or earthed neutral conductor of the circuit.

ix. All switches, regulators, outlets & other accessories shall be white colour with matching white cover plate. In no case ivory or off-white switches shall be accepted.

2. SOCKET OUTLETS: -

i. Socket outlet shall be of the same type, white piano type as their control switches. These shall be rated either for 5A/6A or 15A/16A. Combined 5A/15A or 6A/16A six pin socket outlet shall be provided in `power' circuits.

ii. In an earthed system of supply, socket outlets and plugs shall only be of 3 pin type, 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.

iii. Every socket outlets shall be controlled by a switch or MCB, as specified. The control switch/MCB shall be connected on the `live' side of the line.

iv. Outlet boxes for socket outlets (both15A/16A and 5A/6A) points shall be of size 175 mm x 100mm.

v. Unless and other wise specified, the control switches for the 5A/6A and 15A/16A socket outlets shall be kept along with the socket outlets.

3. SWITCH BOX COVERS :-

Phenolic laminated sheets of approved white shade shall be used for switch box covers. These shall be of white 3 mm thick synthetic phenolic resin bonded laminated sheet as base material and conforming to grade P-I of IS:2036-1974, Secured to the box with counter sunk C.P. Brass Screws. The corners of cover plates shall be at right angle.

SWITCHES & BOXES (Modular Type)

i. The switch box or regulator box shall be made of metal on all sides, except on the front. Since Modular type switches are to be used in the project, hence the boxes shall also be used of the same make and model. The size of box shall be governed by the number of switches/outlets/regulators on the respective board. The boxes shall be with zinc plating and yellow passivation to complies with the rust test as per IS 3854. The boxes should have slotted holes for level adjustments. The boxes shall be fitted with riveted brass earth terminals for earth connections.

ii. Clear depth of the box shall not in a range of 50 mm to 65 mm depending upon the size of board and manufacturer.

iii Control switch shall be placed only in the live conductor of the circuit. No single pole switch or fuse shall be inserted in the protective (earth) conductor, or earthed neutral conductor of the circuit. The switches shall be provided with silver contacts. The neutral should make first and breaks last.

iv. Socket outlet shall be rated either for 5A/6A or 15A/16A. 5/6 Amp sockets shall be of 5 pin type with shutters. Combined 5A/15A or 6A/16A six pin shuttered socket outlet shall be provided in `power' circuits. The earth pin shall be connected to earth through protective (loop earthing) conductor. All sockets shall be provided with safety shutters to allow easy entry of two pin plugs without the need to force the earth terminal by unsafe means. All sockets shall confirm to IS: 1293.

v. Every socket outlet shall be controlled by a switch, as specified. The control switch shall be connected on the `live' side of the line.

Vi The switches and sockets shall be manufactured using engineering plastic to make it fire retardant and highly resistant to impact.

vii. The fan speed regulators shall be of electronic and stepped type

viii. The RJ-45 data socket shall be suitable for cat5/cat 6 data cables.

ix. Gold plated contacts shall be provided in all communication jacks to enhance data and voice transmission.

SWITCHGEAR AND CONTROLGEAR

1. GENERAL ASPECTS :-

i. All items of switchgear and distribution boards (DB' s) shall be metal clad type.

ii. The types, rating and/or categories of switchgear and protective gear shall be as specified in the tender schedule of work.

iii. RCCB's, ELCB's and RCBO's where specified, shall conform to the requirements of current rating, fault rating, single phase or three phase configuration and sensitivity laid down in the tender documents.

iv. While each outgoing way of distribution board (D.B.) shall be of miniature circuit breaker (MCB) as specified, and of suitable rating on the phase conductor, the corresponding earthed neutral conductor shall be connected to a common neutral terminal block and shall be capable of being disconnected individually for testing purpose.

v. **Independent earth terminal block.**

Every distribution board (single phase as well as three phase) shall have an earth terminal block identical to, but independent from neutral terminal block, to enable termination of protective (loop earthing) conductors (incoming as well as out goings) individually by screwed connection and without twisting.

vi. Earthing terminal (1 for single phase and 2 for three phase) shall be provided on the metal cladding of switches and D.B.' s for body earthing. These shall be suitably marked.

vii. Knock out holes, with or without end plates as per standard design of manufacturers, shall be provided in the metal cladding of switches and D.B.' s for termination of conduits/cables.

viii. Each distribution board shall be provided with a circuit list giving details of each circuit, which it controls, and the current rating of the circuit, and the size of the fuse element.

2. MCB TYPE DISTRIBUTION BOARDS (MCB DB) :-

i. MCB DB' s may be of single phase, three phase (horizontal type) suitable for feeding single phase loads or 3 phase (vertical type) suitable for feeding single phase as well as three phase loads, each phase isolation type three phase DB in which each phase can be isolated by a separate circuit breaker or RCCB, as specified. These shall be complete with accessories, but without MCB' s, which shall be specified as a separate item in the tender documents.

ii. The current ratings and the number of ways shall be as specified. Blanking plates shall be provided to close unused ways. These shall be indicated as a separate item in the Schedule of work.

iii. MCB DB' s shall be of surface/flush mounting pattern according to the requirement of their location, and shall be suitable to accommodate MCB' s and MCB type isolators and RCCB (ELCB) at incoming in single pole or multi pole configuration, as required.

iv. MCB DB's shall be double door type; dust and vermin proof conforming to IP 42, and shall be fabricated out of CRCA sheet steel, 1.6 mm thick, with stove enameled paint finish.

v. In case of Concealed / Recessed D.B.'s, cutting of brick work, providing suitable lintel, making good the wall including plastering etc. with necessary civil work including all Civil material shall be included in contractor's scope for proper completion of work.

vi. MCB DB' s shall have removal type end plates with knockouts at the bottom and top, and shall have hinged covers with locking arrangement.

vii. Only the knobs of the MCB' s shall protrude out of the front covers through openings neatly machine made for the purpose.

viii. The bus bars used shall be solid electrolytic copper of appropriate sections.

ix. Din bar(s) shall be provided for mounting the MCB' s.

x. The complete board shall be factory fabricated and shall be duly pre-wired in the works, ready for installation at site.

xi. The board shall be fully pre wired with single core PVC insulated copper conductors/insulated solid copper links, and terminated on to extended type terminal connectors, suitable for connections to the sizes of the respective conductors.

xii. All incoming and outgoing wiring to the pre wired MCBDB' s shall be terminated only in the extended terminal connectors to be provided within the DB. The terminal connectors shall therefore be so provided as to facilitate easy cable connections and subsequent maintenance.

3. <u>MCCB TYPE DISTRIBUTION BOARDS (MCCB DB) :-</u>

i. All MCCB DB' s shall be of three phase suitable for feeding single phase loads or 3 phase loads through SP/TP MCB's, IP 42 enclosure, sheet steel, double door with tinned copper bus bar, neutral bar, earth bar, knock outs etc. The DB's shall be original factory fabricated of approved make.

ii. The current ratings of Incomer MCCB shall be upto 250 amp and the number of ways shall be as specified. Blanking plates shall be provided to close unused ways.

iii. MCCB DB shall be of surface/flush mounting pattern according to the requirement of their location, and shall be suitable to accommodate Four pole MCCB at incomer and SP/TP MCB's at outgoings, as required.

v. MCCB DB's shall be dust and vermin proof conforming to IP 42, and shall be fabricated out of CRCA sheet steel, 1.6 mm thick, with stove enameled paint finish.

v. In case of Concealed / Recessed D.B.'s, cutting of brick work, providing suitable lintel, making good the wall including plastering etc. with necessary civil work including all Civil material shall be included in contractor's scope for proper completion of work.

vi. MCCB DB' s shall have removal type end plates with knock-outs at the bottom and top, and shall have hinged covers with locking arrangement.

viii. The bus bars used shall be solid electrolytic copper of appropriate sections.

ix. Din bar(s) shall be provided for mounting the MCB' s.

4. WORKMANSHIP :-

i. Good workmanship is an essential requirement to be complied with. The entire work of manufacture/fabrication, assembly and installation shall conform to sound engineering practice.

ii. The work shall be carried out under the direct supervision of a first class licensed foreman, or of a person holding a certificate of competency issued by the state Government for the type of work involved, employed by the contractor, who shall rectify then and there the defects pointed out by the Engineer-in-charge during the progress of work.

5. COMMISSIONING ON COMPLETION: -

Before the workman leaves the work finally, he must make sure that the installation is in commission, after due testing.

6. COMPLETION PLAN AND COMPLETION CERTIFICATE :-

i. For all works completion certificate after completion of work shall be submitted to the Engineer-in-charge.

ii. Completion plan drawn to a suitable scale in tracing cloth with ink indicating the following, along with three blue print copies of the same shall also be submitted.

a) General layout of the building.

b) Locations of main switch board and distribution boards, indicating the circuit numbers controlled by them.

c) Position of all points and their controls.

d) Types of fittings, viz. fluorescent, pendants, brackets, bulkhead, fans and exhaust fans etc.

e) Name of work, job number, accepted tender reference, actual date of completion, names of Division/Sub-Division and name of the firm who executed the work with their signature.

7. ADDITION TO AN INSTALLATION :-

An addition, temporary or permanent, shall not be made to the authorised load of an existing installation until it has been definitely ascertained that the current carrying capacity and the condition of the existing accessories, conductors, switches etc affected, including those of the supply Authorities, are adequate for the increased load.

CIRCUIT BREAKERS

A. MINIATURE CIRCUIT BREAKERS (MCB) :-

Miniature Circuit Breaker shall comply with IS-8828-1996/ IEC898-1995 amended upto date.

Miniature circuit breakers shall be quick make and break type for 240/415 V AC, 50 Hz application with magnetic thermal release for over current and short circuit protection.

The breaking capacity shall not be less than 10kA at 415V AC.

MCBs shall be DIN mounted.

MCBs shall be current limiting type (class-3).

MCBs shall be C-curve.

MCBs shall have minimum power loss (watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values.

MCBs shall be of self-extinguishing ULV0 grade thermoset plastic material. The housing shall be heat resistant and having high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection.

All DP, TP, TPN and 4pole MCBs shall have a common trip bar independent to external operating handle.

Mechanical Life shall be 20000 operations and Service life at rated load for In below 32A shall be 20000 and for In above 32A shall be 10000 operations.

B. Earth Leakage Circuit Breaker / Residual Current Circuit Breaker - Current Operated Type (ELCB / RCCB / RCBO)

- **System of operation**

ELCB/ RCCB/RCBO shall work on the principle of core balance transformer. The incoming shall pass through torroidal core transformer. As long as the currents in the phase and neutral shall be the same, no electro motive force shall be generated in the secondary winding of the transformer. In the event of a leakage to earth, an unbalance shall be created which shall cause a current to be generated in the secondary winding, this current shall be fed to a highly sensitive miniature relay, which shall trip the circuit if the earth leakage current exceeds a pre-determined critical value. ELCB/RCCB/RCBO shall be current operated independent of line voltage. Current sensitivity shall be of 30mA at 240/415V AC or as specified in BOQ / drawings and shall have a minimum of 10000 electrical operations. The RCBO shall also provide over load and short circuit protection in addition to the earth leakage protection.

- **Mechanical Operation**

The moving contacts of the phases shall be mounted on a common bridge, actuated by a rugged toggle mechanism. Hence, the closing/opening of all three phases shall occur simultaneously. This also shall ensure simultaneous opening of all the contacts under tripping conditions.

- **Neutral Advance Feature**

The neutral moving contact shall be so mounted on the common bridge that, at the time of closing, the neutral shall make contact. First before the phases; and at the time of opening, the neutral shall break last after allowing the phases to open first. This is an important safety feature which is also required by regulations.

- **Testing Provision**

A test device shall be incorporated to check the integrity of earth leakage detection system and the tripping mechanism. When the unit is connected to service, pressing the test knob shall trip the ELCB/RCCB/RCBO and the operating handle shall move to the "OFF" position.

C. MOULDED CASE CIRCUIT BREAKER (MCCB's)

The rated normal current should be specified at 40°C

1. General

Moulded case circuit breakers shall be incorporated in the switchboard wherever specified. MCCB shall conform to IS:13947 (Part-2): 1993 or IEC-60947-2 in all respects. MCCB shall be suitable either for single phase AC 230 Volts or three phase 415 volts ± 10%. The rated insulation voltage shall be 600 volts. Suitable discrimination shall be provided between upstream and down stream breakers in the range of 10-20 milli seconds. The MCCBs will have earth fault module (if specifically asked) and front operated.

MCCB shall indicate its suitability for isolation and this should appear clearly on the MCCB with the symbol as specified in standard IS: 13947/IEC 60947

2. Construction

The MCCB cover and case shall be made of high strength heat-resistant and flame retardant thermosetting insulating material; operating handle shall be quick make/quick break. The operating handle shall have suitable `ON' `OFF' and `TRIPPED' mechanical indicators notable from outside. Three phase MCCBS shall have a common operating handle for simultaneous operation and tripping of all the three phases.

Suitable arc extinguishing device shall be provided for each contact. **Tripping unit shall be thermal-magnetic type upto 250A and Microprocessor based above 250A (or as specified specifically in Bill of Quantities and drawings)** provided on each pole and connected by a common trip bar such that tripping of any one pole operates all three poles to open simultaneously. Tripping device shall have IDMT characteristics for sustained over load and short circuits.

3. Contact tips shall be made of suitable arc resistant, sintered alloy for long electrical life. Terminals shall be of liberal design with adequate clearances.

4. Accessories

All the accessories shall be mounted from the front and shall be adjustment free. MCCBs shall have the electrical accessories fitted even without removing the circuit breaker from the switchboard so that site changes, if any, can be carried out easily. MCCB shall be provided with the following accessories, if specified in schedule of quantities, such as Under voltage trip, Shunt trip, Alarm switch, auxiliary switches, Rotary and motorized operating mechanism, Plug in and with drawable mechanism etc.

5. Interlocking

Moulded case circuit breakers shall be provided with the following interlocking devices for interlocking the door of a switchboard.

a) Handle interlock to prevent unnecessary manipulations of the breaker.

b) Door interlock to prevent the door being opened when the breaker is in ON position.

c) Defeat-interlocking device to open the door even if the breaker is in ON position.

6. Rupturing capacity

The moulded case circuit breaker shall have a rupturing capacity as mentioned against each in Schedule of Quantity at 415 volts. Wherever required, higher rupturing capacity breakers to meet the system short circuit fault shall be used. In absence of any capacity specifically mentioned in the bill of quantities and drawings, following rupturing capacities shall be used –

100 / 125 Amp : 25 KA

160/200/250 Amp : 35 KA

300/400/630/800 Amp : 50 KA

7. The MCCB shall be **current limiting type** and comprise of quick make – break switching mechanism. MCCBs shall be capable of defined variable overload adjustment. For thermal magnetic protection the O/L adjustment should be 75%-100% and for microprocessor-based release the adjustment should be 40%- 100% and S/c for 2 to 12 times .All MCCBs rated 200 Amps and above shall have adjustable magnetic short circuit pick-up.

8. Electrical Features

All MCCB's & shall be selected on the basis of rated current. Four poles MCCBs shall be always supplied with neutral protection. The MCCBs having 400A & should have category B as per the IEC standards to ensure the selectivity . Minimum Electrical & Mechanical Endurance of MCCB Shall be as follows

Rating of MCCB	**Electrical Endurance**	**Mechanical Endurance**
Upto 160 A	7000 Opns	25000 Opns
Above 160 A	4000 Opns	15000 Opns

9. The trip command shall override all other commands. The manufacturer shall provide both the discrimination tables (with test certificates) and let-through energy curves. Line and Load connections shall be interchangeable.

10. Installation

It should be possible to terminate Aluminium cable of required size for the defined current carrying capacity. The requisite size should be made available by means of extended terminals (as a standard offer) in case the direct terminals are not of adequate size. Adequate phase to phase clearance has to be ensured in case of extended terminations.

The circuit breaker should provide the flexibility of terminating line and load from any direction. Manufacturers should test the circuit breaker for this condition and requisite test certificate should be available.

Phase barrier should be provided as a standard feature.

11. Testing

a) Original test certificate of the MCCB as per BS 3871 or JS-C-8370 shall be furnished.

b) Pre-commissioning tests on the switchboard panel incorporating the MCCB shall be done as per standard specifications.

D. AIR CIRCUIT BREAKER

1. General

Air circuit breakers shall be incorporated in power control center and motor control centers wherever specified. ACB shall conform to **IEC60947 / IS: 13947** Part-2 1993 in all respects. ACBS shall be suitable for operation on 660 volts, 3 phase, 50/60 Hz, AC supply. The rated insulation voltage shall be equal to or greater than 1000V.The rated impulse withstand voltage shall be equal to 12kV, so that the device can be used for every installation category, in compliance with the international standards CEI IEC 664-1.

