TENDER
NATIONAL HEALTH SYSTEMS RESOURCE CENTRE

SUMMARY OF TENDER

Name of Work	**Supply, Installation, Testing and Commissioning of Main LT Panel, AMF, Auto Load Management, Floor Panels Etc at NHSRC, NIHFW Campus, Munirka, New Delhi -110067**
Notice Inviting Tender	**15.11.2018**
Date of issue of tender documents.	**From 15 Nov 2018 to 07 Dec 2018 till 15:00 hrs, can be downloaded from the website of NHSRC. www.nhsrcindia.org**
Date of submission of Tender	**The sealed Tender so as to reach this office on or before07-12-2018 latest by 1500 hrs**
Date of opening of Tender	**On 07-12-2018 at 1530 hrs in presence of party who may be present.**
EMD	**Rs.27, 500.00 (Refundable) - Rupees Twenty Seven Thousand Five Hundred only.**
Performance Guarantee	**5% of Contract Amount**
Tender Cost	**Rs.1000.00 (Non-Refundable) Rupees One Thousand only.**
Completion time	**One Month**
Envelope-1 **Envelope-2** **Envelope-3**	**EMD & Tender Cost** **Pre qualifications Documents with Tender Document (Technical Specification)** **Financial Bid Only**

Dr.Uddipan Dutta
Principal Administrative Officer (NHSRC)

NATIONAL HEALTH SYSTEMS RESOURCE CENTRE
NOTICE INVITING TENDER

Ref:-NHSRC/Admin/18-19/vertical Extn/LT/AMF **Dated:-15-11-2018**

Name of the work: Supply, Installation, Testing and Commissioning of Main LT Panel, AMF, Auto Load Management, Floor Panels Etc at NHSRC, NIHFW Campus, Munirka, New Delhi -110067.

Sealed Tenders are invited on behalf of **National Health Systems Resource Centre, New Delhi for Supply, Installation, Testing and Commissioning of Main LT Panel, AMF, Auto Load Management, Floor Panels Etc at NHSRC, NIHFW Campus, Munirka, New Delhi -110067**.

1. The tender shall be submitted in prescribed form.

2. The works are to be completed in **One Months** from the 7th day after the day on which the department issues the written order to commence the work or from the date of handing over the site, whichever is later.

3. The tender shall be available to download from NHSRC website till 1700 HRS on 07 Dec 2018.

4.1 Annually prequalified Contractors/Manufacturer in appropriate class/ Tendering limit in BSES/PWD/BRO/MES in the category of Electrical (HT/LT) or composite work. The proof of registration/Enlistment should be enclosed of any of these organizations. **The following documents are also required to submit by Contractor.**

4.2 The Contractor/agency should have satisfactory completed the works as mentioned below during the last Three years ending last day of the month previous to the one in which tenders are invited as follows: **The Contractor shall enclose work order with Bill of quantity and Performance certificate for same.**

a) Three similar works of SITC of HT/LT Panel and each costing not less than 40% of the estimated cost.
OR

b) Two similar works of SITC of HT/LT Panel and each costing not less than 60% of the estimated cost.
OR

c) One similar works of SITC of HT/LT Panel and each costing not less than 80% of the estimated cost

"Similar work shall mean works of "SITC HT/LT Panel".

4.3. A tenderer shall enclose a copy of valid PAN Card.

4.4. Proof of registration with GST.

4.5. Charted Accountant Certificate of Turnover for last three years ending March 2018 The turnover should not be less than 25 Lacs in each year.

4.6. History & structure of firm, name of director/partners/proprietor/with Technical staff.

4.7. List of machinery/tools plants and equipment.

4.8. Valid copy of Electrical License.

4.9. All the above certified documents shall be submitted by the firm duly signed and stamped by Notary Public/gazetted officer and self attested with seal of the company and original shall be duly produced for verification as required.

4.10 An affidavit duly notarized on stamp paper of Rs.100/- non-judicial stating that "In case of any ambiguity found in the documents submitted (Listed out) at any stage, we shall be entirely responsible and liable for any action as deemed fit under the Law"

5. The tender document can be down loaded from our website www.nhsrcindia.org. In such case Bidder should fulfil prequalification criteria as per para **"4.1 to 4.10"** and submit the documents in a sealed envelopes super scribed **Envelop No.2**-Technical Bid for pre-qualification for "**Supply, Installation, Testing and Commissioning of Main LT Panel, AMF, Auto Load Management, Floor Panels Etc at NHSRC, NIHFW Campus, Munirka, New Delhi -110067**".

a) Envelope II marked as Technical bid shall contain all the **pre-qualification documents along with tender documents** downloaded from the web site duly signed and stamped as mark of acceptance of all terms and conditions. Any deviation from terms and conditions shall be notified separately.

b) If all the required documents are not complete as per **Para 4 (a) above, Envelope III containing financial bid will not be opened.**

6. a) In case tender documents downloaded from the web site, the tenderers should enclosed tender cost **(Rs 1000.00 (Rupee One Thousand only)** in form of banker's cheque / demand draft in a separate sealed envelope. Super scribed **ENVELOPE-1** for the work of "**Supply, Installation, Testing and Commissioning of Main LT Panel, AMF, Auto Load Management, Floor Panels Etc at NHSRC, NIHFW Campus, Munirka, New Delhi -110067**".

b). The tender shall be accompanied by earnest money **of Rs.27,500.00 (Rupee Twenty Seven Thousand Five Hundred only)** through a Bank Draft/Banker's Cheque issued in favour of **National Health Systems Resource Centre, Payable at New Delhi** from State Bank of India or a Nationalized Bank or any Scheduled Bank. Tenders without the earnest money and Tender cost if any will be summarily rejected

7. Copies of other drawings and documents pertaining to the works signed for the purpose of identification by the accepting authority of his accredited represent representatives and samples of materials to be arranged by the Contractor will be open for inspection by tenderers at the NHSRC office, New Delhi during working hours between the dates mentioned in clause 6 above.

8. Tenderer are advised to inspect and examine the site and its surroundings and satisfy themselves before submitting their tender to the nature of the ground and sub-soil, the form and nature of the site, the means of access to the site, the accommodation they may require and in general shall themselves obtain all necessary information as to the risk, contingencies and other circumstances which may influence or effect their tender. A tenderer shall be deemed to have full knowledge of the site, whether he inspects it or not and no extra charges consequent on any misunderstanding or otherwise shall be allowed.

9. Submission of a tender by a tenderer implies that he has read this notice and all other contract documents and has made himself aware of the scope and specifications of the work to be done and of the conditions and rates at which stores, tools, plant etc. will be issued to him by the NHSRC and local conditions and other factors bearing on the execution of the work.

10. A tenderer shall quote in figures as well as in words for rate(s) tendered. The amount for each item should be worked out and requisites total given. Special care shall be taken to write rates in figures as well as words and the amounts in figures only in such a way that interpolation is not possible. The total amount shall be written both in figures and in words. In case of figures, the words 'Rs' should be written before the figure of rupees and the work 'Paisa' after the decimal figures e.g. Rs. 2.15 P and in case of words 'Rupees' should be precede and the word 'Paisa' should be written at the end. Unless the rate is in whole rupees followed by the word 'only' it should invariably be up to two places of decimal.

11. (a) All rates shall be quoted on the financial bid form and shall include material, labour, transportation all taxes & duties , supervision, tools, plants, wastage, sundries, scaffolding as required mobilization, demobilization, transportation etc. and nothing extra shall be payable on this account. **However, shall not include the GST, which will be paid on actual billing.**

(b) GST or any other tax on materials/ labour in respect of this contract shall be payable by the Contractor and the NHSRC will not entertain any claim whatever in this respect.

(c) As per law of land, statuary deduction like income tax / work contract tax etc shall be made from the Contractor's bill as applicable.

12. In case of item rate tenders, only rates quoted shall be considered. Any tender containing percentage below/above the rates quoted will be rejected.

13. Tender complete in all respect shall be put in the Tender Box placed at Security Gate at NHSRC, NIHFW Campus, Baba Gangnath Marg, Munirka New Delhi-110067 up to **1500 hours on or before 07 Dec 2018**.The tenders received shall be opened on same

day at 1530 Hrs in the presence of tenderers who may be present. The submission of tender shall be as under:

13.1 **Sealed Envelope No.1-supersrcibed"EMD &Tender cost**" consisting of demand draft for Tender cost (Non-refundable) and Earnest money deposit (Refundable) of subject work. It should be superscripted Envelop-1.alongwith name of work-Tender cost & EMD.

13.2 **Sealed Envelop No.2-superscribed "Technical bid"** along with name of work shall contain complete Tender documents and pre-qualification documents as required as listed **4.1 to 4.10** each page duly signed and stamped.

13.3 **A separate sealed envelope No.3 should contain only Financial Bid** each page duly signed and stamped with prices in the manner specified in this NIT. The envelop shall be super scribed as Envelop-3-Financial bid for "**Supply, Installation, Testing and Commissioning of Main LT Panel, AMF, Auto Load Management, Floor Panels Etc at NHSRC, NIHFW Campus, Munirka, New Delhi -110067**".