2. Type and construction

Air circuit breakers shall be of enclosed pattern, dead front type with trip free operating mechanism. Air Circuit breakers shall be **withdrawable typewith horizontal drawout carriage.** The mechanism shall be mechanical if not specifically mentioned for electrical. The ACBs shall be strong and robust in construction with suitable arrangement for anchoring when in fully engaged or fully drawn out positions. The carriage or cradle on which the breaker is mounted shall be of robust design made of fabricated steel, supported on rollers. Cradle shall also comprise of main and secondary separable contacts and all drawout mechanisms in a completely fig welded assembly short circuit on top. There shall be no dependence upon the panel board frame for any critical alignment. The withdrawal arrangement shall be such as to allow smooth and easy movement.

The drawout operation shall be possible through a closed door. Three positions of the moving part shall be possible :

1 - connected / service position - all auxiliary and main circuits engaged

2 - test position - all auxiliary circuits engaged all main circuits disconnected

3 - isolated position - all circuits disconnected.

All three positions should be indicated discreetly on the cradle. Safety shutter to be provided as standard

All the current carrying parts of the circuit breakers shall be silver-plated. Suitable arcing contacts shall be provided to protect the main contacts. The contacts shall be of spring-loaded design. The sequence of operation of the contacts shall be such that arcing contacts `make' before and `break' after the main contacts. Arcing contacts shall be provided with efficient arc chutes on each pole. The arc chutes shall be suitable for ready replacement. Self-aligning isolating contacts with automatic shutters to screen the live parts shall be provided. The design of the breaker shall be such that all the components are easily accessible to inspection, maintenance and replacement. The ACB at its rated current shall be suitable for operation in extremely tropical humid climate at 50°C ambient temp. The manufacturer shall declare ideal de-rating charts.

There should be total segregation between the power circuit and control circuit, thus making double insulation and ensuring fitting of accessories while the circuit breaker is in the ON

position. It shall be possible to inspect the arcing chamber and main contacts. The ACB shall have metal load bearing structures. The main contacts shall be separate from the arc-breaking contacts. It shall be possible to check the wear of the main contacts with the ACB in its racked-out position, removing the arcing chambers. No mechanical junctions in the main contact shall be there so that losses are minimal.

3. Operating Mechanism

Air circuit breaker shall be provided with a **quick-make, trip-free** operating mechanism. The operating mechanism shall be strain-free spring operated. The operating shall be "handle front of the panel" type. The design shall be such that the circuit breaker compartment door need not be opened while moving the breaker from completely connected, through test, in to the disconnected position. The spring shall be charged automatically during the closing operation. Mechanical Indication of the position of the spring charge shall be provided.

4. Interlocking and safety arrangement

Air circuit breakers shall be provided with the following safety and interlocking arrangements:

i) It shall not be possible for breaker to be withdrawn when in `ON" position.

ii) It shall not be possible for the breaker to be switched on until it is either in fully inserted position or for testing purposes it is in fully isolated position.

iii) The breaker shall be capable of being raked in to `testing' isolated and maintenance positions and kept locked in any of these positions.

iv) A safety latch to ensure that the movement of the breaker, as it is withdrawn is checked before it is completely out of the cubicle.

v) If under voltage release is provided then circuit breaker will close only if it is energized. Under voltage release should have time delay to avoid nuisance tripping for transient voltage failure

vi) The operating mechanism shall provide for raking the breaker in to connect, test and disconnected positions without opening the compartment door.

vii) Mechanical interlocks shall be provided between the operation of different breakers (if specified in Bill of Quantities).

The circuit breaker shall provide as a standard feature, the following mechanical indicator in the front Panel

1 Contact portion indicator (on/off)
2. Stored energy status indicator
3. Trip indicator on fault

5. Rating

The CTs range from 250A to 6300A: all the CTs shall have a structure made of self-extinguishing thermoplastic material. The breaking capacity of the ACB shall be greater than or equivalent to 50kA. The Breaking Capacity of the circuit breaker shall be as indicated in the BOQ with minimum of 50kA for upto 1250A, 65kA for 1600 to 2000A and 80kA for 2500 to 3200A. **Icu=Ics for all ACBs**. Icw rating at 1 sec/3sec should be declared. The minimum Electrical & Mechanical Life of ACB at 415/440V shall be as follows:

Rating of ACB	**Electrical Endurance**	**Mechanical Endurance**
Upto 1600 A	10000 Opns	20000Opns

2000-4000 A	5000 Opns	15000 Opns
Above 4000 A	1500 Opns	10000 Opns

6. Accessories

All the accessories like U/V, shunt opening, shunt closing shall be accessible from the front.

Circuit breakers shall be provided with the following Accessories: -

i) Under-voltage relay for the incoming ACB.
ii) Microprocessor based Overload releases with IDMT characteristics.
iii) Microprocessor based Instantaneous earth fault release.
iv) Alarm switches (if specifically asked for)
v) Auxiliary switches
viii) NO and NC auxiliary contacts rated for 10 Amps at 415 V AC and 6 Amp at 48V DC, in addition to ones already in use for the operation of the breaker and will be used in subsequent interlocks to be incorporated in future.

8. Mechanical indicators

Mechanical indication on the front of the air circuit breaker shall be provided to indicate the following :

- main contacts closed "ON"
- main contacts open "OFF"
- springs charged
- springs discharged
- circuit breaker in "service" position (drawout only)
- circuit breaker in "test" position (drawout only)
- circuit breaker in "isolated" position (drawout only)

9. Mounting

Circuit breakers shall be mounted as per the standard specification of power control centers.

10. Testing

Testing of each circuit breaker shall be carried out at the works as per IEC:60947 and the original test certificate shall be furnished in triplicate. The tests shall incorporate atleast the following:

i) Impulse withstand test

ii) Insulation test

iii) Di-electric rigidity /Insulation test

iv) Mechanical operation checking

v) Thermal protection with a current of 3ith starting from cold conditions.

11. Protection

The ACB shall be with an integral self-powered **microprocessor based current release** for Overload, Short-Circuit and Earth Fault protection which works on true rms values for

ensuring accurate protection, if specifically asked for. The protection unit should meet the EMI/EMC requirement as per latest standard. Online Test Fault shall be provided to test healthiness of release and ACB.

12. Setting range of protection release

a) Overload protection shall have adjustable setting from 40% to 100% of the ACBs rated current in steps of 10% and adjustable time setting from 3-18m sec.

b) Short circuit protection shall have adjustable current setting from 100% to 1000% of the overload setting and adjustable time delay setting for fault discrimination from 50-500 m sec.

c) E/F protection if specified will have adjustable current setting from 40% to 100% of ACB rated current and adjustable time setting from 100-800m sec. It shall be possible to charge the release setting on load.

METALLIC CONDUIT WIRING SYSTEM

1. SCOPE :-

This chapter covers the detailed requirements for wiring work in metallic conduits. This chapter covers both surface and recessed types of works.

2. APPLICATION :-

i. Recessed conduit is suitable generally for all applications. Surface conduit work may be adopted in places like workshops, plant rooms, pump rooms, wiring above false ceiling/below false flooring, and at locations where recessed work may not be possible to be done. The type of work, viz. surface or recessed, shall be as specified in the respective works.

ii. Flexible conduits may only be permitted for interconnections between switch gear, DB' s and conduit terminations in wall.

3. MATERIALS :-

3.1 CONDUITS :-

i. All rigid conduit pipes shall be of steel and be ISI marked. The wall thickness shall be not less than 1.6 mm (16 SWG) for conduit up to 32 mm dia. and not less than 2 mm (14 SWG) for conduits above 32 mm. These shall be solid drawn or reamed by welding, and finished with galvanized or stove enameled surface.

ii. The maximum number of PVC insulated cables conforming to IS : 694-1990 that can be drawn in one conduit is given size wise in **table 1**, and the number of cables per conduit shall not be exceeded. Conduit sizes shall be selected accordingly in each run.

iii. No steel conduit less than 20 mm in diameter shall be used.

3.2 CONDUIT ACCESSORIES :-

i. The conduit wiring system shall be complete in all respects, including their accessories.

ii. All conduit accessories shall be of threaded type, and under no circumstances pin grip type or clamp grip type accessories shall be used.

iii. Bends, couplers etc. shall be solid type in recessed type of works and may be solid or inspection type as required, in surface type of works.

iv. a) Saddles for surface conduit work on wall shall not be less than 0.55 mm (24 gauge) for conduits up to 25 mm dia. and not less than 0.9 mm (20 gauge) for larger diameter. The corresponding widths shall be 19mm & 25mm.

b) The minimum width and the thickness of girder clips used for fixing conduits to steel joists, and clamps shall be as per **table 2.**

TABLE - 1

MAXIMUM NUMBER OF PVC INSULATED 650/ 1100 VOLT GRADE COPPER CONDUCTOR CABLE THAT CAN BE DRAWN INTO RIGID STEEL CONDUIT.

Nominal cross sectional area of conductor in Sq. mm.	20 mm	25 mm	32 mm	40 mm
1.50	5	10	14	-
2.50	5	8	12	-
4.00	3	8	10	-
6.00	2	5	8	-
10.00	-	3	5	6
16.00	-	-	3	6
25.00	-	-	2	4

Note :-

The above table shows the maximum capacity of conduits for a simultaneous drawing of cables.

TABLE – 2

GIRDER CLIPS OR CLAMPS

S.No.	Size of conduit	Width	Thickness
i.	20 mm	19 mm	0.9 mm (20 SWG)
ii.	25 mm	19 mm	0.9 mm (20 SWG)
iii.	32 mm & above	25 mm	1.2 mm (18 SWG)

4. INSTALLATION :-

4.1 COMMON ASPECTS FOR RECESSED AND SURFACE CONDUIT WORKS :-

i. CONDUIT JOINTS :-

a) The conduit works of each circuit or section shall be completed before the cables are drawn in.

b) Conduit pipes shall be jointed by means of screwed couplers and screwed accessories only. Threads on conduit pipes in all cases shall be between 13 mm to 19 mm long, sufficient to accommodate pipes to full threaded portion of couplers or accessories.

c) Cut ends of conduit pipes shall have no sharp edges, nor any burrs left to avoid damage to the insulation of the conductors while pulling them through such pipes.

d) 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.

e) No bare threaded portion of conduit pipe shall be allowed, unless such bare threaded portion is treated with anticorrosive preservative or covered with approved plastic compound.

ii. BENDS IN CONDUITS :-

a) All necessary bends in the system, shall be done either by neatly bending the pipes without cracking with a bending radius of not less than 7.5 cm, or alternatively, by inserting suitable solid or inspection type normal bends, elbows or similar fittings, or by fixing cast iron inspection boxes, whichever is most suitable.

b) Conduit fittings shall be avoided as far as possible on conduit system exposed to weather. Where necessary, solid type fittings shall be used.

iii. OUTLETS :-

a) All outlets such as switches, wall sockets etc. may be either flush mounting type, or of surface mounting type, as specified and as required on site.

b) All switches and accessories shall be fixed in flush pattern.

iv. PAINTING AFTER ERECTION :-

After installation, all accessible surface of conduit pipes, fittings, switch and regulator boxes etc shall be painted.

5. ADDITIONAL REQUIREMENTS FOR SURFACE CONDUIT WORKS :-

i. PAINTING BEFORE ERECTION :-

The outer surface of conduit including all bends, unions, tees, junction boxes, etc. forming part of the conduit system , shall be adequately protected against rust when such system is exposed to weather by being painted with 2 coats of red oxide paint applied before they are fixed.

ii. FIXING CONDUIT ON SURFACE :-

a) Conduit pipes shall be fixed by saddles, screwed to suitable approved plugs with screws in an approved manner at an interval of not more than one meter, on either side of the couplers or bends or similar fittings.

b) Where conduit pipes are to be laid along the trusses, steel joists etc. the same shall be secured by means of saddles or girder clips or clamps as required by the Engineer-in-charge.

c) In long distance straight run of conduit, inspection type couplers at reasonable intervals shall be provided, or running threads with couplers and jam nuts shall be provided.

iii. FIXING OUTLET BOXES :-

Only a portion of the switch box may be sunk in the wall, the other portion being projected out for suitable entry of conduit pipes into the box.

6. ADDITIONAL REQUIREMENTS FOR RECESSED CONDUIT WORK :-

i. MAKING CHASE :-

a) chase in the wall shall be neatly made, and of ample dimensions to permit the conduit to be fixed in the manner desired.

b) In the case of buildings under construction, the conduits shall be buried in the wall before plastering, and shall be finished neatly after erection of conduit.

c) In case of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work.

ii. FIXING CONDUIT IN CHASE :-

a) The conduit pipe shall be fixed by means of staples, J-hooks, or by means of saddles, not more than 40 cm apart or by any other approved means of fixing.

b) All threaded joints of conduit pipes shall be treated with some approved preservative compound to secure protection against rust.

iii. FIXING CONDUIT IN R.C.C. WORK :-

a) The conduit pipes shall be laid in position and fixed to the steel reinforcement bars by steel binding wires before the concreting is done. The conduit pipes shall be fixed firmly to the steel reinforcement bars to avoid their dislocation during pouring of cement concrete and subsequent tamping of the same.

b) Fixing of standard bends or elbows shall be avoided as far as practicable, and all curves shall be maintained by bending the conduit pipe itself with a long radius which will permit easy drawing of conductors.

c) Location of inspection/junction boxes in RCC work should be identified by suitable means to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.

iv. FIXING INSPECTION BOXES :-

a) Suitable inspection boxes to the minimum requirement shall be provided to permit inspection, and to facilitate replacement of wires, if necessary.

b) These shall be mounted flush with the wall or ceiling concrete. Minimum 65 mm depth junction boxes shall be used in roof slabs.

c) Suitable ventilating holes shall be provided in the inspection box covers.

v. FIXING SWITCH BOXES AND ACCESSORIES :-

Switch boxes shall be mounted flush with the wall. All outlets such as switches, socket outlets etc. shall be flush mounting type, unless otherwise specified in the Additional Specification.

vi. FISH WIRE :-

To facilitate subsequent drawing of wires in the conduit, GI fish wire of 1.2 mm (18 SWG) shall be provided along with the laying of the recessed conduit.

7. BUNCHING OF CABLES :-

a) Cable carrying alternating current, installed in metal conduit, shall always be bunched so that the outgoing and return cables are drawn into the same conduit.

b) Where the distribution is for single phase loads only, conductors for these phases shall be drawn in one conduit.

c) In case of three phase loads, separate conduits shall be run from the distribution boards to the load points, or outlets as the case may be.

8. EARTHING REQUIREMENTS :

i. The entire system of metallic conduit work, including the outlet boxes and other metallic accessories, shall be mechanically and electrically continuous by proper screwed joints, or by double chuck nuts at terminations. The conduit shall be continuous when passing through walls or floors.

ii. Protective (loop earthing) conductor(s) shall be laid along the runs of the conduit between the metallic switch boxes and the distribution boards/switch boards, terminated thereto. These conductors shall be of such size and material, the protective earth conductors shall be either drawn inside the conduits along with the cables, or shall be laid external to the conduits. When laid external to the conduits, this shall be properly clamped with the conduit at regular intervals.

iii. The protective conductors shall be terminated properly using earth studs, earth terminal block etc. as the case may be.

iv. Gas or water pipe shall not be used as protective conductor (earth medium).

PVC CONDUIT WIRING SYSTEM

1. SCOPE :-

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

2. APPLICATION :-

1. Recessed conduit work is generally suitable for all applications. 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. Flexible non-metallic conduits shall be used only at terminations, wherever specified.

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 the following applications :-

a) In concealed/ inaccessible places of combustible construction where ambient temperature exceeds 60^{o}C.

b) In places where ambient temperature is less than 5^{o}C.

c) For suspension of fluorescent fittings and other fixtures.

d) In areas exposed to sunlight.

3. MATERIAL :-

3.1 CONDUITS :-

i. All non-metallic conduit pipes and accessories shall be of suitable material complying with IS : 2509-1973 and IS : 3419-1988. for rigid conduits and IS : 9537(V)-2000 for flexible conduits. The interior of the conduits shall be free from obstructions. The rigid conduit pipes shall be ISI marked.

ii. The conduit shall be circular in cross-section. The conduit shall be designated by their nominal outside diameter. The dimensional details of rigid non-metallic conduits are given in **Table-3.**

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 cables of 650/1100 V grade conforming to IS : 694-1990 that can be drawn in one conduit of various sizes is given in **table-4**. Conduit sizes shall be selected accordingly.

3.2 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 recessed 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-5.**

vii. For all sizes of conduit, the size of clamping rod shall be 4.5mm (7 SWG) diameter.

4. INSTALLATION :-

1. COMMON ASPECTS FOR BOTH RECESSED AND SURFACE CONDUIT WORKS.

i. The erection of conduits of each circuit shall be completed before the cables are drawn in.

ii. **CONDUIT JOINTS :-**

a) All joints shall be sealed/cemented with an approved cement. Damaged conduit pipes / fittings shall not be used in the work. Cut ends of conduit pipes shall have no 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 CONDUITS :-**

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.

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. **PAINTING :-**

After installation, all accessible surface of metallic accessories shall be painted.

5. ADDITIONAL REQUIREMENTS FOR SURFACE CONDUIT WORK :-

i. Conduit pipe shall be fixed by heavy gauge non-metallic saddles with base, secured to suitable approved plugs with screws in an approved manner, at an interval of not more than 60 cm, on either side of couplers or bends or similar fittings, saddles shall be fixed at a closer distance from the center of such fittings. Slotted PVC saddles may also be used where the PVC pipe can be pushed in through the slots.

ii. Where the conduit pipes are to be laid along the trusses, steel joists etc. the same shall be secured by means of saddles or girder clips as required by the Engineer-in-charge. Where it is not possible to use these for fixing, suitable clamps with bolts and nuts shall be used.

6. ADDITIONAL REQUIREMENTS FOR RECESSED CONDUIT WORK :-

i. **MAKING CHASE :-**

a) chase in the wall shall be neatly made, and of ample dimensions to permit the conduit to be fixed in the manner desired.

b) In the case of buildings under construction, the conduits shall be buried in the wall Before plastering, and shall be finished neatly after erection of conduit.

c) In case of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work.

ii. **FIXING CONDUITS 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 40 cm apart, or shall be fixed by any other approved means of fixing.

b) At either side of the bends, saddles/staples shall be fixed at a distance of 15 cm from the center of the bends.

iii. **ERECTION IN RCC WORK :-**

a) The conduit pipes shall be laid in position and fixed to the steel reinforcement bars by steel binding wires before the concreting is done. The conduit pipes shall be fixed firmly to the steel reinforcement bars to avoid their dislocation during pouring of cement concrete and subsequent tamping of the same.

b) Fixing of standard bends or elbows shall be avoided as far as practicable, and all Curves shall be maintained by bending the conduit pipe itself with a long radius which will permit easy drawing of conductors.

c) Location of inspection/junction boxes in RCC work should be identified by suitable means to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.

iv. **FIXING INSPECTION BOXES :-**

a) Suitable inspection boxes to the minimum requirement shall be provided to permit inspection, and to facilitate replacement of wires, if necessary.

b) These shall be mounted flush with the wall or ceiling concrete. Minimum 65 mm Depth junction boxes shall be used in roof slabs.

c) Suitable ventilating holes shall be provided in the inspection box covers.

v. **FIXING SWITCH BOXES AND ACCESSORIES :-**

Switch boxes shall be mounted flush with the wall. All 50outlets such as switches, socket outlets etc. shall be flush mounting type, unless otherwise specified in the additional specification.

vi. **FISH WIRE :-**

To facilitate subsequent drawing of wires in the conduit, GI fish wire of 1.2 mm (18 SWG) shall be provided along with the laying of the recessed conduit.

7. BUNCHING OF CABLES :-

a) Cable carrying alternating current, installed in metal conduit, shall always be bunched so that the outgoing and return cables are drawn into the same conduit.

b) Where the distribution is for single phase loads only, conductors for these phases shall be drawn in one conduit.

c) In case of three phase loads, separate conduits shall be run from the distribution boards to the load points, or outlets as the case may be.

8. 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. Protective conductors of large size which may not be possible to be carried inside the conduits (as in the case of some sub mains etc.) may be laid external to the conduits and clamped thereto suitably.

iii. Gas or water pipes shall not be used as protective conductors (Earth medium).

TABLE - 3.

DIMENSIONAL DETAILS OF RIGID NON-METALLIC CONDUITS.

(All dimensions in mm)

S.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	$20^{+0.3}$	17.2	0.2	0.5
2.	25	$25^{+0.3}$	21.6	0.2	0.5
3.	32	$32^{+0.3}$	28.2	0.2	0.5
4.	40	$40^{+0.3}$	35.8	0.2	0.5
5.	50	$50^{+0.3}$	45.0	0.4	0.6

TABLE - 4

MAXIMUM NUMBER OF PVC INSULATED 650/ 1100 VOLT GRADE COPPER CONDUCTOR CABLE THAT CAN BE DRAWN INTO RIGID PVC CONDUIT.

Nominal cross sectional area of conductor in Sqmm.	20 mm	25 mm	32 mm	40 mm
1.50	5	10	14	-
2.50	5	8	12	-
4.00	3	8	10	-
6.00	2	5	8	-
10.00	-	3	5	6
16.00	-	-	3	6
25.00	-	-	2	4

Note :-

The above table shows the maximum capacity of conduits for a simultaneous drawing of cables.

TABLE - 5.

ORDINARY CLIPS OR GIRDER CLIPS.

S.No.	Size of conduit	Width	Thickness
1.	20 mm & 25 mm	19 mm	20 SWG (0.9144 mm)
2.	32 mm & above	25 mm	18 SWG (1.219 mm)

EARTHING

1. 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.

2. INSTALLATION :-

1. ELECTRODES :-

i. Plate electrode shall be buried in ground with its faces vertical, and its top not less than 3 m below the ground level. The installation shall be carried out as per standard drawing.

ii. When more than one electrode is to be installed, a separation of not less than 2 m shall be maintained between two adjacent electrodes.

iii. a) The strip or conductor electrode shall be buried in trench not less than 0.5 m deep.

b) If condition 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.

iv. Earth Electrodes shall be kept clear of the building foundation & in no case shall it be nearer than 2 meters from the outer surface of the wall.

3. WATERING ARRANGEMENT :-

i. In the case of plate earth electrodes, a watering pipe 20mm dia. medium class pipe shall be provided and attached to the electrodes. A funnel with mesh shall be provided on the top of this pipe for watering the earth.

ii. The \watering funnel attachment shall be housed in a masonry enclosure of size not less than 30cm*30cm*30cm.

iii. A cost iron/MS frame with MS cover, 6 mm thick, and having locking arrangement shall be suitably embedded in the masonry enclosure.

4. EARTHING CONDUCTOR (Main earthing lead) :-

i. The earthing conductor shall be securely terminated on to the plate with two bolts, nuts, check nuts and washers.

ii. A double C-clamp arrangement shall be provided for terminating tape type earthing conductor with GI watering pipe coupled to the pipe earth electrode. Galvanised "C" shaped strips, bolts, washers, nuts and check nuts of adequate size shall be used for the purpose.

iii. The earthing conductor from the electrode up to the building shall be protected from mechanical injury by a medium class 15 mm dia GI pipe in the case of wire, and by 40 mm dia, 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 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.

iv. The earthing conductor shall be securely connected at the other end to the earth stud/earth bar provided on the switchboard 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.

c) Earthing Terminal / neutral point / earth bus in case of equipments / sub stations.

5. PROTECTIVE (Loop earthing/earth continuity) CONDUCTOR :-

i. Earth terminal of every switchboard in the distribution system shall be bonded to the earth bar/terminal of the upstream switchboard by protective conductor(s).

ii. Two protective conductors shall be provided for a switchboard carrying a 3 phase switch gear thereon.

iii. All the mountings of industrial type switchboards shall be bonded to the earth stud/earth bar using a protective conductor looping from one to another. Loop 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 switchboard by a protective conductor.

v. All metallic switch boxes and regulator boxes in a circuit shall be connected to the earth connector in the DB by protective conductor (also called circuit protective or loop earthing conductor), looping from one box to another up to the DB.

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

vii. Double earthing strips in rising mains, bus trunking etc. shall be securely connected to the earth bar/earth stud at the sending end switchboard. In the case of overhead

bus bar systems, protective conductors shall be provided in addition to feeder cable armouring connection.

6. 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 the Engineer-in-charge.

iii. If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, then the soil resistivity immediately surrounding the earth electrodes shall be reduced by adding sodium chloride, calcium chloride, sodium carbonate, copper sulphate, salt and soft coke or charcoal in suitable proportions.

7. MARKING: -

i. Earth bars/terminals at all switchboards shall be marked permanently either as "E".

ii. Main earthing terminal shall be marked "SAFETY EARTH - DO NOT DISCONNECT".

LIGHTNING PROTECTION SYSTEM

1. GENRAL :-

i. The entire lightning protective system should be mechanically strong to withstand the mechanical forces produced in the event of a lightning strike.

ii. Conductors shall be securely attached to the building, or other object to be protected by fasteners, which shall be substantial in construction, not subject to breakage, and shall be of galvanized steel or other suitable materials, which suitable precautions to avoid corrosion.

iii. The lightning conductors shall be secured not more than 1.2 m apart for horizontal run, and 1.0 m for vertical run.

2. AIR TERMINATION :-

All air terminals shall be effectively secured against overturning either by attachment to the object to be protected, or by means of substantial bracing and fixings which shall be permanently and rigidly attached to the building. The method and nature of the fixings should be simple, solid and permanent, due attention being given to the climatic conditions and possible corrosion.

3. DOWN CONDUCTORS :-

i. The down conductor system must, where practicable, be directly routed from the air termination to the earth termination network, and as far as possible, be symmetrically placed around the outside walls of the structure starting from the corners.

ii. a) Practical reasons may not be some times allow the most direct route to be followed. While sharp bends, such as arise at the end of a roof are in-escapable (and hence permissible), re-entrant loops in a conductor can produce high inductive voltage drops so that the lightning discharge may jump across the open side of a loop. As a rough guide, this risk may arise when the length of the conductor forming the loop exceeds 8 times the width of the open side of the loop.

b) When large re-entrant loops as defined above can not be avoided, such as in the case of some cornices or parapets, the conductors should be arranged in such a way that the distance across the open side of a loop complies with the requirement indicated above. Alternatively, such cornices or parapets should be provided with holes through which the conductor can pass freely.

iii. **Bonding to prevent side flushing :-**

Any metal in, or forming a part of the structure, or any building services having metallic parts which are in contact with the general mass of the earth, should be either isolated from, or bonded to the down conductor. This also applies to all exposed large metal items having any dimension greater than 2 m whether connected to the earth or not.

4. JOINTS AND BONDS :-

4.1 JOINTS :-

i. A lightning protective system should have as few joints as possible.

II. Joints should be mechanically and electrically effective, for example, clamped, screwed, bolted, crimped, riveted or welded.

iii. With overlapping joints, the length of the overlap should not be less than 20 mm for all types of conductors.

iv. Contact surfaces should first be cleaned, then inhibited from oxidation with a suitable non-corrosive compound.

v. Joints of dissimilar metals should be protected against corrosion or erosion from the elements, or the environment, and should present an adequate contact area.

4.2 BONDS :-

i. Bonds have to join a variety of metallic parts of different shapes and composition, and cannot therefore be of a standard form.

ii. There is the constant problem of corrosion and careful attention must be given to the metal involved, i.e. the metal from which the bond is made, and those of the items being bonded.

iii. The bond must be mechanically and electrically effective, and protected from corrosion in, and erosion by the operating environmental.

iv. External metal on, or forming part of a structure, may have to discharge the full lightning current, and its bond to the lightning protective system should have a cross sectional area not less than that employed for the main conductors.

v. Structures supporting overhead electric supply, telephone and other lines must not be bonded to a lightning protective system without the permission of the appropriate authority.

vi. Gas pipe in no case shall be bonded to the lightning protective earth termination system.

5. TEST JOINTS :-

Each down conductor should be provided with a test joint in such a position that, while not inviting unauthorized interference, it is convenient for use when testing.

6. EARTH TERMINATION NETWORK :-

i. An earth station comprising one or more earth electrodes as required, should be connected to each down conductor. This shall be specified.

ii. Each of the earth station should have a resistance not exceeding the product given by 10 ohms multiplied by the number of earth electrodes to be provided their in. The whole of the lightning protective system, including any ring earth, should have a combined resistance to earth not exceeding 10 ohms without taking account of any bonding.

iii. If the value obtained for whole of the lightning protection system exceeds 10 ohms, a reduction can be achieved by extending or adding to the electrodes, or by interconnecting the individual earth terminations of the down conductors installed below ground, some time referred to as a ring conductor. Buried ring conductors laid in this manner are considered to be an integral part of the earth termination network, and should be taken into account when assessing the overall value of resistance to earth of the installation.

iv. A reduction of the resistance to the earth to a value below 10 ohms has the advantage of further reducing the potential gradient around the earth electrode when discharging lightning current. It also further reduces the risk of side flashing to metal in, or of structure.

v. Earth electrodes should be capable of being isolated and a reference earth point should be provided for testing purposes.

CABLES

1. GENERAL

All cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian standards specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drum.

The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

The laying of cable shall be done as per IS 1255 amended up to date.

Cable Identification

(i) Cable identification shall be provided by embossing on the outer sheath the following:
(ii) Manufacturer's name or trade mark
(iii) Voltage grade
(iv) Year of manufacture
(v) Type of insulation
(vi) Printing of cable length on each meter

Core Identification

Respective cores of power/control cables shall be identified with the following pattern :

2 core	:	red (R), black (BK)
3 core	:	5 core red (R), yellow (Y),blue (BL)
4 core	:	red (R),yellow (Y),blue (BL), black (BK)
5 core	:	red (R), yellow (Y),blue (BL), black (BK) & grey (GY)
7&14 cores	:	cores shall be numbered.

Tests

(i) Shop Tests
The cables shall be subject to shop tests in accordance with relevant standards to prove the design and general qualities of the cables as below:

(ii) Routine tests on each drum of cables.

(iii) Acceptance tests on drums chosen at random for acceptance of the lot.

(iv) Type tests on each type of cable, inclusive of measurement of armour D.C. resistance of power cables.

2. MATERIAL

11 kV HT Cables

The 11 KV cable shall be cross linked polyethylene insulated, GI strip armoured, PVC inner and outer sheath (to be extruded type) earthed grade cable. The outer sheath shall be resistant to water, fungus, termite & rodent attacks. Colour of outer sheath shall be black. The cable shall be confirming to IS : 7098 (Part – II) with aluminium conductor as per I.S. 8130.

L T Power Cables

The 1.1 KV cables shall be XLPE insulated PVC sheathed aluminium conductor armoured conforming to IS : 7098 (part - 1) amended up to date or PVC insulated, extruded PVC inner sheath, steel strip armored and extruded PVC overall sheath conforming to 15:1554 (PI).as mentioned in the Bill of Quantities and drawings, laid in trenches, ducts and underground as shown on drawing or as per instruction given by engineer-in-charge.

Control Cables

Control cables shall be of stranded annealed copper conductors with cross section area of 1.5/ 2.5 sq.mm, PVC insulated, colour coded or with core identification, extruded inner sheathed, steel wire armoured and over all PVC extruded outer sheath etc. The cable shall conform to 15: 1554 (P-I).

Cable Termination

a) HT Cable Terminations
Cable termination shall be heat shrinkable type/cold shrink type suitable for sizes as specified in BOQ, XLPE insulated 11 kV (E) grade, and aluminum conductor armoured cables. Termination shall confirm to IS 3573 with latest amendment.

b) L T power, control cable termination

(i) L T cable termination shall be provided with compression cable glands of brass suitable for holding the armour of the cable.

(ii) Lugs shall be crimping type and shall be of copper suitable for copper conductor cable and of aluminum for aluminum conductor cable.

(iii) Termination shall be carried out as per details furnished in this specification.

Compression Glands

Cable glands shall be made of brass casting, machined accurately to the required size with protective coating of nickel.

Cable glands shall be of heavy duty type and shall consist of: gland nipple, neoprene

seal for inner sheath, armour clamping cone, gland body, neoprene seal for outer sheath, skid washer, gland body nut.

The Aluminium conductor shall be stranded, grade H4 class 2 as per IS 8130 and copper conductor shall be annealed copper class 2 as per IS 8130.

Technical data sheets for above cables, including all electrical & mechanical parameters shall be furnished with offer.

11 KV TWO POLE STRUCTURE SYSTEM

a) Two pole structure is intended to receive 11 kV 3 Ph. 50 Hz power supply through 11 kV XLPE cable from overhead line of State Electricity Board.

b) Two pole structure shall be fabricated from steel member and shall comprise of 11 kV Lightning Arrestors, Isolator, Drop out fuses (DO), Supporting channel, ACSR, Disk & pin insulators for cable suppor, Conductor, Outdoor end termination disc and pin insulators for XLPE 11 kV cable, 150 dia. GI pipe for cable protection, nut, bolts etc.

c) All structural work shall conform to relevant Indian Standards, specifications & codes etc.

d) Necessary guy wires shall be provided for supporting the structure (wherever required).

e) The structure shall be painted with two coats of red oxide.

f) Lightning arrestors shall be in single pole assembly heavy duty, station type suitable for outdoor installation & suitable to mount on steel structure.

g) Lightning arrestors shall be adequately rated to discharge the energy of voltage surges and shall be provided complete with mounting brackets as well as line and earth connections.

h) Lightning Arrestors shall be suitable for termination to ACSR conductor.

i) Isolator shall ,be suitable to mount vertically on two pole structure

j) Isolator shall have operating handle with locking arrangement

k) Isolator shall have operating handle with necessary arrangement to operate the isolator from ground

l) Isolator shall also be suitable for ACSR conductor termination

m) Drop out fuses shall be provided of suitable rating.