14. All the three sealed envelopes should be put in separate sealed cover super scribed as Tender document for the work of "**Supply, Installation, Testing and Commissioning of Main LT Panel, AMF, Auto Load Management, Floor Panels Etc at NHSRC, NIHFW Campus, Munirka, New Delhi -110067.**

15. On acceptance of tender, the earnest money will be treated as part of the Security Deposit.

16. **SECURITY DEPOSIT**

(i) The security deposit shall be collected by deductions from the running bills of the Contractor at the rate mentioned below and the earnest money deposited at the time of submission of tender, shall be treated as part of the security deposit. The security deposit can also be accepted in the form of Government Securities, Fixed Deposit Receipts etc.

(ii) A sum @ 5% of the gross amount of the bill shall be deducted from each running bill of the Contractor, till the sum along with the sum already deposited as earnest money amounts to security deposit @ 5% of the tendered amount of the work. Such deductions shall be made unless the Contractor has deposited the amount of security at the rate mentioned in cash or Government securities or Fixed Deposit Receipts. This is in addition to the performance guarantee that the Contractor is required to deposit as per tender. Income tax/work contract tax & other statutory deductions etc shall be made at source as per the prevalent laws of the Govt. of India

17. NHSRC will return the earnest money, where applicable to every unsuccessful tenderer.

18. NHSRC reserve to themselves the right of accepting the whole or any part of the tender and tenderer shall be bound to perform the same at his quoted rates.

19. The validity of the tender(s) shall be up to **90 (Ninety) days** from the date of opening of tender(s).

20. The use of whitener/ eraser in this tender is prohibited. If any correction becomes necessary, the same should be done by SCORING OFF originally written rates/figures etc. and then rewriting should be done under initials of person filling the tender.

21. An undertaking by the agency shall be given to the effect that "they will engage staff and labour of good moral character only at site and will ensure watch and ward and discipline of his employees". Suitable action will be taken against the agency if any deviation is noticed on this account.

23. The contractor whose bid is accepted will be required to furnish performance guarantee of **5% (Five Percent**) of the awarded amount within the **7 days** after award of work. This guarantee shall be in the form of Banker's cheque/ Demand Draft/ Pay order/ Bank Guarantee/ FDR of any Scheduled Bank or the State Bank of India in accordance with the prescribed form in the favor of National Health Systems Resource Centre. In case the contractor fails to deposit the said performance guarantee within **7 days** after award of work, the Earnest Money deposited by the contractor shall be forfeited automatically without any notice to the contractor. In such situation NHSRC reserve the right to approach L2 of this tender to undertake the work at minimum rates quoted by L1. The earnest money deposited along with bid shall be returned after receiving the aforesaid performance guarantee. **The performance guarantee shall be kept till satisfactory handing over of site to NHSRC.**

24. In case it is found during evolution or at any time before signing of contract or after its execution and during the period of subsistence there of that one or more of the eligibility conditions have not been met by the applicant, or the applicant has made maternal misrepresentation or has given any maternally incorrect or false information, the applicant shall be disqualified forthwith, if not, yet appointed as the Contractor/supplier and if the applicant has already been issued the LOA or has entered into the contract, as the case may be, the same shall, not withstanding anything to the contrary contained therein be liable to be terminated along with forfeiter of earnest money deposit (EMD)/ performance security by a communication in writing By the NHSRC to the applicant without the corporation being liable in any matter whatsoever to the applicant and without prejudice to any other right or remedy with the NHSRC may have under the bidding documents the contract or under applicable law.

For & On Behalf of the National Health Systems Resource Centre

Dr.Uddipan Dutta
Principle Administrative Officer
NHSRC

Schedule 'F'

Reference to General Conditions of Contract (To be signed by the Contractor(s) at the time of signing the agreement)

1(a) Accepting Authority National Health Systems Resource Centre
1(i) Market Rate - percentage addition
To cover profit, overheads and supervision - 15%

2. (a) Estimated cost of the Works put to tender - **Rs.13, 53,500.00**
(b) Earnest money (2% of the estimated cost) - Rs.27,500.00
(c) Security deposit - as per NIT

3(ii) Schedule of rates applicable: Market Rate

4. Time allowed for execution of work **30 days** (To be reckoned from the SEVENTH Day after the date of work order or handing over of Site)

5. Compensation for delay: Compensation for Delay: 1% (one per cent) of the contract amount subject to a maximum of Rs. 50,000/- PER WEEK or a part thereof for first 4 weeks of delay for subsequent delay. The Compensation should be 2% (Two Percent) of the contact amount subject to maximum Rs. 1.00 lac per week or a part there of. The total compensation for delay shall further be subject to an overall maximum or 10% (Ten per cent) of the contract amount as awarded. The decision of the competent officer of the Accepting Authority shall be final and binding.

6. Defects liability Period -Electrical works, Substation works, HT/LT Panels and machinery etc. - **TWO YEAR from** the date of Commissioning.

7. For Extra Item/Substitute Item/Deduction Item etc- Latest BSES Manual shall be followed.

Integrity Pact

To be signed by the bidder and same signatory competent / authorized to sign the relevant contract on behalf of NHSRC.

INTEGRITY AGREEMENT

This Integrity Agreement is made at ..... on this ..... day of ..... 20.....

BETWEEN

NHSRC, NIHFW Campus Munirka, New Delhi-110067

'**Principal/Owner**', which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

AND

.....

(Name and Address of the Individual/firm/Company)

through ..... (Hereinafter referred to as the

(Details of duly authorized signatory)

"**Bidder/Contractor**" and which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

Preamble

WHEREAS the Principal / Owner has floated the Tender. (hereinafter referred to as "**Tender/Bid**") and intends to award,under laid down organizational procedure, contract for **Supply, Installation, Testing and Commissioning of Main LT Panel, AMF, Auto Load Management, Floor Panels Etc at NHSRC, NIHFW Campus, Munirka, New Delhi -110067.** Herein after referred to as the "**Contract**".

AND WHEREAS the Principal/Owner values full compliance with all relevant laws of the land, rules, regulations, economic use of resources and of fairness/transparency in its relation with its Bidder(s) and Contractor(s).

AND WHEREAS to meet the purpose aforesaid both the parties have agreed to enter into this Integrity Agreement (hereinafter referred to as "**Integrity Pact**" or "**Pact**"), the terms and conditions of which shall also be read as integral part and parcel of the Tender/Bid documents and Contract between the parties.

NOW, THEREFORE, in consideration of mutual covenants contained in this Pact, the parties hereby agree as follows and this Pact witnesses as under:

Article 1: Commitment of the Principal/Owner

1) The Principal/Owner commits itself to take all measures necessary to prevent corruption and to observe the following principles:

(a) No employee of the Principal/Owner, personally or through any of his/her family members, will in connection with the Tender, or the execution of the Contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

(b) The Principal/Owner will, during the Tender process, treat all Bidder(s) with equity and reason. The Principal/Owner will, in particular, before and during the Tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential / additional information through which the Bidder(s) could obtain an advantage in relation to the Tender process or the Contract execution.

(c) The Principal/Owner shall endeavour to exclude from the Tender process any

person, whose conduct in the past has been of biased nature.

2) If the Principal/Owner obtains information on the conduct of any of its employees which is a criminal offence under the Indian Penal code (IPC)/Prevention of Corruption Act, 1988 (PC Act) or is in violation of the principles herein mentioned or if there be a substantive suspicion in this regard, the Principal/Owner will inform the Chief Vigilance Officer and in addition can also initiate disciplinary actions as per its internal laid down policies and procedures.

Article 2: Commitment of the Bidder(s)/Contractor(s)

1) It is required that each Bidder/Contractor (including their respective officers, employees and agents) adhere to the highest ethical standards, and report to the Government / Department all suspected acts of **fraud or corruption or Coercion or Collusion** of which it has knowledge or becomes aware, during the tendering process and throughout the negotiation or award of a contract.

2) The Bidder(s)/Contractor(s) commits himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the Tender process and during the Contract execution:

a) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm, offer, promise or give to any of the Principal/Owner's employees involved in the Tender process or execution of the Contract or to any third person any material or other benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the Tender process or during the execution of the Contract.

b) The Bidder(s)/Contractor(s) will not enter with other Bidder(s) into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to cartelize in the bidding process.

c) The Bidder(s)/Contractor(s) will not commit any offence under the relevant IPC/PC Act. Further the Bidder(s)/Contract(s) will not use improperly, (for the purpose of competition or personal gain), or pass on to others, any information or documents provided by the Principal/Owner as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

d) The Bidder(s)/Contractor(s) of foreign origin shall disclose the names and addresses of agents/representatives in India, if any. Similarly Bidder(s)/Contractor(s) of Indian Nationality shall disclose names and addresses of foreign agents/representatives, if any. Either the Indian agent on behalf of the foreign principal or the foreign principal directly could bid in a tender but not both. Further, in cases where an agent participate in a tender on behalf of one manufacturer, he shall not be allowed to quote on behalf of another manufacturer along with the first manufacturer in a subsequent/parallel tender for the same item.

e) The Bidder(s)/Contractor(s) will, when presenting his bid, disclose any and all payments he has made, is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the Contract.