11 KV HT SWITCHGEAR

1. Design Criteria

a) 11 KV HT Panel shall be used to receive the power from SEB and to feed supply to the plant through the step down transformer.

b) Switchgear shall be located in a clean but hot, humid and tropical atmosphere.

c) For continuous operation at specified ratings. temperature rise of the various switchgears components shall be limited to the permissible values stipulated in the relevant standards.

d) The switch gears and components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the short circuit current listed in the annexure without any damage or deterioration material.

e) Circuit breakers, instrument transformers, bus-bars cable compartment etc. shall be housed in separate compartment within the cubicle. The design shall be such that failure of one equipment shall not affect the adjacent units.

f) Circuit breakers of identical rating shall be physically and electrically interchangeable.

2. Specific Requirements

a) Construction Features

(i) The Switchgear shall be indoor, metal-clad, floor mounted, drawout type.

(ii) The Switchgear shall be such as to allow extension at either end.

(iii) The Switchgear enclosure shall conform to the degree of protection IP4X.

(iv) The minimum thickness of sheet steel used shall be 2 mm.

(v) The switchgear shall be dead-front, free standing type vertical cubicle.

(vi) Switchgear shall have a front hinged door with latches and a removable back cover.

(vii) All covers and doors shall be provided with neoprene gaskets.

(viii) All relays, meters, switches and lamps shall be flush mounted on the respective cubicle door or on control cabinet built on the front of the cubicle.

(ix) The complete structure shall be free, rigid, self supporting, free from twist and bends etc.

b) Bus and Bus Taps

(i) The main buses and connections shall be of high conductivity aluminium / aluminium alloy, sized for specified current ratings with maximum temperature limited to 85 degree C (i.e. 35 degree Crise over 50 degree C

ambient)

(ii) Busbars and connection shall be fully insulated for working voltage with adequate phase! ground clearances. Insulating sleeves for busbars and cast-resin shrouds for joints shall be provided.

(iii) All buses and connections shall be supported and braced to withstand stresses due to maximum short circuit current and also to take care of any thermal expansion.

(iv) Busbars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from front of the switchgear assembly.

c) Circuit Breakers

(i) Circuit breakers shall be triple pole, single throw and shall be Vacuum type / SF6 type.

(ii) Circuit breakers shall be drawout type, having SERVICE, TEST and DISCONNECTED position with positive indication for each position.

(iii) The operating time (break time) of the breaker shall be maximum of 3 cycles.

(iv) Circuit breaker shall have motor wound spring charged trip free mechanism with anti-pumping feature and shunt trip. In addition, facility for manual charging of spring shall be provided.

(v) For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open-close open operation of the circuit breaker shall be possible after failure of power supply to the motor.

(vi) Mechanical safety interlock shall be provided to prevent:

- The circuit breaker from being racked in or out of the service position when the breaker is closed.
- Racking in the circuit breaker unless the control plug is fully engaged.

(vii) Automatic safety shutters shall be provided to fully cover the female primary disconnects when the breaker is withdrawn.

(viii) Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indication, an operation counter and mechanism charge! discharge indicator.

(ix) Each breaker shall be provided with following:

- Auxiliary switch, with 6 NO + 6 NC contacts, mounted on the drawout portion of the switchgear.
- Position/cell switch with 3NO + 1 NC contacts, on each for TEST and

SERVICE position.

(x) Control & Indication:

Breaker cubicle shall be equipped with following:

- One (1) No. spring return type TNC switch for closing and tripping of the breaker.
- One (1) No. Push button operated mechanical mechanism for tripping.
- Three (5) Nos. indicating lamps on front of compartment

GREEN	Breaker Open	
RED	Breaker Closed	
AMBER	Breaker Trip	
	BLUE	Spring Charged
	WHITE	Trip circuit healthy

- Lamps shall be of LED type. Lamps and lens shall be replaceable from the front.
- Each circuit breaker shall be provided with a anti-pumping relay. Trip coil supervision relay and fast trip relay in addition to those shown in the drawing.
- Metering device and protective relays for switchgear shall be provided as shown in the attached drawings.

d) Current Transformers

(i) Current transformer shall be cast resin type. All secondary connections shall be brought out to terminal blocks where wye or delta connections will be made.

(ii) Accuracy class of Current Transformers shall be :

- Class 5P20 for relaying
- Class 1.0/0.5 as specified and ISF<5 for metering.

e) Voltage Transformers

(i) Voltage Transformers shall be of cast-resin type having accuracy class of *1.0/* 0.5 and shall be mounted on drawout trolly.

(ii) High voltage winding of voltage transformer shall be protected by current limiting fuse. The voltage transformer and fuse shall be completely disconnected and visibly grounded in fully draw-out position.

(iii) Low voltage fuses, sized to prevent overload, shall be installed in all ungrounded secondary leads. Fuse shall be suitably located to permit easy replacement while the switchgear is energised.

f) Relays

(i) Relay shall be of drawout design with built - in testing facilities. Small auxiliary relays may be in non-drawout execution and mounted with in the cubicle.

(ii) Relays shall be rated for operation on secondary voltage and secondary currents as shown on drawings. Number and rating of relay contacts shall suit the job requirements.

g) Meters

Indicating instruments (96 x 96 mm) shall be digital meter, switch board type and accuracy class of + (1% full scale + 1 count).

h) Secondary Wiring

(i) The switchgear shall be fully wired at the factory to ensure proper functioning of control, protection, transfer and interlocking schemes.

(ii) Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired upto terminal blocks.

(iii) Wiring shall be done with flexible, 650V grade, PVC insulated switchboard wires with stranded copper conductors of 2.5 sq. mm for control and current circuits and 1.5 sq. mm for voltage circuits.

(iv) Each wire shall be identified, at both ends, with permanent markers bearing wire numbers as per contractor's Wiring Diagram.

(v) Wire terminations shall be made with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

i) Terminal Blocks

(i) Terminal blocks shall be 660 V grade box-clamp type with marking strips similar to ELMEX 6 Sq. mm or equal. Terminals for CT secondary leads shall have provision for shorting.

(ii) Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.

j) Cable Termination

(i) Switchgear shall be designed for cable entry from the bottom. Sufficient space shall be provided for ease of termination and connection.

(ii) Power cables shall be XLPE insulated, armoured, overall PVC sheathed with stranded Aluminium conductor.

(iii) Control cables shall be PVC insulated, armoured, overall PVC sheathed with 2.5 Sq. mm stranded copper conductor.

(iv) The gland plates shall be minimum 4 mm thick. The gland plate and supporting arrangement for *IIC* power cables shall be such as to minimise flow of eddy current. In such case, gland plate shall be non ferrous metal.

(v) Sufficient space shall be provided between the power cable termination (end-boxes) and gland plate. Core accommodated within this space.

k) Ground Bus

(i) A ground bus, rated to carry maximum fault current, shall extend to full length of the switchgear.

(ii) The ground bus shall be provided with two- bolt drilling with G.I. bolts and nuts at each end to receive 50 x 6 mm G.I flat.

(iii) Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and drawout V.T. unit shall be grounded , through heavy multiple contacts at all times.

(iv) Wherever the schematic diagrams indicate a definite ground at the switchgear, a single wire for each circuit thus grounded shall be run independently to the ground bus and connected thereto.

(v) C.T. and P.T. secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing other.

l) Nameplates

(i) Nameplates of anodised aluminum shall be furnished at each cubicle and at each instrument, device mounted on or inside the cubicle.

(ii) Caution notice on suitable metal plate shall be affixed at the back of each vertical panel.

m) Space Heaters

Cubicle shall be provided with thermostat-controlled space heaters.

n) A.C/D.C Power Supply

(i) The following power supplies shall be made available at each switchgear by the, contractor:

AC. Supply	:	Single Feeder
D.C supply	:	Double Feeder

(ii) Isolating switch fuse units shall be provided at each switchgear for the incoming supplies, 4- pole, single throw for A.C. and 2-pole, double throw for D.C.

(iii) Bus-wires of adequate capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating switchfuse units shall be provided at each cubicle for *ACt* D.C. supplies.

(iv) AC. load shall be so distributed as to present a balance loading on three-phase supply system.

o) Tropical Protection

(i) All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects & corrosion.

(ii) Screen of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entrance of insects.

p) Painting

(i) All surfaces shall be sand blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease and rust.

(ii) After cleaning, the surfaces shall be given a phosphate coating followed by 2 coats of high quality primer and stoved after each coat.

(iii) The panels shall be finished in Siemens Grey, RAL7032 with polyster enamel paint.

3. TESTS

The switchgear shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

Routine Test

The tests shall include but not necessarily limited to the following:

a) Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme & proper functioning of the equipment.

b) All wiring and current carrying part shall be given appropriate High Voltage test.

c) Primary current and voltage shall be applied to all instrument transformers.

d) Routine test shall be carried out on all equipment such as circuit breakers, instrument transformers, relays, meters etc.

Type Test

Type test reports of similar switchgear shall be furnished.

Test Witness

All tests shall be performed in presence of *Owner's* representatives, if so desired by the Owner's. The Contractor shall given at least fifteen (15) days advance notice of the date when tests are to be carried out.

4. SYSTEM DESCRIPTION & REQUIREMENTS

System Description

a) System Details

(i)	Voltage	:	011/12 KV (Nom. / Max.)
(ii)	Nos. of Phase	:	3
(iii)	Frequency	:	50 Hz. ± 5%
(iv)	System Neutral	:	Non effectively earthed

b) Insulation Level

(i)	1 minute 50 Hz withstand	:	28 KV rms.
(ii)	Impulse withstand	:	75 KV peak

c) Short Circuit Rating

(i)	Interrupting	:	350 MV A
(ii)	Withstand time	:	1 Sec.

d) Circuit Breaker

i)	Breaking Current	:	18.3 kA

e) Auxiliary Power supply available : 24V DC

f) Heater/Lamp/Socket : 415V/240V±10%
50 Hz± 5% 3Ph./1 Ph.

g) Spring wound motor for circuit breaker : 220V-240V 1 Ph. 50 Hz

h) Shunt trip coil & Closing coil : 24V DC

TRANSFORMER

1. DESIGN CRITERIA

a) Transformer is intended to step down incoming 11 KV power supply to 433 V for feeding power supply to 415V Main L T PCC for further distribution.

b) Transformer shall be installed indoor in hot, humid and tropical atmosphere. All equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

c) The transformer shall be capable of withstanding the short circuit stresses due to a terminal fault on one winding with full voltage maintained on the other winding for minimum period of three (3) seconds.

d) The transformer shall be free from annoying hum or vibrations. The design shall be such as not to cause any undesirable interference with radio or communication circuits.

e) Transformer shall be provided with **OFF LOAD TAP CHANGER** on HV side.

f) The safety clearances of all live parts of equipment shall be as per relevant standard.

2. SPECIFIC REQUIREMENTS

a Tank

a) Tank shall be of all welded construction and fabricated from good commercial grade low carbon steel of adequate thickness. All seams shall be properly welded. All welding shall preferably be stress relieved.

b) The tank wall shall be reinforced by stiffener to ensure rigidity so that it can withstand without any deformation, mechanical shock during transportation and during oil filling by vacuum.

c) Transformer tank shall be provided with one set of bi-directional flanged wheels for rolling the transformer parallel to either center line.

d) All heavy removable parts shall be provided with eye bolt for ease of handling.

e) Hand holes of sufficient size shall be provided for access to leads, windings, bottom terminals of bushings and taps.

b Core & Coils

a) The transformer may be of core type. The core shall be built up with high grade, non-aging, low loss, high permeability, grain oriented, cold-rolled silicon steel laminations specially suitable for core material.

b) The coils shall be manufactured from electrolytic copper conductor and fully insulated for rated voltage.

c) Insulating material shall be of proven design. Coils shall be so insulated that

impulse and power frequency voltage stresses are minimum.

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

e) All leads from the windings to the terminal board and bushings shall be rigidly supported to prevent injury from vibration or short circuit stresses. Guide tube shall be used where practicable.

c Radiators

a) Radiators shall be made from pressed steel and shall be detachable type.

b) Radiators shall be interchangeable type. Top and bottom shut off valve shall be provided for each radiator.

c) Each radiator shall be provided with air release plug, drain valve and lifting lugs.

d Tapings

a) Off load taps shall be provided on the high voltage winding.

3. Insulating Oil

a) The transformer shall be filled with mineral insulating oil suitably inhibited to prevent slugging.

b) First filling of oil along with 10% excess shall be furnished for each transformer. Oil shall be supplied in non-returnable containers suitable for outdoor storage.

4. Terminal Arrangements

a) Terminals on HV shall be through HT cable where as the LV side shall be through bus duct.

b) Cable-end box shall be weatherproof, air filled type with sufficient space inside for termination and connection of cables.

c) Cable-end box shall be furnished complete with removable gland plate.

d) A separate LV. neutral bushing shall be provided for connection to station earthing. Necessary insulators shall be provided on transformer body for bringing down the conductor.

5. Marshalling Box

a) A sheet steel, weatherproof, IP55 marshalling box shall be provided for each transformer. The box shall contain all auxiliary devices except those, which must be located directly on the transformer.

b) All terminal blocks for cable connection shall be located in this box. The

terminal blocks shall be Phoenix 10 sq.mm.

6. Wiring

a) All control, alarm and indication devices provided with the transformer shall be wired upto the terminal blocks.

b) Wiring shall be done with PVC wires in conduit or PVC armoured cable. Minimum wire size shall be 2.5 sq. mm copper. Not more than two wires shall be Connected to a terminal. 10% spare terminals shall be provided.

c) All devices and terminal blocks within the marshalling box shall be identified by symbols corresponding to those used in applicable schematic or wiring diagram.

7. Grounding

a) Two grounding pads, located on the opposite sides of the tank, shall be provided for connection to station ground mal

b) Grounding pad shall have dean buffed surface with two tapped holes, M10 GJ. bolts and spring washers for connection 50 x 6 mm G.I. flat.

c) Ground terminals shall be also provided on marshalling box to ensure its effective Earthing.

d) Bonding shall be provided between various non-current carrying parts of transformer wherever the same are connected thru' gaskets.

8. Fittings And Accessories

Each transformer shall be equipped with fittings and accessories as listed below:

a) Oil conservator with filter cap, drain plug and plain oil level gauge (with coloured prismatic front).

b) Silica gel breather with connecting pipe and oil seal.

c) Air release plugs.

d) Pressure release device. Explosion vent, should be double diaphragm type.

e) 150mm dial magnetic oil level gauge with low level alarm contact.

f) 150 mm dial oil temperature indicator with maximum reading pointer and electrically separate contacts for trip and alarm.

g) 150 mm dial winding temperature indicator with maximum reading pointer and electrically separate sets of contacts for trip and alarm.

h) Thermometer pockets.

i) Double float Buchholz relay with gas release cock, shut-off valve on either side and separate sets of contacts for trip and alarm.

j) Sampling valve/ Filter valve with threaded adopted (top and bottom).

k) Drain valve with threaded adopted.

l) Jacking pads, handling and lifting lugs.

m) Cover lifting eyes.

n) Bi-directional rollers and skids.

o) Radiators (Detachable type).

p) Clamping devices.

q) Two grounding pads.

r) Remote tap changer control panel.

s) Weatherproof marshalling box for housing control equipment and terminal connections.

t) Rating and terminal marking plates.

u) Neutral bushing with earthing conductor bringing down duly supported on insulators.

v) HT cable box! L T suitable for Bus Duct connection.

w) CTs in neutral as specified.

9. Painting

a) All steel surfaces shall be thoroughly cleaned by sand blasting or chemical agents, as required, to produce a smooth surface free of scales, grease and rust.

b) The internal surfaces in contact with insulating oil shall be painted with heat resistant insulating varnish, which shall not react with and be soluble in the insulating liquid used.

c) The external surfaces, after cleaning, shall be given a coat of high quality red oxide or yellow chromate primer followed by filler coats.

d) The transformer shall be finished with two coats of Siemens Grey (RAL 7032) polyster enamel paint.