3) The Bidder(s)/Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

4) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm indulge in fraudulent practice **means a willful misrepresentation or omission of facts or submission of fake/forged documents in order to induce public official to act in reliance thereof, with the purpose of obtaining unjust advantage by or causing damage to justified interest of others and/or to influence the procurement process to the detriment of the Government interests.**

5) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm use Coercive Practices (means the act of obtaining something, compelling an action or influencing a decision through intimidation, threat or the use of force directly or indirectly, where potential or actual injury may befall upon a person, his/ her reputation or property to influence their participation in the tendering process).

Article 3: Consequences of Breach

Without prejudice to any rights that may be available to the Principal/Owner under law or the Contract or its established policies and laid down procedures, the Principal/Owner shall have the following rights in case of breach of this Integrity Pact by the Bidder(s)/Contractor(s) and the Bidder/ Contractor accepts and undertakes to respect and uphold the Principal/Owner's absolute right:

1) Contract has committed a transgression through a violation of Article 2 above or in any other form, such as to put his reliability or credibility in question, the Principal/Owner after giving 14 days notice to the Contractor shall have powers to disqualify the Bidder(s)/Contractor(s) from the Tender process or terminate/determine the Contract, if already executed or exclude the Bidder/Contractor from future contract award processes. The imposition and duration of the exclusion will be determined by the severity of transgression and determined by the Principal/Owner. **Such exclusion may be forever or for a limited period as decided by the Principal/Owner.**

2) **Forfeiture of EMD/Performance Guarantee/Security Deposit**: If the Principal/Owner has disqualified the Bidder(s) from the Tender process prior to the award of the Contract or terminated/determined the Contract or has accrued the right to terminate/determine the Contract according to Article 3(1), the Principal/Owner apart from exercising any legal rights that may have accrued to the Principal/Owner, may in its considered opinion forfeit the entire amount of Earnest Money Deposit, Performance Guarantee and Security Deposit of the Bidder/Contractor.

3) **Criminal Liability:** If the Principal/Owner obtains knowledge of conduct of a Bidder or Contractor, or of an employee or a representative or an associate of a Bidder or Contractor which constitutes corruption within the meaning of IPC Act, or if the Principal/Owner has substantive suspicion in this regard, the Principal/Owner will inform the same to law enforcing agencies for further investigation.

Article 4: Previous Transgression

1) The Bidder declares that no previous transgressions occurred in the last 5 years with any other Company in any country confirming to the anticorruption approach or with Central Government or State Government or any other Central/State Public Sector Enterprises in India that could justify his exclusion from the Tender process.

2) If the Bidder makes incorrect statement on this subject, he can be disqualified from the Tender process or action can be taken for banning of business dealings/ holiday listing of the Bidder/Contractor as deemed fit by the Principal/ Owner.

3) If the Bidder/Contractor can prove that he has resorted / recouped the damage caused by him and has installed a suitable corruption prevention system, the Principal/Owner may, at its own discretion, revoke the exclusion prematurely.

Article 5: Equal Treatment of all Bidders/Contractors/SubContractors

1) The Bidder(s)/Contractor(s) undertake(s) to demand from all subContractors a commitment in conformity with this Integrity Pact. The Bidder/Contractor shall be responsible for any violation(s) of the principles laid down in this agreement/Pact by any of its SubContractors/ sub-vendors.

2) The Principal/Owner will enter into Pacts on identical terms as this one with all Bidders and Contractors.

3) The Principal/Owner will disqualify Bidders, who do not submit, the duly signed Pact between the Principal/Owner and the bidder, along with the Tender or violate its provisions at any stage of the Tender process, from the Tender process.

Article 6- Duration of the Pact

This Pact begins when both the parties have legally signed it. It expires for the Contractor/Vendor 12 months after the completion of work under the contract or till the continuation of defect liability period, whichever is more and for all other bidders, till the Contract has been awarded.

If any claim is made/lodged during the time, the same shall be binding and continue to be valid despite the lapse of this Pacts as specified above, unless it is discharged/determined by the Competent Authority.

Article 7- Other Provisions

1) This Pact is subject to Indian Law, place of performance and jurisdiction is the **Head quarters of the Division** of the Principal/Owner, who has floated the Tender.

2) Changes and supplements need to be made in writing. Side agreements have not been made.

3) If the Contractor is a partnership or a consortium, this Pact must be signed by all the partners or by one or more partner holding power of attorney signed by all partners and consortium members. In case of a Company, the Pact must be signed by a representative duly authorized by board resolution.

4) Should one or several provisions of this Pact turn out to be invalid; the remainder of this Pact remains valid. In this case, the parties will strive to come to an agreement to their original intensions.

5) It is agreed term and condition that any dispute or difference arising between the parties with regard to the terms of this Integrity Agreement / Pact, any action taken by the Owner/Principal in accordance with this **Integrity Agreement/ Pact or interpretation thereof shall not be subject to arbitration.**

Article 8- LEGAL AND PRIOR RIGHTS

All rights and remedies of the parties hereto shall be in addition to all the other legal rights and remedies belonging to such parties under the Contract and/or law and the same shall be deemed to be cumulative and not alternative to such legal rights and remedies aforesaid. For the sake of brevity, both the Parties agree that this Integrity Pact will have precedence over the Tender/Contact documents with regard any of the provisions covered under this Integrity Pact.

IN WITNESS WHEREOF the parties have signed and executed this Integrity Pact at the place and date first above mentioned in the presence of following witnesses:

.....
(For and on behalf of Principal/Owner)
.....
(For and on behalf of Bidder/Contractor)
WITNESSES:
1. .....
(signature, name and address)
2. .....
(signature, name and address)
Place:

Dated :

Special Conditions of contract

1. **CONFORMITY WITH STATUTORY ACTS, RULES, REGULATIONS, STANDARDS AND SAFETY CODES**

a) Indian Electricity Act and Rules All electrical works in connection with installation of electric shall be carried out in accordance with the provisions of Indian Electricity Act, 2003 and the Indian Electricity Rules, 1956 amended upto date. Wherever I.E. rule numbers have been indicated, they are based on I.E. Rules, 1956 amended up to date.

b) **Indian Standards**:- The Main LT Panel equipments and their installation shall conform to relevant Indian standards.

c) **Other Acts and Rules**:- The installation shall also comply with the following:-

(i) Factories Act wherever applicable.

(ii) Any other Act or Rules in force

d) **Safety Codes and Labour Regulations:-** In respect of all labor employed directly or indirectly on the work, the tenderer, here in after called the Contractor, at his own expense will arrange for the safety provision of these specifications to comply with the statuary regulations, ISI recommendations and BSES codes. In case of default, the department shall be at liberty to make arrangements and provide facilities as aforesaid and recover the cost from the Contractor. The Contractor shall provide necessary barriers warning signals and other safety measures to avoid accidents. He shall also indemnify department against claims for compensation arising out of negligence in this respect. Nothing in these specifications shall be construed to relieve the Contractor of his responsibility for the design, manufacture and installation of the equipment with all accessories in accordance with applicable statutory regulations and safety codes in force from the safety angle.

2. **INFORMATIONS AND DRAWINGS TO BE SUPPLIED BY THE DEPTT**

a) Specification Drawing:- The tender specifications shall indicate, for a particular job, the reference drawings to help the Contractor to work out the tender. The drawings shall also indicate the schematic of main connections and shall form part of the specifications. All the drawings specified and issued with the tender are for purpose of tendering only and shall be deemed to be specification drawings.

3. **WORKS TO BE DONE BY THE CONTRACTOR**:-

In addition to supply, installation, testing and commissioning of all equipments as per schedule of work. The following work shall be deemed to be included within the scope of work, to be executed by the Contractor.

a) All minor building works, such as equipments foundation if required cutting and making good holes, grouting of channels belts as required. Cutting and making good damages etc.
b) Provision of supports / clamps for equipments, cables etc. wherever required.
c) Small wiring, inter-connection etc. inclusive of all materials and accessories, necessary to comply with the regulations as well as proper and trouble free operation of the equipment.
d) Closing of the cable entry points in sub-station against seepage of water, rodents etc.
e) Tools and tackles required for handling and installation.
f) Necessary testing equipments for commissioning.
g) Watch and Ward of materials and/or installation and equipments till their handing over to the department.

4. **SITE CONDITIONS**:- All the equipments and their installation shall be suitable for the environmental conditions encountered at the location.

5. **INSPECTION OF SITE AND COLLECTION OF DATA:-** The Contractor shall be deemed to have examined the tender documents, detailed specification, data etc. and to have visited the site or ascertained all relevant details for offering suitable equipments/ installation.

6. **INTERFERENCE WITH COMMUNICATION EQUIPMENT:-** Suppressors or other protection devices shall be provided, if required as per schedule of quantities, wherever the sub-station installation is likely to interfere during the operation with any other electric or electronic equipment.