10. TESTS

a ROUTINE TESTS

During manufacture and on completion, all transformer shall be subjected to the IS routine tests.

b TEST WITNESS

Tests shall be performed in presence of Owner's representative if so desired by the

Owner. The Contractor shall give at least fifteen (15) days' advance notice of the date when the tests are to be carried out.

c SYSTEM DESCRIPTION & REQUIREMENT

a)	Application	:	LT. Transformer.
b)	Service	:	Outdoor/indoor, step-down.
c)	Type	:	Oil immersed
d)	Rated output	:	as per bill of quantities
e)	Cooling	:	ONAN
f)	Rated voltage (line to line)	:	11 KV / 0.433 KV.
g)	Number of phases	:	3
h)	Rated frequency	:	50Hz.
i)	System fault level at 11 KV	:	350 MV A
j)	Temperature rise above 50 Deg. C		
	i) In oil by thermometer	:	45 deg. C.
	ii) In winding by resistance	:	50 deg. C.
k)	Insulation level on HV side	:	*75/28* KV (peak rms)
l)	Vector group	:	Dyn 11
m)	Type of Radiator	:	Detachable type
n)	Type of taps provided	:	Off Load
o)	Taps provided on	:	HV. Winding.
p)	Range of taps steps	:	+ 10% and -15% in total of 15
q)	Percentage impedance at 75deg.C on full load.	:	6%
r)	Method of tap changer control	:	a) Manual Mode b) Electrical Local c) Electrical Remote
s)	<u>Terminal Connection</u>		
	HV Cable end box suitable	:	XLPE cable
	for LV Terminal box suitable for	:	XLPE Cable
t)	Additional Neutral Bushing for Earthing.	:	1 No.
v)	Full load Losses	:	12.0 KW *(Maximum)

w) No Load Losses : 1.75 KW * (Maximum)

* Transformers having losses more than specified above are not acceptable.

DESIGN CRITERIA OF 415V L T PANEL

a) One nos. transformers of 1000 KVA each and two DG sets of 200 KVA each have been envisaged to cater the campus loads.

b) Generally in normal condition, Transformer shall feed power to Main L T Panel with bus coupler in open condition.

c) As long as SEB power supply shall be available, the whole plant load shall be fed through Transformers.

d) There shall be two positions selector switch (Auto/ Manual) on each breaker of L T panel
   (i) In Auto Mode: Closing/ switching off of breaker shall be automatic.
   (ii) In Manual Mode: Closing/switching off of breaker shall be manual through TNC switch, located on breaker panel.
   (iii) In no condition, two different supplies shall get paralleled.

e) There shall be three positions selector switch (Auto/test/Manual) on each DG set breaker panel
   (i) In Auto Mode of breaker panels:
   All operation i.e. starting of required DG set, their parallel operations, load sharing (Active/Reactive), outgoing breakers closing, switching off breakers on power resumption, switching off DG sets etc. shall be totally automatic.
   (ii) In Manual Mode of breaker panels
   All operation defined above shall be manual.
   (iii) In test mode of DG power Panel
   It shall be possible to check the system without energizing its breaker.

f) In case of failure of power, following shall happen:

   (If selector switches of breakers of L T panel & breakers of DG power panel are kept on Auto Mode).
   (i) DG sets shall be started automatically (Based on load requirement) one by one.
   (ii) DG set shall get paralleled automatically. Their breakers of DG synchronization panel (whatever is required) shall get closed on parallel operation. '
   (iii) Outgoing breakers of DG Synchronization panel shall get closed automatically
   (iv) At Main L T panel side, respective breaker from transformer supply shall open out and breakers from D G supply shall get closed automatically.
   (v) DG Sets shall share active / reactive load automatically.

g) On resumption of power, following shall happen: (if selector switch of breakers of LT panel & breakers of DG Power Panel are kept on Auto mode)
   (i) An Alarm shall be sounded for resumption of power for a fixed duration.
   (ii) First one outgoing of DG Panel shall be switched off and through reducing

the load of DG Sets.

(iii) After some time, second outgoing breakers shall be switched off.

(iv) Breakers from D G supply on Main Panel shall get switched off automatically.

(v) Subsequently breakers from Transformer supply shall be switched ON automatically.

(vi) DG sets shall run on NO Load for the prescribed time before they are switched off.

i) Main L T Panel shall receive power supply from transformer through cables & DG synchronization panel through cables and shall feed power supply various feeders / services

j) Further power distribution shall be as indicated in the enclosed single line diagram.

k) Operating height of boards shall be limited within 350 mm to 1900mm from floor level.

l) The type and rating of the Panels covered herein shall be as follows:

System voltage	:	415V
System Frequency	:	50 Hz
No. of phases	:	3 Phase (4 wires)
Busbar rating	:	As specified in drawings.
High voltage Test	:	2.5KV for 1 minute.
Degree of Enclosure	:	IP52 (as per IS 2147)

m) All switchgear and its components provided in the panel shall have same fault withstand capacity as indicated for bus bar in single line diagram.

L. T. PANEL

1. CONSTRUCTION FEATURES

a) Panels shall be indoor, metal clad, modular construction, fix type (except circuit breaker cubicles) air insulated and floor mounted type.

b) Unless otherwise mentioned, panels shall be of single front construction and shall be of dead front type.

c) All panels shall be extensible on both sides.

d) All panels shall be dust proof and vermin proof.

e) The panels shall have horizontal Busbar Chamber at top of the panel even for top cable entry.

f) All panels shall have provision for cable entry from top or from bottom or both as required. The same shall be confirmed to the Vendor during detailed engineering ! approval of shop drawing of panel manufacturer.

g) All panels including capacitor panels shall be fully compartmentalized with metal! insulating partitions between individual compartments.

h) The Horizontal busbar chamber shall be separate & totally enclosed.

i) Minimum thickness of CRCA MS sheet member shall be 1.6 mm for non load bearing members and 2.0 mm for load bearing members.

j) All panels shall comprise a continuous line up of dead front, free standing vertical sections. The installation of circuit breakers shall be limited to the bottom two tiers only. In two tiers formation two nos. of upto 1000 Amp. breakers can be provided.

k) All doors and cutouts shall be provided with neoprene gaskets.

l) The back doors of the panels shall be double door leaf type where the panels have more than 400 mm width.

m) Strong concealed type hinges shall support all doors.

n) All relays, meters, and switches etc. shall be flush mounted type.

o) All incoming terminals shall be provided with shrouds. Support shrouds shall be transparent and shall be made of SMC/DMC material. However Bakelite/Hylam material is not acceptable and shall not be used any where in panels.

p) The complete structure shall be rigid, self-supporting free from vibration, twists and bends etc.

q) The panels housing circuit breaker feeders shall be in single front draw out execution. The incoming & bus coupler circuit breaker feeders shall be in single tier formation while the outgoing circuit breaker feeders may be in double tier formation, unless otherwise specified.

r) A suitable barrier shall be provided between the circuit breaker and the

associated control.

s) The number of modules shall be so decided that the cable alleys are not over crowded. However the number of module in any panel shall not exceed six. The minimum size of module shall be 300mm and 225mm for starter and switch fuse / MCCBs feeders respectively. The minimum clear width of cable alley shall be 300mm.

t) In cable alley, outgoing terminals shall be identified with feeder number.

2 BUS AND BUS TAPS

a) The main buses and connection shall be of high grade of aluminium bus bars conductivity aluminium 1 aluminium alloy (Grade EC-91 E), sized for specified current ratings with max, temp. limited to 85 deg.C (35 deg. above 50 deg. ambient temp.).

b) Vertical bus bars shall be designed depending upon the actual feeder requirement. Bimetallic connector shall be provided for connection between dissimilar metals.

c) Busbars and connections shall be fully insulated for working voltage with adequate phase 1 ground clearances. Insulating sleeves for Bus bars and shrouds for joint shall be provided. Minimum clearance of 25 mm is required between phases and between phase & earth.

d) Shrouds for busbars joints tapping points shall be of fiber glass only. Bus insulators shall be flame retardant, track resistant type with high creepage surface and of non-hygroscopic material such as epoxy SMC DMC.

e) Busbars shall be supported and braced to withstand the stresses due to max. short circuit current and also to take care of any thermal expansion. .

f) The busbar size shall be of similar size as of busduct.

3 CHANGEOVER SWITCHES

a) Changeover switches shall be 4 pole, heavy duty, group operated load break fault make type with AC 23A duty.

b) The switches shall be capable of successfully withstanding the thermal stress for one sec. caused by the short circuit corresponding to the fault level specified.

c) The switches shall be able to withstand mechanical stresses caused by the peak short circuit currents corresponding fault level specified.

d) The switches shall be provided with operating handle compartment door and shall be so interlocked that on the hinged compartment door and shall be so interlocked that :

i) The door can be opened only when the switch is in OFF position.

ii) It shall not be possible to close the switch when the door is open.

e) The switch shall be provided with pad-locking arrangement for 250A and above rating.

f) The switch shall be provided with defeat interlock facilities.

4 FUSES

a) All fuses shall be HRC cartridge link type.

b) The fuses shall be provided with visible indication when they have operated.

c) Rating of the fuses shall be so chosen so as to have co-ordination with switch. Fuses shall preferably mounted directly on plug in type fuse bases & sufficient number of insulated fuse pullers shall be supplied.

d) Fuses and links functionally associated with the same circuit shall be mounted side by side.

Earthing and neutral links in main supply circuits shall be of silver plated copper & of bolted pattern.

5 CONTACTORS

a) Contactors shall be of double break, single throw and electromagnetic and non-gravity type.

b) Contactors shall be suitable for interrupted duty and shall be rated for class AC-3 duty.

c) Main contacts of contactors shall be silver faced.

d) Operating coils of contactors shall be suitable for operation on 220/240V AC, 1 phase, 50 Hz supply.

e) Contactors shall be provided with at least two pairs of 'NO' and 'NC auxiliary contacts.

f) Contactors shall not drop out at voltages down to 70% of coil rated voltages and min. pick up voltage shall be 85%.

6 OVERLOAD RELAYS

a) Overload protection for each motor feeder (wherever required) shall be provided by thermal overload relay on each of the three phases.

b) The relay shall be duly compensated against fluctuations on ambient temp. and frequency and shall have single phasing preventer feature.

c) Relay shall be hand reset type from the front of the cubicle door.

Overload relay for fan applications shall be of heavy duty type with provision of by-passing the same during starting of the fan.

7 CAPACITORS

a) The capacitor shall be of mixed dielectric type rated for 440Volts. Capacitors shall be provided with discharge resistors. The value of discharge resistors should be such that the residual voltage be less than 50V in one minute.

b) Capacitors shall be suitable for prolonged operation at an rms. voltage between terminals not exceeding 1.10 times the rated voltage, excluding transients.

c) Capacitors shall be suitable for continuous operation at an rms. line current not exceeding 1.30 times the current which occurs at rated sinusoidal voltage and rated frequency excluding transients.

d) The maximum continuous reactive output of a capacitor (including any due to flow of harmonic currents) shall not exceed 30% over rated reactive output of a capacitor.

e) Loss in the capacitors shall be kept as low as possible. (Max. 0.5W/KV AR).

f) Wherever capacitor consists of several elements inside the units, each element shall be provided with individual fuses, so that the unit need not be discharged or disconnected (although with moderate reduction in output), if one of short circuit to any of the elements.

8 AUTOMATIC POWER FACTOR CONTROL RELAY

a) Automatic Power factor control relay (APFCR) shall operate its auxiliary relay by sensing the power factor of the plant thru' current and voltage signals.

b) APFCR shall have no. of steps specified in drawings.

c) APFCR shall be provided with Built in PF meter (0.5 lag to 0.5 lead), calibrated setting dial.

d) APFCR shall be suitable for 5A secondary current.

e) APFCR shall be suitable for flush mounting in capacitor panel/MCCs.

f) Current rating of its auxiliary relay shall be compatible with switching and continuous energization of main contactor of capacitors. Otherwise, additional relay shall be provided.

9 COOLING

a) All the Capacitor Panels shall be properly ventilated. If required a small exhaust fan of suitable rating shall be provided on the rear door of the panel, with the opening properly covered with fine wire mesh. The fan shall start/stop automatically along with normal start/stop provision.

b) Louvers shall be provided on the door on rear side with a fine wire mesh.

10 CURRENT TRANSFORMERS

a) Current Transformers shall be cast - resin type .AII secondary connections shall be brought out to terminal blocks where connection will be made.

b) Accuracy class of the current transformers shall be:
   (i) Class 5P20 for protection.
   (ii) Class 1.0 for metering.
   (iii) Class PS for differential Protection & REF.

c) Current transformer shall be provided with test links and shorting on both secondary leads for setting purpose.

d) All current transformers shall be earthed by a separate earth link on terminal blocks.

e) Additional nameplate of CTs/ PTs shall be provided (if required) at such a place that it shall be possible to find out details of CTs/ PTs after mounting in the panel.

11 VOLTAGE TRANSFORMERS

a) Voltage transformers shall be cast-resin, fixed type and shall have an accuracy class of 1.0.

b) Low voltage fuses, sized to prevent overload, shall be installed in all ungrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the board is energized.

12 RELAYS

Relays wherever provided shall be of draw-out design with built-in testing facilities. Small auxiliary relays may be in non-drawout execution-.

13 CONTROL AND SELECTOR SWITCHES

a) Control and selector switches shall be of rotary type having enclosed contacts, which are accessible by the removal of cover.

b) Control and selector switches shall be of flush mounted type and on front of panels. .

c) Selector switches shall be of stay-put maintained contact type.

d) Control switches shall be provided with escutcheon plate clearly marked to show the position.

14 INDICATING METERS AND INSTRUMENTS

Indicating instrument (96 x 96 mm) shall be digital meter, switch board type and accuracy class of 1 (1 % full scale ± 1 count).

15 INDICATING LAMPS

a) Indicating lamps shall be of LED type, low watt consumption and provided with

appropriate value of resistors. The LEDs shall also have an in-built surge suppressor.

b) Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panel.

16 PUSH BUTTONS

a) All push buttons shall be of the push to actuate the contact type.

b) All push buttons shall be oil tight and shall be provided with adequate no. of contacts.

17 POWER AND CONTROL CABLE TERMINATION

a) Suitable supporting arrangement shall be provided for all power and control cables entering the panel.

b) Removable undrilled gland plate of 3 mm thick of MS for multicore cables and 4mm thick of Aluminium for single core cables sufficient in size to accommodate all compression type, heavy duty brass glands shall be provided.

c) Adequate termination arrangement shall be provided for all power cables which shall be aluminium / copper conductor, PVC insulated, sheathed, armoured PVC sleeved overall, heavy-duty cables, 1.1 KV grade. Power cables termination shall be by means of crimping type lugs on conductor cables.

d) The terminal blocks shall be bolted lug type for cables. These shall be protected type and rated for 1100 Volts service. The minimum current rating of terminal block shall be 16 Amp. The construction shall be such that after the connection of cable by means of lugs, necessary clearance and creepage distance are available.

e) Wherever there is more than one equipment connected on the same feeder, separate terminals shall be provided.

18 INTERNAL WIRING

a) All internal wring shall be carried out with stranded copper conductors, PVC insulated, 1100/650 V grade.

b) Min. size of conductor for power wiring shall be 2.5 sq.mm, 1.5 sq.mm for AC control wiring and 4.0 sq.mm. for DC control wiring. Current transformer secondary wiring shall be with 2.5 sq.mm conductor.

c) All wiring shall be run on the sides of the panels and shall be neatly bunched and shall not affect access to equipment mounted in the panels.

d) Wiring shall be terminated on terminal blocks using crimping type lugs and without joints or tees on their runs.

e) Power wiring shall be done either by phase identifying coloured wires or suitably coloured PVC sleeves shall be provided at each end of wire.

The following wiring codes shall be used.

Instrument Transformer	:	Red, yellow or blue depending upon phase with which wire is associated.
A-C phase wire	:	White
A-C Neutral wire	:	Black
Earth connection	:	Green

f) PVC identification ferrules, yellow colour with black engraved letter shall be provided at each end of all control wires marked to correspond with equipment designation & termination numbers.

g) Ferrules provided shall be oil tight and numbered from left to right.

19 TERMINAL BLOCKS

a) Terminal blocks for control wiring shall be 650V grade 10 sq.mm size.

b) Terminal blocks shall be grouped depending on circuit voltage. Different voltage groups of terminals blocks shall be segregated.

c) Terminals blocks shall be numbered for identification and provision shall be provided for terminal labels.

d) Terminal blocks requiring duplication shall be provided with solid bonding links.

e) Terminal blocks for current transformer secondary lead wires shall be provided with shorting, disconnecting *I* earthing facilities.

f) Terminal blocks and control wiring shall be so arranged that only one conductor of external wiring required to be terminated in at each terminal.