7. **EXTENT OF WORK**: - The scope of work shall consist of cost of all materials, labour i/c supervision, installation, calibration, adjustments as required for commissioning of the sub-station. The term complete installation shall mean, not only, major item of the plant and the equipments covered by these specifications, but also, incidental sundry components necessary for complete execution and satisfactory performance of installation with all labour charges, whether or not specifically mentioned in the tender documents, which shall be provided by the Contractor at no extra cost.

8. **COMPLETENESS OF TENDER: -** All fittings, unit assemblies accessories, hardware foundation bolts, terminals blocks for connections, cable glands and miscellaneous materials and accessories of items of work which are useful and necessary for efficient assembly and working of the equipment shall be deemed to have been included within the scope of the work in the tender and within the overall details for complete item whether they have been specifically mentioned or not.

9. **DATA MANUALS AND DRAWINGS TO BE FURNISHED BY CONTRACTOR After Award of Work**

a) The Contractor shall submit the following drawing within a fortnight of the award of the work or as specified in tender document which shall prevail, for approval by the department.

(i) General arrangement or location drawing of the equipment complete with dimensions and clearances.

(ii) General arrangement drawing of H.V. Panel, Transformers, M.V. panels, Earthing, Cable route etc. including details of grouting of channels / bolts of various equipments.

(iii) All panels' schematics & wiring diagram including control wiring.

(iv) Bar chart indicating general programme for supply, installation, testing and commissioning and handing over.

(v) Any other drawing or data that may be necessary for the job

b) **Before Commencement of Installation:-**

The Contractor shall also furnish 3 copies of detailed installation, operation and maintenance manuals of manufacturers for all items of equipment together with all relevant data sheet, spare parts catalogues, repairs, assembly and adjustment procedure etc., in triplicate.

10. QUALITY OF MATERIALS AND WORKMANSHIP

All parts of equipment shall be of such design, size and material so as to function satisfactorily under all rated conditions of loading and operation. All components of the equipment shall have adequate factors of safety. Materials/components which are not conforming to standards laid down by Bureau of Indian Standards (BIS) shall be got approved from the department before use on the work. The entire work of fabrication, assembly and installation shall conform to sound engineering practice and on the basis of "fail safe" design. The mechanical parts subject to wear and tear shall be of easily replaceable type. The construction shall be such as to facilitate ease of operation, inspection, maintenance and repairs. All apparatus shall also be designed to ensure satisfactory operation under working conditions as specified.

11. INSPECTION, TESTING AT MANUFACTURERS WORKS

The Contractor will be required to furnish such facilities as will be necessary for inspection of the equipment before dispatch at the manufacturer's works and also for witnessing such tests, at the works, if so required by the NHSRC. The Contractor shall furnish information for this purpose and will also give sufficient notice regarding the dates proposed for such test to Inspection agency.

12. TEST CERTIFICATE

Copies of all documents for routine, acceptance and type test certificates of the equipment carried out at the manufacturers premise shall be furnished to the department along with supply of the equipment.

13. DISPATCH OF MATERIALS AND STORAGE

The Contractor shall commence work as soon as the drawings submitted by him are approved. The Contractor should dispatch all materials to site in consultation with the department where suitable storage accommodation may be made available to him temporarily. For this purpose the programme of dispatches of materials shall be framed keeping in view the building progress so that suitable storage accommodation could be made available to the Contractor. Safe custody of all machinery and equipment supplied by the Contractor shall be his own responsibility till the final taking over by the NHSRC.

14. **COORDINATION WITH OTHER AGENCIES**

The Contractor shall coordinate his work and cooperate with other agencies by exchange of all technical information like details of foundation if required, weight, over all dimensions, clearance and other technical data required for successful and proper completion of his portion of the work in relation to the work of others without any reservation. No remuneration should be claimed from the department for such technical cooperation. If any unreasonable hindrance is caused to other agencies and any completed portion of the works has to be dismantled and redone for want of the cooperation and coordination by the Contractor during the course of work, such expenditure incurred will be recovered from the Contractor during the course of work, if the restoration work to the original condition of Specification of the dismantled portion of the work was not under taken by the Contractor.

15. **CARE OF BUILDINGS**:- Care shall be taken, while handling/ installing the equipment to avoid damage to the building. On completion of the installation, the Contractor shall arrange to repair all damages to the building caused during plant installation so as to bring to the original condition. He shall also arrange to remove all unwanted waste materials from substation room and other areas used by him.

16. **PAINTING AND PROTECTION: -** All damages to painting during transport and installation shall be set right to the satisfaction of the department before handing over. All structural frame work for support of various items of equipment shall be given the final coat of paint of approved shade at site after erection is complete. Additional protection measures against corrosion shall be provided when installed in special environment.

17. **TRAINING OF DEPARTMENTAL PERSONNEL:-** The operation and maintenance staff of the NHSRC shall be associated with the Contractor's personnel during the installation, testing and commissioning of the equipments.

18. **COMPLETION DRAWING** :- Four sets of completion drawings comprising the following shall be submitted by the Contractor while handing over the installation:

a) Equipments layout drawing(s) giving complete details of the entire equipments.
b) Electrical drawings for the entire electrical equipments showing cable sizes, equipment capacities, switch-gear's ratings, control components, control wiring etc.
c) Schematic diagram of the entire sub-station installation.

19. **FINAL INSPECTION AND TESTING: -** When the installation is complete, the Contractor shall arrange for inspection and testing of the installation. Test results obtained shall be recorded. The installation shall not be accepted until it complies with the requirement of these Specifications. The installation shall be got inspected by the Contractor from local licensee and/or Electrical Inspector and their clearance taken before energizing. All the observations/ deficiencies pointed out by the inspecting authorities shall be complied with by the Contractor on priority. The department shall render all help

and pay mandatory charges to Electrical Inspector and local licensee, if any, in this regard.

20. **DATE OF ACCEPTANCE: -** The date of taking over of the Panel shall be reckoned after its trouble free operation during the running in period.

21. **GUARANTEE**

The Contractor shall guarantee the entire sub-station installation as per specifications. **All equipments shall be guaranteed for TWO YEAR from** the date of acceptance against unsatisfactory performance or break down due to defective design, manufacture and installation. The installation shall be covered by the conditions that whole installation or any part thereof found defective within one year from the date of taking over shall be replaced or repaired by the Contractor free of charge as decided by the department. The warranty shall cover the following:-

a) Quality, strength and performance of materials used.
b) Safe mechanical and electrical stress on all parts under all specified conditions of operation.
c) Satisfactory operation during the maintenance period.
d) Performance figures and other particulars as specified by the tenderer under schedule of guaranteed technical particulars.

22. **AFTER SALES SERVICES:-** The Contractor shall ensure adequate and prompt after sales services in the form of maintenance personnel and spares as and when required with a view to minimizing the break down period. Particular attention shall be given to ensure that all spares are easily available during the normal life of installation.

23. **Requirement of Technical Representative(s) and recovery Rate**

S.no	Minimum Qualification of Technical Representative	Discipline	Minimum Experience	No's	Rate at which recovery shall be made from the Contractor in the event of not full filling provisionof clause 23
1	Graduate or Diploma Engineer	Electrical/ Mechanical	**2 Year for Graduate** **5 year for Diploma**	**1**	**Rs.15000.00 Per Month**

Assistant Engineer retired from Government services that are holding Diploma will be treated at par with Graduate Engineers.

24. Some restrictions may be imposed by the security regulations etc., on the working and/or movement of labour, materials etc. The CONTRACTOR shall be bound to follow all such restrictions/instructions and nothing shall be

payable due to any inconvenience, irregularity, additional lead, travel, etc., incurred by him due to this.

25. a) The work shall be carried out as per BSES, DELHI rules and specifications or such local Bye laws as applicable and the CONTRACTOR shall obtain and submit necessary completion certificate and/or no objection certificate from such authorities after completion of the work, and nothing extra shall be payable to him on this account. The tenderer shall possess license valid in DELHI. For doing such work, and must not further assign or sub contract any portion of their work. The Telephone System work shall be carried out as per telephone department rules and specifications.

c) The CONTRACTOR shall comply with proper and legal orders & directions of BSES and/or any statutory local or public authority or municipality and abide by their rules and regulations and pay all fees and charges as and when they become liable, before and upon completion of the work.

d) The electrical fittings and other materials shall be of approved quality of BSES and shall conform and the relevant BSES specifications for electrical works external. The work shall be carried out as per the approved drawings and the CONTRACTOR shall obtain approval from the municipal authorities, BSES, DELHI authority etc., before commencing if required. and on completion of the work, at his own cost. Materials for telephone system shall have approval of telephone department.

26. External Electrification shall be carried out in accordance with the conditions specified hereunder and shall be in conformity with Indian electricity Act 1910 as amended. Indian Electricity Rules 1956 as amended up to date relevant Indian Standard code of practice for electrical installations, supplementary regulations, of State Electricity Department and electricity undertaking/Board concerned. Telephone system work shall be carried out in conformity to telephone department rules.