20 GROUND BUS

a) A ground bus, rated to carry maximum fault current, shall extend to full length of the panel.

b) The ground bus shall be provided with two-bolt drilling with GJ. bolts and nuts at each end to receive 75X 10 mm G.I. flat. .

c) Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and shall be grounded through heavy multiple contacts at all times.

d) Wherever the schematic diagrams indicate a definite ground at the switchgear, a single wire for each circuit thus grounded shall be run independent to the ground bus and connected thereto.

e) C.T. shall be earthed through removable links so that earth of one circuit may be removed without disturbing other.

f) Frames and non current carrying metal parts of all equipment mounted shall be effectively to earth bus.

g) All hinged doors shall be connected to earth bus by flexible tinned bare copper

wire.

h) Instrument and relay cabinets shall be connected to earth by 2.5 sq.mm stranded copper insulated wire 1100 V grade.

21 SPACE HEATERS

Each cubicle shall be provided with thermostat controlled space heaters.

22 AC/DC POWER SUPPLY

a) The panels shall be suitable to receive following power supplies.
AC Supply : Single Feeder
DC Supply : Double Feeder

b) Isolating switch fuse units shall be provided at each switchgear for the incoming supplies, 4-pole, single throw for AC.

c) Bus-wires of adequate capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating switch-fuse units shall be provided at each cubicle for AC supplies.

d) AC load shall be so distributed as to present a balance loading on three phase supply system.

23 NAME PLATES

a) Name plates of anodized aluminium shall be furnished at cubicle and at each instrument, device mounted on and inside the cubicle.

b) Caution notice on suitable metal plate shall be affixed at the back of each vertical panel.

c) Name plates for feeders shall be provided on front and back of the panel.

24 TROPICAL PROTECTION

a) All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion.

b) Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entrance of insects.

25 PAINTING

a) All surfaces shall be sand blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease and rust.

b) After clearing, the surfaces shall be given a phosphate coating followed by 2 coats of high quality primer and stoved after each coat.

c) The panels shall be finished with two coats of Siemens Grey (Shade RAL 7032) powder coated / Polyester enameled.

26 TESTS & INSPECTION

a) The following routine and acceptance tests shall be carried out during final acceptance list.

i) Mechanical operation test.
ii) Electrical operation test.
iii) High voltage test on power circuits.
iv) High voltage test on control circuits.
v) Millivolt test on the circuit breakers.
vi) Millivolt Drop test on Busbar joints

b) All tests shall be performed in the presence of Owner's representative, if so desired by the owner. The contractor shall give at least 15 days advance notice of the date when tests are to be carried out.

c) Contractor shall furnish test certificate indicating that equipment has been tested by their quality control department for compliance of technical specification and approved drawings. The same shall be forwarded to owner! consultants along with inspection call.

d) These inspections shall however, not absolve the vendor from the responsibility for making good any defect with may be noticed subsequently.

27. The bank at its discretion may purchase light fixtures and supply it to the contractor for installation. Contractor cannot claim any compensation for supply of fixtures by the bank.

BATTERY & BATTERY CHARGER

1. BATTERY

General

a) The battery shall be maintenance free type

b) The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuation of load.

2. BATTERY CHARGER

General

a) The charger shall be natural air cooled, solid state type with full wave, fully controlled, bridge configurations.

b) The charger shall be provided with automatic voltage regulation, current limiting circuitry smoothing filter circuit and soft start feature.

c) Voltage control shall be step-less, smooth and continuous.

d) The charger shall be self-protecting against all A-C and D-C transients and steady state abnormal currents and voltages.

e) Voltage setters shall be provided for setting the output of float boost charge. Setting shall be independent of each other so that setting of one voltage shall not require resetting other.

f) There shall be separate transformers for float and boost charger.

g) Charger A-C input and D-C output shall be electrically isolated from each other and also from panel ground.

h) Isolation shall also be provided between power and control circuits.

i) Batteries shall also be housed into the Battery Charger cubical.

Construction

a) The charger shall be freestanding, floor mounted with sheet steel enclosure with all access from the front.

b) The panel shall conform to the degree of protection IP 42. Minimum thickness of sheet metal used shall be 2 mm.

c) Access door shall be with concealed hinges and neoprene gaskets. Ventilating louvers shall be covered with fine wire mesh.

d) All equipment within the panels shall be arranged in modular units and laid out with sufficient space for easy maintenance.

e) Switches, meters, relays etc. shall be flush mounted on the front of the panels. Nameplates of approved size and type shall be provided for all circuits and devices.

Charger Equipment

a) All power diodes and control rectifiers shall be silicon type. Rectifier Transformer shall be dry type, double wound, with copper conductor and class B insulation.

b) Blocking diodes shall be fully rated and redundant so that failure of a single diode shall not incapacitate the system in any way.

c) Isolating switches shall be heavy duty, load break type, operated by an external handle with provision for padlocking in ON and OFF position.

d) Changeover switch shall be 3 position, 4 pole, load break type with 2 NO + 2 NC auxiliary contacts.

e) Contactor shall be air-break type with thermal overload relays having in built single phase preventor.

f) Fuses shall be HRC type and arranged for easy replacement. Semi conducting device fuses shall be fast-acting.

g) Indicating lights shall be low-watt filament type with series resistor. Both lamp and lens shall be replaceable from front.

h) Meters shall be 96 x 96mm switchboard type, 250 deg. scale, antiglare glass, :!: 2% accuracy with zero adjuster on the front.

Alarms

a) One (1) ten-points alarm facia shall be provided on charger panel, complete with proper actuating devices, circuitry and legends.

b) The arrangement shall be such that on occurrence of a fault the corresponding window will light up and stays lighted until the fault is cleared and reset button is pressed.

c) Each time a window lights up, a master relay will get energized to provide group alarm signals for Owner's remote panel.

d) Following minimum annunciation shall be provided:
   i) A. C. Supply failure *
   ii) D. C. Voltage low *
   iii) D. C. Voltage high *
   iv) D. C. System ground *
   v) Charger overload *
   vi) SCR fuse blown
   vii) Filter fuse blown
   viii) D. C. Output fuse blown

e) Alarm points marked with an asterisk (*) shall have electrically separate spare set of contacts wire_ up to the terminal block for Owner's use.

f) Alarm contacts shall be rated 2A at 24V D. C. And SA at 240V A.C.

Outgoing Feeders

a) Each Outgoing feeder shall be provided with double pole switch and with HRC fuses.

b) Outgoing feeders shall be located in separate module forming part of charger panel with separate cable alley for terminated outgoing cable.

Lamp / Space Heaters / Receptacles

a) The charger panels shall be provided with :
- Internal illumination lamp with door switch.
- Space heater with thermostat control.

b) Lamp, heater circuits shall have individual switch fuse units.

Wiring / Cabling

a) The panels shall be completely wired-up. All wiring shall be routed through wiring troughs. Wires shall be ferruled at both ends for identification.

b) Panels shall have removable gland plates at the bottom for cable entry. All incoming / outgoing cables shall be terminated in suitable terminal blocks.

c) Control terminal blocks shall be box-clamp type ELMEX 10 Sq. mm or approved equal.

Grounding

a) The charger panels shall be fully rated ground bus with two ground terminals, one at each end.

b) Each terminal shall comprise two-bolt drilling with M10 G.I. bolts and nuts to receive Owner's ground connection of 50 x 6 mm G.I. flat.

Tropical Protection

a) All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion.

b) Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entrance of insects.

Painting

a) All surfaces shall be sand blasted, pickled as required to produce a smooth, clean surface free of scale, grease and rust.

b) After cleaning, the surfaces shall be given a phosphate coating followed by 2 coats of

high quality primer and stoved after each coat.

c) The panels shall be finished in powder coated Siemens Grey, RAL7032 ..

Tests

a) All equipment and components there of shall be subject to shop tests as per relevant IS standards. The tests shall included but not limited to:

b) Tests on battery charger.

- Dielectric tests.
- Voltage regulation check from 0 to 100% load with ±10% input voltage variation.
- Ripple content measurement.
- Heat run test on current limiting value.

Test Witness

All tests shall be performed in presence of Owner's representatives, if so desired by the Owner. The contractor shall give at least fifteen (15) days advance notice of the date when tests are to be carried out.

3. REQUIREMENT

Battery

i)	Type	:	Lead Acid
ii)	Nos. of Cells per Battery	:	12
iii)	Battery nominal voltage	:	24 V
iv)	Ten hour rating to 1.85 Volt/Cell at 27 deg. C.	:	300 AH

Battery Charger

i)	Charger	:	Float & Boost
ii)	Type	:	Solid state, rectifier
iii)	Rating	:	40A
iv)	A.C. Input Supply 1Ph., 50Hz.,	:	415V, 3ph,4 w/230V, 2 wire.
v)	Ripple content in charger DC output	:	± 1%
vi)	Outgoing feeders - 12 Nos	:	Each consisting of double pole MCB of 32A.

DIESEL GENERATING SET
(Radiator Cooled)

1.0 ENGINE

1.1 GENERAL

a) Engine shall be internal combustion type, multistroke, multi-cylinder, V type, turbo charged after cooled, suitable for High Speed Diesel Fuel

b) The engine shall be capable to run on 10% overload for 1-hour duration in every 12 hours of service as per ISO regulations.

c) The engine shall be directly coupled with the generator set.

d) The engine shall be designed to have provision for easy maintenance, overhaul, cleaning, inspection & replacement of parts.

e) The engine shall be of similar design and shall permit interchangeability of parts among various units.

f) All parts subjected to substantial temperature variations shall be designed & supported to permit free expansion and contraction without resulting in leakage, excess of clearance, harmful distortion or misalignment.

g) Vibration, noise, mechanical, thermal stresses & exhaust gas conditions shall be not exceed the permissible or acceptable limits of the guiding standards / codes.

h) DG Sets and its governor / A VR shall be suitable for auto parallel operation. However **Governor** shall be electronics type

1.2 COOLING

a) The engine cooling shall be done through a closed loop forced circulation system. Engine driven pumps shall be used to circulate the primary cooling water through the cylinder jackets, charge air cooler, lube oil cooler, valves, cylinder block and other water cooled moving parts.

b) Thermostat, temperature gauge, with high temperature alarm trip shall be provided in the control circuit.

c) Secondary cooling shall be through radiator.

1.3 LUBRICATION

a) The engine lubricating oil system shall comprise an engine driven pump complete with oil coolers, duplex oil filters, strainers etc. Priming pump if required shall also be provided.

b) Lubricating system shall also consist of pressure gauge, temperature and oil level indicators, pressure switch for "oil pressure low" alarm for interlock and alarm along with necessary piping, fittings, valves etc.

1.4 FUEL SYSTEM

a) Engine shall be suitable to run on High-Speed Diesel fuel.

b) The fuel oil system of the engine shall be direct injection type provided with fuel piping, governor injectors, shutdown valve with fuel strainer and filters.

c) Fuel day tank of suitable capacity for each DG set shall be provided with stand, level gauge, valve and complete piping up to engine.

1.5 ASPIRATION AND EXHAUST

a) Engine shall be turbo-charged radiator cooled. Air intake shall be provided either with dry type replaceable filters or oil bath type filters. Air cleaner assembly shall also have service indicator.

b) Exhaust manifold and exhaust pipe shall be suitably legged with asbestos rope. Exhaust system shall be insulated and shall be fitted with bellows type coupling and supported suitably with anti vibration spring mountings.

c) Silencer shall be of the residential type.

d) The height and size of the exhaust hooks shall be fixed considering the emission of gases and the environmental law of Government of India and the local authorities.

e) The noise level and gas emission temperature and volume shall be as per relevant standards.

1.6 STARTING SYSTEM

a) Engines shall be started with 24 volts starter motors.
Charging of battery shall be through panel-mounted static Battery charger. AH rating of Battery shall be suitable for three successive starts of DG Set, and control supply of DG panel completes with battery leads etc.

1.7 ENCLOSURE

a) The complete DG Set shall be housed in a sheet steel enclosure with suitable acoustic system to reduce the noise level.

b) The enclosure shall also be provided with Air Cooling System to maintain the temperature of the Engine.

c) Enclosure shall have necessary doors for maintenance of Engine /Alternator.

d) Enclosure shall also be provided with Fuel Tank.

e) Side walls of enclosure shall be fabricated from 1.6 mm CRCA sheet and shall be filled with 100mm thick acoustic material having 96 *Kg/m3* density which should be then be covered with fibre cloth/ tissue paper and finally with perforated MS Sheets.

f) The D.G. chamber shall be fitted with internal lighting system for ease of maintenance.

g) Residential type silencer shall be provided and shall be isolated from main D.G. chamber to avoid excess heat in genset operational area.

h) Air inlet and outlet space should be provided with sound dampers.

i) Enclosure shall level the Noise Level to 68-72 dBA or as per DPCC norms (what ever is lower).

2.0 ALTERNATOR

2.1 General features of the alternators shall be as follows:

Capacity	:	As per BOQ at 0.8 PF, 415V, 3 Ph. 50 Hz.
Voltage	:	415V, 3 Phase, 4 wire, 50 Hz.
Speed	:	1500 rpm
Enclosure	:	IP23
Insulation	:	"H"
Temp. Rise	:	"H"
Excitation	:	Separately-excited (PMG), self regulated with brushless system and static voltage control unit suitable to maintain terminal voltage constant at all loads. The voltage control unit to be provided with facility for adjusting the output voltage (±5% of rated voltage).

2.2 Alternator winding shall have *2/3* Pole pitch winding to take care of heating due to

"Harmonics" in the system.

2.3 Damper winding shall be provided to assist parallel operation of Alternators. The damper bars of copper brazed to heavy copper and connector shall be located in semi-closed circular slots situated in the pole faces.

2.4 The generator shall be capable of delivering rated output at rated p. f. with:

a) The terminal voltage shall not differ by more than ± 0.5% of set value of terminal voltage.
b) The frequency shall not differ by more than ± 4% of rated value.

2.5 The Generator shall withstand 10% overload for 1 hour at every six hours.

2.6 Transient Voltage Dip shall not be more than 14% on application of full load at rated power factor.

2.7 The Generator shall be capable of withstand minimum 25% unbalance load of its rated load without exceeding the current in any of the phases beyond full load current.

2.8 Alternator winding shall be suitable to take minimum 70% Thyristor load of rated capacity.

2.9 Anti Condensation heater of 240V, 1 Ph, 50Hz shall be provided with thermostat control switch.

2.10 All alternators shall be suitable for paralling operation

3.0 <u>LIST OF FITTINGS & ACCESSORIES</u>

Following Accessories shall be provided with DG Set.

3.1 **WITH ENGINE**

a) Tachometer with hour meter
b) Flywheel
c) Flexible coupling with guard
d) Electronics Governor
e) Electronic control panel (ECP)
f) Radiator for cooling
g) Corrosion resistor
h) Heat Exchanger
i) Air cleaner
j) Turbo charger
k) Fuel pump
l) Fuel Tank for 990 Its. with low level alarm switch
m) Fuel/lube oil filter
n) Air intake manifold

o) Residential type silencer
p) Exhaust pipe with asbestos, vibration isolators (if required), rain water hood
q) Exhaust manifold
r) Anti vibration pads
s) Engine mounted instrument panel with control key switch and gauges for
    i) Lube oil pressure
    ii) Cooling water temperature

t) Starter Motor
u) Speed switch
v) Lube oil pressure switch for low pressure

3.2 WITH ALTERNATOR

a) Terminal box suitable for cable connection.
b) Space Heater
c) Energy meter to record DG power consumption (as per requirement of PWD).

3.3 24V LEAD ACID BATTERIES

Suitable for 3 starts of engine and for control of DG Set.

3.3.1 Master Engine control switch.
3.3.2 Engine Running Hour Meter & Engine operation counter.

ERECTION & COMMISSIONING

1.0 GENERAL

1.1 EQUIPMENT ERECTION

a) The equipment in disassembled condition shall be received at site by the contractor.

b) The contractor shall unpack, assemble all parts, mount and wire up loose equipment, fitting and accessories and complete all connections.

c) The contractor shall mount the equipment on respective foundation/ supports, level & align the same & arrange for necessary grouting/anchoring.

d) The erection work shall be carried out in compliance with manufacturer's instruction and shall include all adjustments, checks and measurements.

e) The contractor shall record results of all erection tests and measurements and furnish copies of the same to the owner for his reference and record.

f) Any internal wiring of the equipment, which has been left incomplete because of shipping, split or which requires minor modifications shall be carried out by the contractor. This includes mounting of items like relays, meters etc. and connecting the same as per wiring scheme diagram furnished by the original manufacturers.

1.2 CONSUMABLES AND HARDWARE

The contractor shall furnish all erection materials, hardware and consumables required for the completion of the installation. The materials shall include but not limited to the following:

a) Consumables : welding rods & gas, oil & grease, cleaning fluids, paints, electrical tape, soldering materials etc.

b) Hardware : bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims etc.

c) Materials : junction boxes, terminal blocks, connectors, ferrules, lugs, brass glands, rigid/flexible conduits, cables, ground wires etc.