27. The specifications generally applicable to this work shall be as per BSES specification for electrical works external/telephone department for telephone works as amended except as otherwise specified in the description of items given in the schedule of works. The requirements of these specifications will be fulfilled by the CONTRACTOR within tendered rates. The item rates quoted shall be deemed to have taken these conditions and specifications into account.

28. In the interpretations of specifications or items where descriptions are conflicting or incomplete or otherwise subject to dispute, the following order of decreasing importance shall prevail

1. Description of item in the schedule of works
2. Specifications attached to the tender
3. BSES Specifications for Electrical works amended upto date and Telephone Department specifications for the telephone works.
4. Indian Standard Specifications.
5. National Electrical code.

Anything not covered by the above shall be as per I.E. rules and regulations.

29. If any alterations are found necessary, due to site conditions or otherwise, the CONTRACTOR will carry out the same within the tendered rates.

30. During the progress of work completed portions of the installation may be occupied and put to use by the Owner however the CONTRACTOR will remain fully responsible for maintenance of the Electrical Installation till the entire work covered by this contract is satisfactorily completed by him and taken over by BSES, Owner & Other Authorities.

APPROVALS

The CONTRACTOR, while executing the work, shall conform to the provision on any government act relating to the work and to the regulations and Bye Laws of the local authorities, and of the company to whose system to supply the installation is proposed to be connected. The CONTRACTOR shall give all notices, required by the Acts, regulations or Bye Laws. He will also undertake to provide Test certificate and drawings as required and will make necessary arrangements to procure electricity supply without any extra charge. The CONTRACTOR shall also obtain all approvals from appropriate authorities for the items of work done under this contract. All inspection fees, departmental charges or submission fees paid by the CONTRACTOR will be reimbursed by the Owner only against valid official receipts. CONTRACTOR shall possess a valid electrical CONTRACTOR's license issued by the Inspector of the Local Government (BSES). CONTRACTOR shall liaison and be responsible for preparing drawings, follow up and arrange inspections, obtain approvals, commission the installation and handover the same to Owner or the concerned authorities. All incidental charge/expenses associated with the above work shall be borne by the CONTRACTOR. Liaison, follow up and completion of all formalities with the Chief Electrical Inspector/BSES and concerned Electricity Board will be the responsibility of the Electrical CONTRACTOR. Liaison follow-up and completion of all formalities with telephone authorities concerned will also be responsibility of the CONTRACTOR for telephone works.

All above work shall be done by the CONTRACTOR within the tendered rates.

31. The CONTRACTOR will submit 4 sets of working drawings indicating detailed layout, for prior approval and proceed with work there after only all fabrications drawings prepared on the basis of the approved design and other literature will also be prepared and submitted by him in advance for approval.

32. The CONTRACTOR shall submit one complete set of original tracings and further two copies of layout drawings to the Owner through the Consultant after completion of the work. These completion drawings shall incorporate all changes and all details of the work as finally executed at site. No completion certificate will be issued until the completion drawings are submitted.

33. a) The recommended positions of the poles, pipes underground cable etc., as shown on the layout drawings will be generally adhered to.

b) Should there be any discrepancy or incomplete description ambiguity or omission in the drawings and other documents, whether original or supplementary, forming the contract, completion or maintenance of the installation, the CONTRACTOR shall immediately on discovering the same, draw attention of the Consultant.

c) The dimensions and other details of the electrical drawings shall be compared with the Civil drawings at site before execution of the work.

34. The general character and the intended scope of the work, to be carried out under this contract, is illustrated in the drawings and complete the work under this contract, and all other work assigned therewith, in every respect in conformity with the regulations of the BSES, local electric Supply undertaking, and associated authorities, and upon the directions and to the satisfaction of the Consultant's and in accordance with these special specifications, I.E. Rules etc., unless otherwise stated.

35. The entire work and its installations are to be handed over completed in all respect to the Owner or BSES (through Owner) and the CONTRACTOR shall obtain a certificate of completion from Owner or BSES on the completion of the work. The CONTRACTOR shall carry out modifications in the work as and when directed to do so by them at his own cost and without claiming any payment for the same from the Owner. Similarly, the telephone system, will be handed over to Owner or the local. Telephone authority if required after getting all the works to their satisfaction and CONTRACTOR shall obtain a certificate of completion from the authority / Owner as per their rules.

a) The CONTRACTOR shall produce all the materials in advance so that there is sufficient time for testing of the materials and clearance of the same before use in work.

b) Samples of various materials required for testing shall be provided free of charge by the CONTRACTOR. Testing charges if any, shall be borne by the CONTRACTOR. All other expenditure required to be incurred for taking the samples, conveyance, packing etc., shall be borne by the CONTRACTOR himself.

c) In case there is any discrepancy in frequency of testing as given in list of mandatory tests and that in individual sub heads of work as per BSES specifications for Electrical works for External, the higher of the two frequency of testing shall be followed and nothing extra shall be payable to the CONTRACTOR on this account.

CONTRACTOR shall be required to produce manufacturer's Test certificates for the particular batch of materials supplied to him. The test carried out shall be as per the relevant Indian Standards.

For examination and testing of materials and work at the site, CONTRACTOR shall provide all testing and gauging equipment necessary.

All such equipment shall be tested for calibration at any approved laboratory if required by the Consultant.

All testing equipment shall be preferable located in special room meant for the purpose.

35. The CONTRACTOR shall submit to the Consultants four copies of the shop drawings before commencing and upon completion of the work. These drawings shall be submitted under following conditions.

a) Showing any changes in layout in the drawings.

b) Equipment, layout, poles and schematic diagrams.

c) Manufacturers of CONTRACTORs fabrication drawings for any materials or equipment.

36. Route of PVC pipes for laying of UG telephone cables, location of pillars, chambers etc., for telephone system.

37. The CONTRACTOR shall submit four copies of catalogues, manufacturer's drawings, equipment characteristics data or performance chart as required by the Consultant. Based on Consultant's drawings, the CONTRACTOR shall within 4 weeks of award submit and obtain Consultant's approval of details drawings of the system on the basis of which work is proposed to be carried out by him.

On completion of work CONTRACTOR shall submit one complete set of original tracings and two prints of `AS BUILT' drawings to the Consultant.

CONTRACTOR shall provided four sets of catalogues, performance data and list of spare parts, together with the name and address of the manufacturers for all electrical and mechanical equipment provided by him.

All "Warranty Cards" given by the manufacturer's shall be handed over to the Consultants.

All equipment, machinery, materials ducting and earthings system shall be tested as specified under the relevant clause of the specifications.

Tests shall be performed in presence of the Consultant/Owner and the system should provide required performance to satisfaction of BSES/Consultants and Owner.

All materials and equipment found defective shall be replaced and the whole work tested to meet the requirements of the specifications, at the cost of CONTRACTOR.

CONTRACTOR shall perform all such tests as may be necessary and required by the local authorities to meet the municipal or other bye-laws enforce wherever necessary and required.

CONTRACTOR shall provide all labour, equipments and materials for the performance of the tests.

38 The CONTRACTOR shall obtain approval in writing of the entire installation from the appropriate authorities before commencing if required and upon completion of the work, and forward the same to the Consultant. The rates quoted in this tender shall be deemed to include any fees payable to these Authorities and no payment shall be made by either Owner and/or Consultant for the same. Subsequent and periodic inspection, approvals etc., will also be got done by the CONTRACTOR, and he shall be responsible for the correctness of the system, and its adherence to the local laws, etc., and obtain all approvals connected therewith.

39 Painting of all poles , equipment, panels, ducting, and other components of the system under this specifications and directed by Consultants with synthetic enamel paint after installation is included in the rates of the respective items of work. The CONTRACTOR shall also provide at his cost display signs/boards on the equipments for public guidance as required and directed by the Consultants.

40 The CONTRACTOR shall guarantee that all materials, machinery, equipment used by him is of best quality and that these shall be guaranteed to yield the specified performance and the system as a whole shall be guaranteed to provided the required performance.

6.00 'B' SPECIAL CONDITIONS

1. GENERAL

1.1 This is a Lump Sum Contract. The Detailed specification given in this tender are tentative and CONTRACTOR has to execute the contract in the final Lump Sum figure arrived at by virtue of product of rates of each item and thereafter algebraic sum of all figures. Thus, if CONTRACTOR feels that the items indicated are on higher/lower side, he may adjust by increasing or decreasing the final amount arrived at in the main summary by a fixed percentage.
Similarly CONTRACTORs are also to clarify if any item is missing or superfluous or if any item is taken extra in the description of items in this tender on the basis of the enclosed tender drawings/specifications, failing which no claim of SECOND PARTY in this regard shall be entertained after submission of bid thereafter and decision of Executive Director NHSRC shall be final and binding on the CONTRACTOR.

1.2 These special conditions are intended to amplify the General Conditions of Contract, and shall be read in conjunction with the same. For any discrepancies between the General Conditions and these Special Conditions, the more stringent shall apply.

2. SCOPE OF WORK

(I) The general character and the scope of work to be carried out under this contract is illustrated in Drawings, Specifications and Detailed specification. The CONTRACTOR shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Project Director/Consultant. The CONTRACTOR shall furnish all labour, materials and equipment as listed under Detailed specification and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete electrical system as described in the Specifications and as shown on the drawings. This also

includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The electrical system shall comprise of (but not limited to) the following :

a. Supply & installation of LT cables & termination.
b. Cables on cable trays and / or within suspended ceiling spaces including installation, cable trays, hangers, supports, cable terminations and all fixing accessories.
c. Supply and installation of cabling, feeder pillars, earthling.
d. Liaison fees for final inspection of CEIG and Pollution Control Board and getting NOC.

(II) Associated civil works

Following civil works associated with electrical installation are included in the scope of this contracts along with all major and minor civil works like wall chasing by wall chaser making holes etc. There shall be executed by the CONTRACTOR in accordance with approved shop drawings and under direct supervision of the Project Director and Consultant.

i) RCC foundation for LT Panels, AMF/Auto Load sharing panels etc.

ii) RCC/Brick Trenches inside substation room and supports for laying of LT Cables.

iii) RCC/PVC heavy duty pipes as per drawing/items Specification.

iv) Repair of all disturbed surface/openings

v) Fencing for Outdoor substation and DG sets.

3. PROJECT EXECUTION AND MANAGEMENT

The CONTRACTOR shall ensure that senior planning and erection personnel from his organization are assigned exclusively for this project. The CONTRACTOR shall appoint one Project Manager holding senior management position in the organization. He shall be assisted on full time basis by a minimum of two electrical engineer & three senior supervisors. The entire staff shall be posted at site on full time basis. Separate ID card shall be given by the CONTRACTOR to each worker working on site.

The project management shall be through modern technique. The CONTRACTOR's office at site shall be fully equipped with fax, computers & plotter and shall prepare proper shop drawings, bar chart and completion schedules to be submitted & ensure timely completion. Erection engineer and supervisors shall be provided with mobile communication system so that they can always be reached.

For quality control & monitoring of workmanship, CONTRACTOR shall assign at least one full-time engineer who would be exclusively responsible for ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the electrical installation. CONTRACTOR shall furnish details of licenses of supervisors/workmen to be employed at site.

5. BYE-LAWS AND REGULATIONS

The work shall be carried out to the satisfaction of the Owner's site representative and in accordance with the Specifications, Regulations of the Electric Supply Authority, Indian Electricity Rules and Regulations, latest Indian Standards and as per the requirements of the Chief Fire Officer.

6. FEES AND PERMITS

The CONTRACTOR shall pay any and all fees and obtain permits required for the installation of this work. On completion of the work, the CONTRACTOR shall obtain and deliver to the Owner, certificate of final inspection and approval by the local electricity authority (CFO/ Municipal, State/Central govt. whichever is applicable).

7. DRAWINGS

The Electrical Drawings listed, which may be issued with tenders, are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The architectural/interiors drawings and details shall be examined for exact location of equipment, electrical points & fixtures.

The CONTRACTOR shall follow the tender drawings in preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work is to be installed.

Maximum headroom and space conditions shall be maintained at all points. Where headroom appears inadequate, the CONTRACTOR shall notify the Consultant/ Project Director before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and CONTRACTOR shall rectify the same at his own cost.

The CONTRACTOR shall examine all architectural, structural, plumbing, HVAC and other services drawings and check the as-built works before starting the work and report to the Consultant/Project Director any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Consultant/Project Director without additional cost to the Owner.

8. SPECIFICATIONS

The Specifications shall be considered as part of this contract. The Drawings indicate the extent and general arrangement of power distribution, location of lighting fixtures, controlling switches, wiring system, cabling and earthing. These drawings are essentially diagrammatic. The Drawings indicate the locations of sub stations, transformers, point of termination of conduit runs and broadly suggest the routes to be followed. The work shall be installed as indicated on the Drawings. However, any change found essential to coordinate the installation of this work with other trades shall be made without any additional cost to the Owner. The data given herein and on the Drawings is as exact as could be secured, but its complete accuracy is not guaranteed. The drawings are for the guidance of the CONTRACTOR, exact locations, distances and levels shall be governed by the site conditions and the Architectural & Interior layouts.

9. SHOP DRAWINGS

9.1 All the shop drawings shall be prepared on computer through Autocad System based on Architectural Drawings, site measurements and Interior Drawings. Within eight weeks of the award of the contract, CONTRACTOR shall furnish, for the approval of the Consultant/Owner, Four sets of detailed shop drawings of all equipment and materials including layouts for all conduit layouts, distribution panels, switch boards, cabinets, special pull boxes, cable trays and any other requirement to be fabricated or purchased by the CONTRACTOR.

9.2 These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Consultant/Project Director. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other CONTRACTORs. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/ works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings.

Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer strictly from the manufacturers listed in Appendix-IV.

When the Consultant/Project Director makes any amendments in the above drawings, the CONTRACTOR shall supply two fresh sets of drawings with the amendments duly incorporated along with check print, for approval. The CONTRACTOR shall submit further six sets of shop drawings to the Consultant/Project Director for their exclusive use. No material or equipment may be delivered or installed at the job site until the CONTRACTOR has in his possession, the approved shop drawing for the particular material/equipment/installation.

9.3 Shop drawings shall be submitted for approval sufficiently in advance of planned delivery and installation of any material to allow Consultant/ Project Director ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved programme.

9.4 Manufacturers drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labeled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

9.5 Samples of all materials like conduits, accessories, switches, wires, control cables etc shall be submitted to the Consultant/ Project Director prior to procurement. These shall be submitted in two sets for approval and retention by Consultant/ Project Director and shall be kept in their site office for reference and verification till the completion of the Project.

9.6 Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the CONTRACTOR of the responsibility or requirement to furnish material and perform work as required by the contract.

9.7 Where the CONTRACTOR proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the CONTRACTOR at his own expense and gotten approved by the Consultant/ Project Director.

10. ACCESSIBILITY

The CONTRACTOR shall verify the sufficiency of the size of the shaft openings, clearances in wall cavities and suspended ceilings for proper installation of his conduits cables, cable trays, panels etc.. His failure to communicate insufficiency of any of the above, shall constitute his acceptance of sufficiency of the same**.** The CONTRACTOR shall locate all equipment which must be serviced, operated or maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed control damper, valve or other devices requiring attendance, shall be finalized and communicated in sufficient time, to be provided in the normal course of work. Failing this, the CONTRACTOR shall make all the necessary repairs and changes at his own expense. Access panel shall be standardized for each piece of equipment / device / accessory and shall be clearly nomenclature / marked.

11. MATERIALS AND EQUIPMENT

All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be strictly in conformity with list of approved manufacturers as per list.

The CONTRACTOR shall be responsible for the safe custody of all materials and shall insure them against theft or damage in handling or storage etc. A list of items of materials and equipment, together with a sample of each shall be submitted to the Consultant/ Project Director within 15 days of the award of the contract. Any item which is proposed as a substitute, the CONTRACTOR shall state the credit, if any, due to the Owner in the event the substitution is approved. All changes and substitutions shall be requested in writing and approvals obtained in writing from the Consultant/ Project Director.

12. MANUFACTURERS INSTRUCTIONS

Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, manufacturer's instructions shall be followed in that case after the approval in writing from the Project Director and Consultant.

13. COMPLETION CERTIFICATE

On completion of the electrical installation a certificate shall be furnished by the CONTRACTOR countersigned by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local, state/central govt./ municipal / fire /BSES authorities concerned.

14. INSPECTION AND TESTING

The CONTRACTOR shall produce samples of all materials and shall obtain approval of these in writing from Project Director and Consultant before he places

bulk order for the materials for incorporation in the works. The samples must be produced at least six weeks before these are incorporated in the work. Materials to be incorporated in the work shall confirm to latest relevant ISI. The items should be ISI marked where manufactured.

The Owner may also carry out inspection and testing at manufacturer's works for this contract. No equipment shall be delivered without prior written confirmation from the Consultant/ Project Director. In case factory inspection is carried out then all traveling and lodging expenses for two persons one from owner and one from Consultant shall be borne by the CONTRACTOR, also all expenses related to testing shall be to CONTRACTORs account. Tests on site of completed works shall demonstrate the following:

That the equipment installed complies with specification in all respect and is of the correct rating for the duty and site conditions.

That all items operate efficiently and quietly to meet the specified requirements.

That all circuits are fully protected and that protective devices are properly coordinated.

That all non-current carrying metal parts are properly and safely grounded in accordance with the specification and appropriate Codes of Practice.

Sample from fresh concrete shall be taken as per IS-1199-1959 and tested at 7 days and 28 days in accordance with IS-516-1959. Bricks, stone aggregate, sand and all other materials including slump cone test shall be tested as per relevant IS codes/BSES specifications to the complete satisfaction of the Project Director and Consultant.

The CONTRACTOR shall provide all necessary instruments and labour for testing, shall make adequate records of test procedures and readings, shall repeat any tests directed by the Consultant/ Project Director and shall provide test certificate signed by a authorised person. Such test shall be conducted on all materials and equipment and tests on completed work as called for at CONTRACTOR's expenses.