Supply of cement, sand, stone etc. required for the execution of the contract shall be responsibility of the contractor.

1.3 ERECTION TOOLS & TACKLES

a) The contractor shall provide all tools, tackle, implements, module equipment such as chain pulley block, trailers etc. which are required for transportation, handling and erection of equipment.

b) Special erection tools, if any, furnished by the Manufacturer along with the equipment may be used by the contractor. such tools and equipment, however, shall be returned in good working conditions to the owner on completion of the job.

c) The contractor shall also arrange for major testing equipment as list below:

- Insulation Tester : Motor operated Megger 1000V & 10KV grade.
  Hand operated Megger 1000V.
- Hand driven earth resistance megger, range 0-1/3/30 ohms.
- Tong testers of suitable ranges.
- Contact resistance measuring set for micro-ohms.
- Torque wrench.
- Primary / secondary injection set and relay testing kit.
- Multimeters, test lamp, field telephone with buzzer sets, different gauges etc.
- Streamline filter.
- Chain pulley block, cable jacks & spindle, cable, collars, electricians tool kit, jointer's tool kit, fitters tool kit, welding transformer, phase sequence meter, HV testing kit, primary & secondary injection kit.

other test equipment as required for testing and commissioning of the equipment shall have to be arranged by the contractor.

1.4 METHODS AND WORKMANSHIP

a) All work shall be installed in a first class, neat workman like manner by mechanics / electricians skilled in the trade involved.

b) The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

c) All details on installation shall be electrically and mechanically correct.

d) The installation shall be carried out in such a manner as to preserve access to other equipment installed.

e) If in the opinion of the contractor any work is insufficiently specified or require modification, the contractor shall refer the same in writing to the owner and obtain his instruction / approval before proceeding with the work.

f) If the contractor fails to refer such instances, any excuse for the faulty erection, poor workmanship or delay in completion shall not be entertained.

g) Equipment and material, which are wrongly installed shall be removed and re-installed to comply with the design requirement at the contractor's expense, to the satisfaction of the owner/consultant.

h) All scaffolding pipes and frames shall be of tubular steel. Bamboo's/ *ballies*/ timer frames are not permitted under any circumstances. All vertical & horizontal scaffolds shall be of MS pipes of adequate size to withstand the loads & pressures. The working platforms shall be either of conduit pipes or MS bars.

1.5 ALLOWABLE WASTAGE

a) The erection contractor shall make every effort to minimize wastage during

erection work. In any case, the wastage shall not exceed 1 %

b) Measurement shall be taken at site jointly by contractor and owner's representative.

c) If the actual wastage be more than the quoted figure then equivalent price of the balance amount will be deducted from contractor's bills.

d) The contractor shall submit a detailed account of materials issued to him after completion of work. The excess materials after completion of job shall be returned back to the owner's store.

1.6 FOUNDATION AND CIVIL WORK

a) The contractor shall check the foundations provided by owner before commencement of erection to ensure their suitability.

b) All final adjustments of foundation levels, chipping and dressing of foundation surfaces, drilling holes on foundation channels to suit the equipment setting and grouting of anchor bolts, sills, inserts and fastening devices shall be carried out by the contractor including minor modification of civil work as may be required for erection.

c) Any cutting of masonry work which is necessary shall be done by the Contractor at his own cost and shall be made good to match the original work. The contractor shall obtain approval of owner/ consultant before proceeding with any cutting of masonry / concrete work.

1.7 EXCAVATION AND BACK FILLING

a) The contractor shall perform all excavation and back filling as required for the scope of work pecified.

b) The contractor shall make his own arrangement for pumping out any water that may accumulate in the excavation.

c) All excavation shall be back filled to the original level with good consolidation.

1.8 REPAIR OF DAMAGE SUBSTAINED DURING TRANSIT

The contractor shall repair minor damages sustained during transit or subsequent storage in purchaser's store. The repair charges shall be paid to the contractor on the basis of extra work.

1.9 INSPECTION

a) After completion of erection / installation, each piece of equipment shall be thoroughly tested as per approved procedure and inspected in presence of the owner/consultant for correctness and completeness of erection and acceptability for start up.

b) A check list in triplicate will be furnished by the owner/consultant wherein all

details to be checked and necessary instruction shall be listed. the inspection and checking shall strictly follow the checklist.

c) on completion of the inspection (2) copies of the check list duly filled-in shall be handed over to the owner/consultant.

d) This check list shall be jointly signed by the contractor and the owner/consultant. Such endorsement, however, shall not relieve the contractor of his obligations under the contract.

2.0 11 KV SWITCHGEARS

2.1 11 KV HT Switchgears shall be installed in accordance with IS:3072 and manufacturer's instructions. The contractor shall be required to install and align any channel sills which form part of the foundation. The HT Switchgears shall be made absolutely vermin proof.

2.2 Control wiring (if any) between 11 KV HT switchgears & other electrical equipment shall be carried out as per the instructions of the manufacturers & site-in-charge.

3.0 TRANSFORMER

3.1 Installation of the transformer shall be in accordance with the IS : 1886, manufacturer's instructions and as per the enclosed drawings.

3.2 Care shall be taken during handling of insulating oil to preventing ingress of moisture or foreign material. Testing and sampling of oil shall be in accordance with manufacturer's instructions and related IS. If oil filtration is required the same shall be carried out at site by the Contractor.

3.3 Control wiring between Transformer & other electrical panels shall be carried out as per the manufacturer's drawings and as per the instructions of site - in - charge.

4.0 415 V BUS DUCT

4.1 Bus duct will be received in transportable pieces. The Contractor shall erect the bus duct including bends, wall seating copper flexible at both ends and complete all connections in accordance with Manufacturer's drawings. The work also includes erection of steel hangers / supports for these bus ducts wherever necessary.

4.2 All steel structure / support / hardware for supporting bus duct shall be calculated by the contractor.

5.0 MAIN PCC / CAPACITOR PANELS

5.1 All above panels & DBs will be available in split - up - sections for ease of

transportation and handling. However in some cases, breakers, busbars relays, meters and control switches may be supplied loose to be mounted and connected at site as per the relevant drawings.

5.2 All alignments leveling, grouting, anchoring and adjustments shall be carried out in accordance with manufacturer's instructions and/or as directed by the Engineer. All boards shall be cleaned by using blower before installation.

5.3 All connections in the panels shall be completed, checked and adjusted to ensure safety and satisfactory operation of the equipment. This includes the following activities:

a) Functional test on circuit breakers.
b) Setting of protective relays and thermal over load relays.
c) Adjustment of zero error of various indicating instruments.
d) Testing of thermal overload relays by primary injection and protective relays by secondary injection.

5.4 In some cases, minor modifications may have to be carried out at site in the wiring of an equipment to meet the requirements of the desired control scheme and the Contractor shall have to do the same at no extra cost.

6.0 MISC. ITEMS AND LOCAL PANEL INSTALLATION

6.1 The contractor shall install miscellaneous items such as local control station, start-stop push button stations, and local starter units. control panels, misc. panel etc.

6.2 These equipment will be generally wall or column mounted excepting a few which are floor mounted. The exact locations will be as decided by the Engineer at site.

6.3 All supports or brackets need for installation shall be fabricated by the Contractor.

6.4 All welding, cutting, chipping and grinding as and when necessary shall be carried out by the Contractor at no extra cost.

7.0 CABLING SYSTEM

7.1 CABLE TRAYS AND RACKS

a) The contractor shall install the cable racks, trays, risers, shafts and supports.

b) Cable trays and risers shall be aligned and leveled correctly. All runs shall be installed parallel to the trench/building walls and floors except otherwise noted on the drawings.

c) The contractor shall provide embedded steel inserts/supports on wall, ceiling or floor by suitable anchoring & shall secure racks and supports by welding these to inserts.

d) The trays in general shall be supported at a distance of 1.5 to 2 meters on

horizontal and vertical run.

e) Cable trays shall be installed as per drawings furnished to the Contractor. Any deviation in routes shall have the prior approval of the Engineer In charge.

f) Prefabricated cable trays and accessories shall be assembled and erected at site as per instructions of Manufacturer. Alternately, the Contractor shall fabricate and install all cable trays, risers, shafts and supports as agreed upon during finalization of the award.

g) Sufficient spacing not less than 250 mm shall be provided between trays and maintained to permit adequate access for installing and maintaining the cables.

h) Contractor shall co-ordinate with other contractors (such as for piping etc.) where there is a common support for cable trays and for other services.

i) All necessary steel & all consumables as specified elsewhere shall be provided by the contractor.

7.2 STORAGE AND HANDLING

a) Cable drums shall be stored on hard and well drained surface so that they may not sink. In no case the drum shall be stored on the flat Le. with flange horizontal.

b) Rolling of drum shall be avoided as far as practicable. For short distance, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum.

c) In absence of any indication the drums may be rolled in the same direction as it was rolled during taking up the cable.

d) For unreeling the cable, the drum shall be mounted on jacks or on cable wheel. The spindle shall be strong enough to carry the weight without bending.

e) The drum shall be rolled on the spindle slowly so that cable should come out over the drum and not below the drum.

f) While laying cable, cable rollers shall be used at an interval of 2000 mm. The cable shall be pushed over the roller by a gang of people positioned in between rollers.

g) Cable shall not be pulled from the end without having intermediate pushing arrangement. Bending radius of the cable shall not be less than that is specified by the manufacturer.

h) All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends.

7.3 CABLE LAYING

a) Cable shall generally be installed in ladder type / perforated trays in trenches or buried in ground except for some short runs in conduit for protection or

crossings the roads etc.

b) Each length of run shall be physically measured at site before cutting the cable. Contractor shall furnish cable cutting the schedule to engineer in charge with respect to able drum length available at site and runs of cables & sizes of cables.

c) Cable may also be laid through hume pipes in road crossings etc. The hume pipes shall be supplied and placed in position by the Contractor.

d) Cable laid on trays and risers shall be neatly dressed and clamped at an interval of 3000 mm and 900 mm for horizontal and vertical cable run respectively and at each bend of cable.

e) All power cables shall be clamped individually and control cables shall be clamped in groups of three or four cables.

f) Clamps for multicore cables shall be fabricated of 25 x 3 mm G.I. flats. Single core power cables shall be laid in trefoil formation and clamped with trefoil clamps made of Fiber glass/PVC.

g) Cable openings etc. in walls/floor made by the Contractor or by others shall be sealed by the Contractor suitably by Hessian tape and bitumen compound or by any other proven method to prevent ingress of water.

h) Directly buried cables shall be laid as per detail shown in drawing. These cables shall be laid on and covered with sand/raddle earth and protected by brick barriers as sides and precast concrete slab brick on top. Job also involve digging/excavation of earth and refilling the same after laying of cables. For cables laid underground a loop of diameter of 3 meters shall be provided near each terminating ends.

i) After completion of installation and prior to connection, all High Voltage Power cables shall be given a high potential test. The contractor shall provided this Hipot Test set having provision of leakage current measurement.

j) Laying cost shall include all above activities including supply and fixing of clamps etc.

k) Cables for machines in clean area shall be laid in suitable size of stainless steel conduit.

7.4 CABLE TAGS AND MARKERS

a) Each cables and conduit run shall be tagged with numbers that appear in the cable schedules. Cables and conduits shall be tagged at every thirty (30) meters. Cables and conduits shall also be tagged on either side of a floor/wall passage.

b) The tags shall be of PVC or Aluminium with the number engraved on it and securely attached to the cable by not less than two turns of G.!. wire.

c) Location of cables laid directly underground shall be indicated clearly by cable

marker made of cast iron.

d) The location of cable joints, if any, shall be clearly indicated with cable marked with an additional inscription "Cable Joint".

e) The marker shall project 100 mm above ground and shall be spaced at an interval of 30 meters at every change of direction.

f) Where cables are cut from the drums the ends of the cables at the drums shall be properly sealed.

g) The power and control cable shall be laid with a provision of extra length at one of the end terminations. This length shall be confirmed by the Engineer in charge before laying.

h) Cost of laying shall also include supply and fixing of tags, cable markers etc.

7.5 TERMINATIONS JOINTS AND CONNECTION

a) The termination, Joints and connections of cables shall be done by qualified jointers strictly in accordance with manufacturer's instruction drawings and/or as directed by the Engineer.

b) The work shall include all clamping, fittings, fixing, plumbing, soldering, taping, compound filling, epoxy cable jointing, crimping, connecting, shorting and earthing as required for all such operations should be available with concerned contractor. For all size of L T termination, crimping tool (Hydraulic type) shall be used. Further, inhibiting compound shall be provided before termination.

c) The equipment will be generally provided with blank plates for cable/conduit entry and cable end box for power cables.

d) The Contractor shall perform all drilling, cutting on the blank plates and any minor modification work required to complete the job.

e) If the cable-end box or terminal enclosure provided on the equipment is found unsuitable and requires major modification, the same shall be carried out by the Contractor as extra work item.

f) Control cable cores entering control panel/switch gear / MCC etc. shall be neatly bunched and served with nylon cord or PVC perforated tape to keep in position at the terminal block.

g) The contractor shall provide oil resistance ferrules for all control cable cores at all terminations including at all junction boxes. and at all terminations. The ferrules shall carry terminal numbers as per drawing. The ferrules shall be of interlocked plastic type or approved equal.

h) Spare cores shall be similarly tagged, crimped with lug and taped on the ends. Spare cores shall be tagged with individual cable number.

i) Terminations and connections shall be carried out in such a manner as to avoid strain on the terminals.

j) All cable entry points shall be sealed and made vermin and dust proof. Unused opening, if any shall be effectively closed.

k) Termination kits for HT cables, Straight through joint kits for HT & L T cables, cable of all glands lugs shall be arranged by the Contractor, which includes furnishing consumable materials such as plumbing and soldering material, electrical tape including bitumen compound/resin if not a part of kit shall be included in the erection rates.

8.0 IMPORTANT NOTES FOR ERECTION ACTIVITIES

8.1 CABLES AND CONDUITS

a) Approximate lengths of cables and conduits runs will be given in the cable schedule. Before commencement of work the Contractor shall take actual measurements and prepare his own cable cutting schedules to reduce wastage to a minimum.

b) During the erection period the Contractor shall furnish weekly / fortnightly report on cable position in an approved proforma so as to keep the Engineer In Charge apprised of the position and to enable him to intimate any procurement action in time.

c) The Contractor shall also maintain and submit when requested, a record of cable insulation value when drawn from store, after laying, before and after termination/jointing.

8.2 EXCAVATION AND BACK FILLING

a) The Contractor shall perform all excavation and back filling as required for the scope of work specified.

b) The Contractor shall make his own arrangement for pumping out any water that may accumulate in the excavation.

c) All excavation shall be back filled to the original level with good consolidation.

8.3 FOUNDATION AND CIVIL WORK

a) The contractor shall provide foundations wherever required & in case same has been provided by the employer earlier, same shall be checked for correctness before commencement of erection to ensure their suitability.

b) All final adjustments of foundation levels, chipping and dressing of foundation surfaces, drilling holes on foundation channels to suit the equipment setting and grouting of anchor bolts, sills, inserts and fastening devices shall be carried out by the Contractor including minor modification of civil work as may be required for erection.

c) Any cutting of masonry work which is necessary shall be done by the Contractor at his own cost & shall be made good to match the original work.

The Contractor shall obtain approval of Engineer before proceeding with any cutting ,of masonry /concrete work.

8.4 STRUCTURAL FABRICATION WORKS

a) All chequered plate covers, cable racks, trays, supports, hangers and brackets wherever necessary shall be supplied/fabricated by the Contactor. Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edge.

b) Every effort shall be made to minimize the wastage of steel as far as practicable during fabrication. The wastage in no case shall exceed as specified else where in this specification.

8.5 TESTING AND COMMISSIONING

a) On completion of erection work, the Contractor shall request the Engineer, for inspection and tests with minimum of fourteen (14) days' advance notice.

b) The Engineer shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor.

c) The installation shall be then tested and commissioned in presence of the Engineer.

d) The Contractor shall provide all men, material and equipment required to carry out the tests.

All rectification, repairs or adjustment work found necessary during inspection, testing and commissioning shall be carried out by the Contractor, without any extra cost. The handing over of the installation shall be effected only after the receipt of written instruction from the Purchaser/his authorized representative.

9.0 SCHEDULE OF PRE-COMMISSIONING TESTS

9.1 CIRCUIT BREAKER

a) Insulation resistance test on each pole by Meggar.

b) Insulation resistance test on control circuit.

c) Checking of all joints for leakage in breaker.

d) Measurement of contact resistance for all the Three Phases.

e) Checking the auxiliary circuits associated with circuit breaker.

f) Functional check of breaker operation electrically at 70% and 110% of rated D.C. supply voltage.

g) Checking of interlock provided in Control Circuits and tripping through simulated protective relay contacts.

h) Auto-reclosing duty cycle check wherever auto-reclosing is required.

i) Measurement of resistance of closing and tripping coils.

9.2 CURRENT TRANSFORMER

a) Insulation Resistance test on each winding by Meggar to earth and between windings.

b) Checking of all ratios on all cores by Primary injection set.

c) Polarity check on each winding.

d) Continuity test.

e) Check for connection to correct taps.

f) Oil level check.

9.3 EARTHING

a) Continuity of earthing connection.

b) Testing of Earth Resistance of Individual Electrode.

c) Testing of Earth Resistance of the combined earthing system.

9.4 SWITCHBOARDS / MCC / DISTRIBUTION BOARD / PANELS

a) Measurement of insulation Resistance of Bus-bar System.

b) Measurement of I. R. of Control Circuit.

c) Functional check of circuit components

d) Continuity check of different circuits.

e) Calibration test of Relays and Meters.

f) Space heater operation.

g) Annunciations.

9.5 RELAYS & METERS

a) Calibration test.

b) Operation / performance test.

NOTE

Tests required for some of the major items are indicated for Bidder's reference. Apart from the tests listed herein and also as mentioned elsewhere in this specification, any other test as necessary per relevant standards, recommendations, Code of Practice, Manufacturer's recommendations etc., shall have to be carried out by the Contractor without any implication within the quoted price and time schedules.

DATA SHEET (to be filled by the Bidder)

PROPOSAL PARTICULARS

(to be filled by the Bidder)

1.0 GENERAL

1.1 Bidder's Complete company Name and Address :

1.2 Proposal Ref. & Date :

1.3 Validity of Proposal :

1.4 Name and designation of the Officer of Contractor to whom all references shall be made for expeditious technical co-ordination :

1.5 i) Bidder's license No. :

ii) License issued by :

iii) Validity date of License :

1.6 Performance guarantee period for :

a) The equipment offered :

i) From the date of commissioning at site. :

ii) From the date of dispatch :

b) Installation work from date of commissioning. :

2.0 SPECIFIC

2.1 . Details of facilities for Design / Engg. Available with the Contractor. :

2.2 Details of documents enclosed with this offer :

2.3 Prices quoted are

- inclusive of :
- exclusive of :

PROPOSAL PARTICULARS

(to be filled by the Bidder)

3.0 GENERAL TECHNICAL REQUIREMENT

3.1 Ambient temp. considered :

3.2 Equipment offered are suitable for :

a) Voltage variation :

b) Frequency variation :

c) Combined voltage & Frequency Variation :

3.3 Details of Codes / Standards to be followed :

4.0 LIST OF PERSONNEL

Contractor shall give below the list of personnel proposed to be employed for efficient execution of the job under this specification.

Sl. No.	Personnel Category	Trade	Number	Remark
01.	Resident Engineer			
02.	Senior Engineer			
03.	Junior Engineer			
04.	Supervisor			
05.	Jointer			
06.	Wireman			
07.	Fitter			
08.	Labour			
09.	Driver			
10.	Others			

5.0 DEVIATION SHEET

Bidder shall list out deviations (if any) with respect to clause no. and page no. of specification.

.....

Bidder's Signature

6.0 PERT CHART

Bidder shall submit a pert chart for various activities with time schedule.

.....

Bidder's Signature

7.0 SPARE PARTS

Bidder shall list out the spare parts for each equipment suitable for two year's trouble free operation.

.....

Bidder's Signature

8.0 INSPECTION SCHEDULE

Witness of routine / Type test (as per relevant standards/ agreed schedule) of various equipment shall be carried out at the works of manufacturer by Owner/ owner's representative. The Contractor shall furnish the following details and freeze this schedule within 2 weeks after placement of LOI in consultation with Owner/ Consultants.

ITEMS	TESTING DATE OF INSPECTION	PLACE	NAME OF MANUFACTURER

NOTE

It is the obligation on the part of Contractor to inform actual date of inspection 2 weeks in advance.

Contractor's engineer shall be present in all inspection.

In some cases, Owner/ Owner's Representative may give waiver of inspection.

In all cases, test certificate shall be furnished by the contractor and the same shall be approved by owner/ Consultant.…….....

Bidder's Signature

APPROVED LIST OF ELECTRICAL MATERIAL

Description	Brand
11 KV CIRCUIT BREAKER PANEL	ABB / SEIMENS / AREVA
11 KV / 0.4 KV TRANSFORMERS	CROMPTON / KIRLOSKER / AREVA / SEIMENS
BATTERY CHARGING PANEL	KELTRON / NELCO
BATTERIES	EXIDE / AMCO / STANDARD
L T PANEL	NEPTUNE (INDIA) LTD. / ZETA SWITCH GEARS / KRYPTON POWER CONTROL INDIA PVT LTD. / ADLEC SYSTEM / N E C
11 KV Isolator and D O Fuses	AMEI / ELLPRO / STERLING
Capacitor	L & T / DUCATI / EPCOS
APFC relay	L & T KHATAU / DUCATI / SYNTRON
M.C.B. / RCCB / RCBO	LEXIC / HAGER / ABB
Distribution Boards	LEXIC / HAGER / ABB
Switch Fuse Units With HRC fuses	GE / L&T / ABB
Moulded Case Circuit Breaker (MCCB)	ABB (T max) / L & T (D sine)
Air Circuit Breakers	ABB (EMEX/L&T(C POWER)
Current Transformer / Meters / Voltage Transformers / Relays / Starters / Contactors / Selector Switch / Indicating Lamps	L & T / SIEMENS / AUTOMATIC ELECTRIC / CONTROL & SWITCH GEARS / ABB
Change Over Switches	GE / L&T / HH ELCON
Cable Glands and Sockets	SIEMENS
PVC insulated Copper conductor wires	FINOLEX / RR / POLYCAB (FIRE REATRDENT)
Telephone Wires and cables	FINOLEX / (RPG/BIRLA ERRICCSON POLYCAB
Television Coaxial cable	FINOLEX / RR /RPG / L&T
PVC / XLPE Insulated 11 KV / 1.1 KV Cables	UNIVERSAL /FORT CLOSTER / NICCO / FINOLEX/POLYCAB
Switches and Sockets outlets (Conventional piano type)	ANCHOR/LEGRAND/LEON
Switches and Sockets outlets (Modular type)	LK Fuga / MK / MDS-MOSAIC
Industrial outlet	LEXIC / HAGER / ABB
MIS Conduits and Accessories	B.E.C./AKG/MK
PVC Conduits and accessories	AKG/BEC/CAP/SEIKO / [POLYCAB
Fluorescent Tube Fitting	PHILIPS /WIPRO/TULLIP
LED LIGHT FITTINGS	PHILIPS/HAVELLS/TULLIP/
Incandescent Light Fitting	DECON/PHILIPS / BAJAJ / WIPRO
Hpmv/hpsv/ halogen Lamp	PHILIPS / WIPRO
Ceiling Fans / Exhaust Fans/wall fans	CROMPTON / BAJAJ/USHA/havells
Floor / Wall Raceways to date	MK/ LK/ MDS
Computer networking - outlet	AMP/SYSTEMAX / LUCENT
Electronic Energy Meters	SECURE / L&T
UPS	EMERSON / POWERWARE / TATA LIBERT
Ceiling Rose holders	ANCHOR
Buzzers/Bell Push bell	ANCHOR/LEGRAND
MCB Distribution Board	MOS/LEGRAND/SIEMENS /HAGER
HRC Switch Fuse nits	SIEMENS ABB/GE/L&T
Cable Glands/Lugs	SIEMENS/DOWELLS
Electronic Regulator	MK/ANCHOR/ROMA/DEGRAND/MDS
Contractors	SIEMENS/L&T/ABB/SCHNIEDER
Geysers/water/heater	SPHERE HOT /RACOLD/USHA

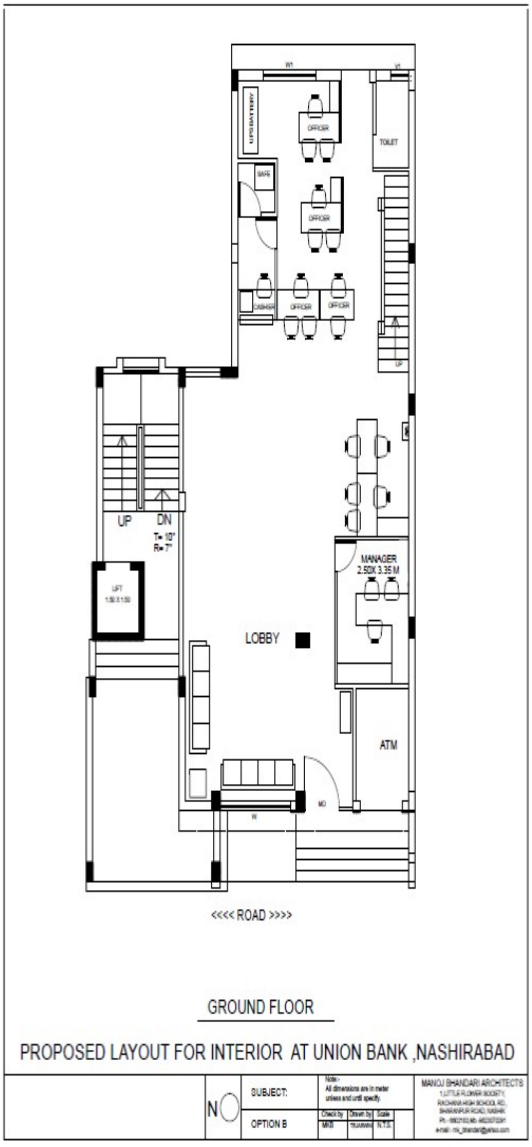
NOTE :

Sr. No.	Description
1.	The choice of the final makes shall be made by the owner/ consultant
2.	The samples or Cat.No. of all type of switches & light fittings should be approved before execution.

ESTIMATE FOR ELECTRICAL WORK FOR BRANCH AT NASIRABAD					
SR. NO	**Item**	**Qty**	**Per**	**Rate**	**Amount**
1)	**Main distribution box**				
	PANELS				
	Supply ,installation ,testing and commissioning of cubicle type panel as specified and complete With :-				
	a) Tinned copper busbars				
	b) Switchgear , wiring				
	c) 7 take pre - treatment , powder coated finish (Siement' s white)				
	d) Earthing				
	e) All MCCBc with rotary handles				
	Floor Panel consisting of :				
	a) 1 no 100 A 4pole MCCB as incomer ,25 kA				
	b)2nos. 32 A TPN MCCBs				
	c)2 no 6 to 32 A 2 pole MCB				
	d) 8 nos 6 A to 16 A MCBs				
	e) 2 nos . 32A TPN MCBs with 32A TP contactor , NO/ OFFpush button				
	f) 1 set RYB phase indicating lamps with fuses				
	g) 1 no comdined digital meter to read current etc .IME make (including UPS SUB-DB)	1.0	no		
	a) Indusrtial Earthing (600 x 600 x 6 copper plate)	2.0	no.		
	Providing 600 x 600 x 6 mm.thick copper plate earthing generally as per IS : 3043 and complete with soil treatment ,masonary chambers, test link heavy duty CI . cover etc as per IS 3043				
	e)8 swg conductor upto the earthing in PVC pipe with trench,refilling complete as directed	25.0	RN.M		
	WIRING and POINTS(CONCEALED)				
	a) Light point in 1,5 MM wire including switches including provision for inverter wiring/controls.	60.0	pts.		
	b) Ceiling fan point with fan step regulator	14.0	no		
	Supply and installation of 1200 mm dia sweep ceiling fan OR WALL MOUNTED 400 DIA FANS (Havells,Bajaj) in any color or any finish.				
	c) 5 or 6 Amps 3 pin plug socket with 3 pin plug socket and switch plate without wiring.	42.0	no		

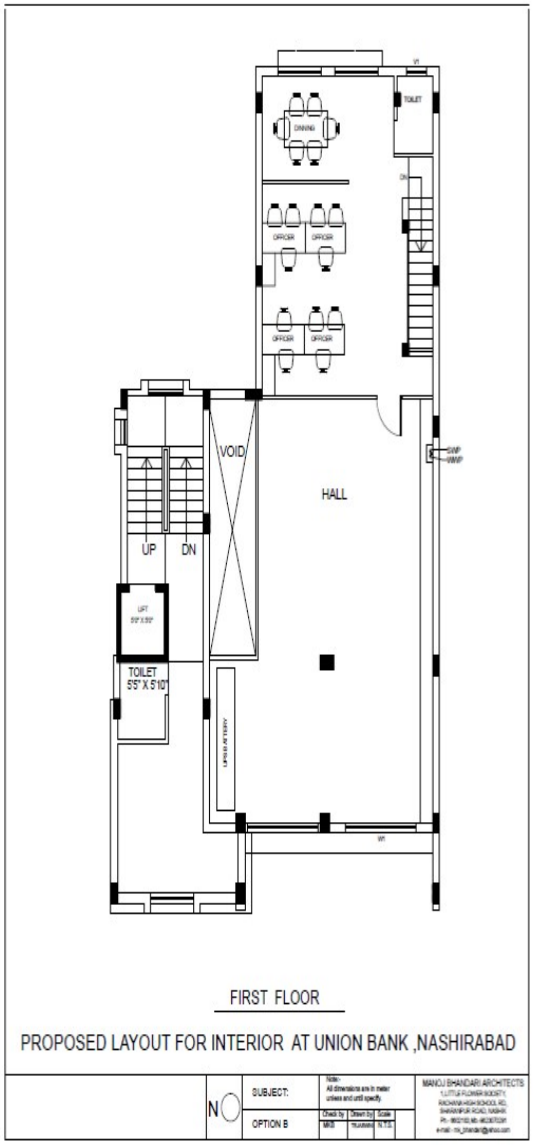
	d)20A A.C.socket without wire	6.0	no.		
	e)Power point for U.P.S.,printer,battery backup(MCB)	8.0	no.		
	f)Lighting main from D.B. to switch boards including	325.0	R.m		
	earthing wiring /inverter mains in conduit (3x 2.5)				
	g)Power main from D.B. to power points in conduit (6 sq.mm x 3)	325.0	R.m		
	h)Mains for A.C.units including 6 sq.mm x 4 and	180.0	R.m		
	1x 2.5 sq.mm in conduit				
	i)2 pair telephone wire with 25 dia pipe concealed	200.0	Rn.M		
	thro wall,flooring				
	j)S.I.T.C. of cat-6 lan cable including conduit complete	400.0	Rm		
	k) S.I.T.C of speaker wire in conduit and casing	200.0	Rm		
	l) I.O. sets of D-link	0.0	no.		
	m)25 x 3.5 core main cable	25.0	Rm		
	N)cctv wiring icluding power suppy cable	1.0	Rm		
	LIGHT FITTINGS & FANS				
	Supply and/or installation, testing and commissioning light fittings and fans complete with				
	a) Fixture with lamp & control gear accessories				
	b) Termination & earthing				
	c)Fixing/mounting accessories				
	d)Suspension chains , down rods and mounting				
	fremes for ceiling exhaust fans				
	e)Low loss vacuum impregnated open type Ballast				
	.(5.5W loss max.) for fluorescent / CFL fittings &				
	HPF capacitors.				
	FITTING				
	Supply and erection of 600 X 600 LED tube light fitting	8.0	no		
	IN 36 W complete with all electrical accessories				
	double parabolic louvers similar to Havells				
	LHEWEBP_7 UL 1 W036 7 UL 1 W036 /philips/OSRAM				
	Supply and installation of 18 w round COB type LED spotlight (7"dia)	40.0	no		
	of philips ,TULIP or equivalent				
	Supply and erection of 40 w flurocscent tubes	10.0	Nos.		
	of strimline or minolta make(phillips)				

	Supply and installation of 48" dia Bajaj ceilling/wall fans	14.0			
	Supply and installation of 10" dia Bajaj exhust fans	2.0			
	Supply and installation of white powder coated	6.0			
	speakers or wall mounted speakers as directed				
	TELEPHONE & COMPUTER				
	Supply & erection of Telephone outlet	12.0	NO		
	sockets with top complete with PVC/M.S.				
	box concealed in wall/furniture				
	Supply and erection of 25mm Dia. Pvc	40.0	Mtr.		
	conduit concealed in wall/flooring				
	(For telephone and computer cables.)				
	TOTAL				
	IN words.Rs. GST as applicable.				



GROUND FLOOR

PROPOSED LAYOUT FOR INTERIOR AT UNION BANK ,NASHIRABAD



FIRST FLOOR

PROPOSED LAYOUT FOR INTERIOR AT UNION BANK ,NASHIRABAD