If it is proved that the installation or part thereof is not satisfactorily carried out then the CONTRACTOR shall be liable for the rectification of the same. Consultant's decision as to what constitutes a satisfactory installation shall be final.

All tests shall be carried out by a test house approved by the Consultant/ Project Director.

15. COMPLETION DRAWINGS

Upon completion of the work and before issuance of certificate of virtual completion the CONTRACTOR shall submit to the Consultant/ Project Director four sets of layout drawings in progressive manner for individual systems drawn at approved scale indicating the complete wiring system as installed. Drawings shall be prepared on AUTO-CAD (latest version) . Along with the hard copies, the CONTRACTOR shall submit copies of all drawings on CD and one set of all drawings on RTF shall also be submitted. These drawings must provide:

a. Substation equipment layout & all power distribution panel layout.

b. Single line power distribution diagram including control wiring.

c. Cable Trays with number and size of cables installed.

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

e. Raceways and Junction Boxes.

f. Number and size of conductors in each conduit with phase identification.

g. Location and rating of sockets and switches controlling the lighting and power outlets.

h. Location and details of distribution boards/panels, mains, switches along with phase balancing details.

i. A complete wiring diagram as installed and single line diagrams showing all connections in the complete electrical system.

j. Location of all earthing stations, route and size of all earthing conductors manhole.

k. Layout and particulars of all HT & LT cables.

l. Instruction, maintenance and operation manuals including maintenance schedule for all equipment. Testing & commissioning reports of all electrical equipment.

16. OPERATING INSTRUCTION & MAINTENANCE MANUAL

Upon completion and commissioning of part Electrical system **t**he CONTRACTOR shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the CONTRACTOR shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant/ Project Director and two for Owners Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment.

17. MAINTENANCE DURING DEFECTS LIABILITY PERIOD

17.1 Complaints

The CONTRACTOR shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 6 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

17.2 Repairs

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Owner.

18. UPTIME GUARANTEE

The CONTRACTOR shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

The CONTRACTOR shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all temperatures, pressures, humidity, power consumption. starting and stopping times for various equipment, daily services rendered for the system alarms, maintenance and record of unusual observations etc. CONTRACTOR shall also submit preventive maintenance schedule.

Tenderer shall submit along with the tender, a detailed operation assistance proposal for the Consultant/ Project Director's review. This shall include the type of service planned to be offered during Defects Liability Period.

20. OPERATION AND MAINTENANCE

CONTRACTOR shall be required to assist the owner to carry out the operation of the Electrical installation for the defects liability period or thereafter if the defect liability period gets extended due to defaults attributable to the CONTRACTOR. Decision of Project Director and Consultant in this regard shall be final and binding on the CONTRACTOR without any extra cost to the owners.

21. METHOD OF MEASUREMENT

The works shall be measured in accordance with relevant IS codes. Notwithstanding any general or local custom, except where otherwise specifically described or prescribed in the contract.

22. DEMONSTRATION TO OWNER

At completion, devices subject to manual operation shall be operated atleast five times in presence of Consultant/ Project Director to demonstrate satisfactory operation.

23. TOOLS AND TACKLES

The CONTRACTOR shall provide and install all necessary hoists, ladders, scaffolding, tools, tackles, all transport for labour and materials and plant necessary for the proper execution and completion of the work to the satisfaction of the Consultant/ Project Director.

24. PARTIAL ORDERING

Owner through the Consultant/ Project Director reserves the right to order equipment and material from any and all alternates, and /or to order high side and /or low side equipment and materials or parts thereof from one or more tenderers**.**

25. WATER AND POWER REQUIREMENT

The CONTRACTOR shall make their own arrangement for water and power including piping and electricity cables and remove the same on completion. In case of termination of contract, NHSRC shall retain whole of the work thus executed without ancompensation to the CONTRACTOR on account of the same. Any delay in works due to availability of water and electricity will be on CONTRACTOR's account.

7.0 TECHNICAL SPECIFICATIONS

1. DG CONTROLLER BASED SYNCHRONIZING AND AUTOMATIC MAINS FAILURE / EMERGENCY PANEL

1.1 SCOPE

The scope of this section comprised of fabrication, supply, earthing, testing & commissioning of Synchronizing/ AMF panels. These panels shall be suitable for operation on 3 Phase 415 volts, 50 cycles. The degree of protection for enclosure shall be IP-55(Double door construction with canopy) suitable for outdoor application. All panels shall be CPRI approved.

Synchronizing panels / AMF panels shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per IS-13947-1993.

1.2 CONSTRUCTION FEATURES

Synchronizing and AMF panels shall be 2 mm thick sheet steel cabinet for outdoor installation, dead front, floor mounting type and shall be form 3b construction. The Synchronizing / AMF panels shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors, Neoprene

gasket and padlocking arrangement. Panels shall be suitable for the outdoor climatic conditions. Steel sheets used in the construction of Synchronizing / AMF panels shall be 2 mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to IS-8623-1993 (Part-1) for factory built assembled switchgear & control gear for voltage upto and including 1100 V AC.

All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self threading screws shall not be used in the construction of Synchronizing / AMF panels. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panels. Minimum clearance of 275 mm shall be provided between the floor of AMF panels and the lowest unit.

Synchronizing / AMF panels shall be of adequate size with a provision of spare switchgear as indicated on the Single Line Diagram. Switches shall be arranged in multi-tier. Knockout holes of appropriate size and number shall be provided in the AMF panels in conformity with the location of cable/conduit connections.

Synchronizing / AMF panels shall be suitable for Bottom cable connection for incoming from alternator and cable connection for outgoing to various emergency panel. Every cabinet shall be provided with Trifoliate or engraved metal name plates. All panels shall be provided with circuit diagram engraved on PVC sheet. All live accessible connections shall be shrouded and minimum clearance between phase and earth shall be 20 mm and phase to phase shall be 25 mm.

All panels shall have provision of pad locking of breaker handles in OFF position.

i **BUS BAR CONNECTIONS**

Bus bar and interconnections shall be of high conductivity electrolytic aluminium as per BOQ and of rectangular cross section suitable for carrying the rated full load current and short circuit current without overheating of phase and neutral bus bars and shall be extendable on either side. Bus bars and interconnections shall be insulated with heat shrinkable sleeve and shall be colour coded. Bus bars shall be supported on glass fiber reinforced thermosetting plastic insulated supports at regular intervals to withstand the force arising from in case of short circuit in the system. All bus bars shall be provided in a separate chamber and all connections shall be done by bolting. Additional cross sectional area to be added to the bus bar to compensate for the holes. All connections between bus bars and breakers shall be through solid strips of proper size to carry full rated current and insulated with insulating sleeves.

ii **TEMPERATURE - RISE LIMIT**

Unless otherwise specified, in the case of external surface of enclosures of bus bar chamber and trunking system which shall be accessible but do not need to be touched during normal operation, an increase in the temperature rise limits of 25°

C above ambient temperature shall be permissible for metal surface and of 15° C above ambient temperature for insulating surfaces as per IS 8623(Part-2) 1993.

AMF / Synchronizing panels shall be provided with ACB's / MCCB's of appropriate capacity as per Single Line Diagram. AMF / Synchronizing Panels shall be completely factory wired, ready for connection. All the terminals shall be of proper current rating and sized to suit individual feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and circuits shall be distinctly marked with a small description of the service installed.

iii **CABLE COMPARTMENTS**

Cable compartment of adequate size shall be provided in the AMF / Synchronizing panels for easy clamping of all incoming and outgoing cables entering from the top/bottom. Adequate supports shall be provided in cable compartment to support cables.

iv **AIR CIRCUIT BREAKERS (ACB)**

The ACB shall conform to the requirements of IEC 60947-2 / IS 13947. The circuit breaker shall be suitable for 415 ± 10% 50 Hz supply system. Air Circuit Breakers shall be moulded housing, draw out type and shall be provided with a trip free manual operating mechanism or as indicated in drawings and bill of quantities with mechanical "ON" "OFF" "TRIP" indications.

The ACB shall be 3/4 pole with modular construction, draw out, manually or electrically operated version as specified and shall be capable of providing short circuit, overload and earth fault protection through micro processor based control unit sensing the true RMS valve to ensure accurate measurement meeting the EMI/EMC requirement as per standard.

The circuit breakers shall be for continuous rating and service short Circuit Breaking capacity shall be as specified on the single line diagram and shall be equal to the short circuit withstand values.

Circuit breakers shall be designed to `close' and `trip' without opening the circuit breaker compartment door. The operating handle and the mechanical trip push button shall be at the front of the breakers panel and integral with the breaker.

The ACB shall be provided with a door interlock. The contacts shall be of silver plated copper with a feature of contact wear inspection, indicating the life of the contacts. The ACB shall have double insulation (Class-II) with moving and fixed contacts totally enclosed for enhanced safety and in accessibility to live parts. All electrical closing breaker shall be with electrical motor wound stored energy spring closing mechanism with mechanical indicator to provide ON/OFF status to the ACB.

CRADLE

The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. The movements shall be free from jerks, easy to operate and shall be on steel balls/rollers and not on flat surfaces.

There shall be 4 distinct and separate position of the circuit breaker on the cradle.

Service Position	:	Main Isolating contacts and control contacts of the breaker are engaged.
Test Position	:	Main Isolating contacts are isolated but control contacts are still engaged.
Isolated Position	:	Both main isolating and control contacts are isolated.
Maintenance	:	Circuit breaker fully outside the panel ready for maintenance after the cubicle door is opened.

There shall be provision for locking the breaker in any or all of the first three positions.

SAFETY FEATURES

I. The safety shutter shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle.

II. It shall not be possible to interchange two circuit breakers of two different thermal ratings.

III. There shall be provision of positive earth connection between fixed and moving portion of the ACB either thru connector plug or sliding solid earth mechanism. Earthing bolts shall be provided on the cradle or body of fixed ACB.

IV. Arc Chute covers wherever necessary shall be provided.

V. The AMF panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, electronic type meter of accuracy class 1..0 with suitable ratio CT's to measure and display various electrical quantities as mentioned in Schedule of Quantities with built-in selector switches, MCB for protection circuit and current transformers.

VI. It shall be possible to bolt the draw out frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration and shocks.

v MOULDED CASE CIRCUIT BREAKER (MCCB)

MCCB shall be Current Limiting and comprise of Quick Make - break switching mechanism, preferably Double Break Contact system, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCB's shall be capable of defined Variable overload adjustment. All MCCB's upto 250 Amps shall have thermal magnetic releases and above 250 amps shall have microprocessor based release with adjustable magnetic short circuit pickup. Wherever MCCB with earth fault protection mentioned in BOQ, the protection shall be an integral part of the release with adjustable magnetic short circuit and earth fault protection with time delay.

The trip command shall override all other commands. MCCB shall employ maintenance free double break contact system to minimize the let thru' energies and capable of achieving discrimination upto full short circuit capacity of downstream MCCB. The manufacturer shall provide both discrimination tables and let thru energy curves.

The breaking capacity of MCCB's shall be as asked for in the schedule of quantities. The breaking capacities specified shall be ICU=ICS i.e. type-2. Co-ordination as per IEC-60947-2, 1989/IS 13947-2, 1993.

The MCCB's shall be provided with rotary handle operating mechanism. The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to Disconnection as per the IS/IEC indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection.

vi MINIATURE CIRCUIT BREAKER (MCB)

Miniature Circuit Breaker shall comply with IS-8828-1996/IEC898-1995. Miniature circuit breakers shall be quick make and break type for 240/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall be classified (B,C,D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values.

The housing shall be heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP, TPN and 4 Pole miniature circuit breakers shall have a common trip bar independent to the external operating handle.

vii **EARTHING**

Earthing shall be provided as per IS:3043-1987.

viii **PAINTING**

All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivating (seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be RAL-7032 of IS Code No.5.

ix **LABELS**

Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the distribution panels shall be pasted on inside of the panel door and covered with transparent plastic sheet.

x **METERS**

i. All voltmeters and indicating lamps shall be through MCB's.

ii. Meters and indicating instruments shall be digital electronic type.

iii. All CT's connection for meters shall be through Test Terminal Block (TTB).

iv. CT ratio and burdens shall be as specified on the Single line diagram.

xi CURRENT TRANSFORMERS

Current transformers shall be provided for Synchronizing / AMF / AUX panels. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondaries for operation of associated metering.

The CTs shall confirm to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast/ Flame Retardant resin filled Nylon type robust to withstand thermal and dynamic stresses during short circuits. Metering CTs, shall have inbuilt busbar mounting arrangement. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The secondary terminal should be covered with insulation cap/cover so that there should not be any possibility of touching the live terminal. The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class I.

xii SELECTOR SWITCH

Where called for selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

xiii CONTACTOR

Contactor shall be built into a high strength thermoplastic body and shall be provided with an are shield for quick are extinguishing. Silver alloy tips shall be provided to ensure a high degree of reliability and endurance under continuous operation. The magnet system shall consist of laminated yoke and armature to ensure clean operation without hum or chatter.

Starters contactors shall have 3 main and 2 Nos. NO / NC auxiliary contacts and shall be air break type suitable for making and breaking contact at minimum power factor of 0.35. For design consideration of contactors the starting current of connected motor shall be assumed to be 6 times the full load current of the motor in case of direct-on-line starters and 3 times the full load current of the motor in case of Star Delta Starters. The insulation for contactor coils shall be of Class "E".

Coil shall be tape wound vacuum impregnated and shall be housed in a thermostatic bobbin, suitable for tropical conditions and shall withstand voltage fluctuations. Coil shall be suitable for 240 / 415 + 10% volts, 50 cycles AC supply.

xiv THERMAL OVERLOAD RELAY

Thermal overload relay shall have built in phase failure sensitive tripping mechanism to prevent against single phasing. The relay shall operate on the differential system of protection to safeguard against three phase overload, single phasing and unbalanced voltage conditions.

Auto-manual conversion facility shall be provided to convert from auto-reset mode to manual reset mode and vice-versa at site. Ambient temperature compensation shall be provided for variation in ambient temperature from –5deg C + 55 deg C.

All overload relays shall be of three element, positive acting ambient temperature compensated time logged thermal over load relays with adjustable setting. Relays shall be directly connected for motors upto 35 HP capacity. C.T. operated relays shall be provided for motors above 35 HP capacity.

xv TIME DELAY RELAYS

Time delay relays shall be adjustable type with time delay adjustment from 0-180 seconds and shall have one set of auxiliary contacts for indicating lamp connection.

xvi TOGGLE SWITCH

Toggle switches, where called for in Schedule of Quantities, shall be in conformity with relevant IS codes an shall be of 5 amps rating.

xvii PUSH BUTTON STATIONS

Push button shall be provided for manual starting and stopping of motors / equipment "Green" and "Red" colour push buttons shall be provided for 'Starting' and 'Stopping' operations. 'Start' or 'Stop' indicating flaps shall be provided for push buttons. Push buttons shall be suitable for panel mounting and accessible from front without opening door, Lock lever shall be provided for 'Stop' push buttons. The push button contacts shall be suitable for 6 amps current capacity.

xviii **INDICATING PANEL**

All meters and indicating instruments shall be in accordance with relevant Indian Standards. The meters shall be flush mounted type. Indicating lamps shall be of low burden, and shall be backed up with 2 amps MCB.

1.3 TESTING

Testing of panels shall be as per following codes:

I. IS: 8623 (Part -I) 1993 for factory built assemblies of switch gear for voltages upto and including 1000 VAC.
II. IS: 13947 : 1993 Degree of protection
III. IS: 5578 & 11353:1985 Arrangement of bus bars.

ANTI-CONDENSATION SPACE HEATERS

1 No. 100 W, 240 Volts single phase, 50 Hz AC Anti Condensation space heaters controlled by thermostat and protected by 6 amps MCB's or MPCB's as per fault level at the panel shall be provided in each vertical section of AMP / Synchronizing panel and 1 No. 60 watt Anti Condensation space heater shall be provided in each cable alley of DG Auxiliaries panel and sub distribution boards. Supply and control equipment for the above shall be provided by the vendors.

1.4 DG CONTROLLER FUNCTION

i GENERAL

The auto synchronizing cum LT panel shall have DG controller with following general requirements for AMF start, Auto synchronizing and Auto Load sharing functions.

ii AMF function

In the case of failure of normal power supply of individual substations

1. Generator to start after a prefixed time of three second on any of the following conditions :

    a. Total absence of voltage.
    b. Failure of one or two phases.
    c. Under voltage below 375 volts.
    d. Overvoltage of more than 6%.

2. After a lapse of 10-12 seconds normal power supply breaker to open and Generator supply breaker to close.

3. All auxiliaries (Supply Air & exhaust air fan of Acoustic enclosure.) to run automatically.

In the case of Resumption of Normal Power supply :

1. Generator breaker to open and normal power supply breaker to close after three seconds on resumption of normal power on the following conditions.

   a. All the three phases available at the normal supply breaker.

   b. 375-415 volts available at the normal supply breaker.

2. Generator to over run for the three minutes and stop automatically.

3. All auxiliaries to stop automatically.

4. Generator to be ready for the next operation automatically.

iii Auto Synchronising & Auto Load sharing function

A. Sequence of Operation in Auto Mode.

In auto mode Master GENERATOR set (Selected by DG controller) shall start through cranking relay & close its ACB / NIC after verifying frequency and voltage. However, the transfer of load shall take place only when the generator output reaches 90% of its rated voltage and frequency.
As load increases beyond 90% (settable from 80 to 100%) of ratings of DG set which is running, other generator will start and synchronize on the same bus. Required no of DG sets as per demand shall run, synchronized automatically and shall feed the loads accordingly
As the load increases or decreases, accordingly switching ON and OFF of the generator on the synchronizing bus shall continue with the help of DG controller. If any time only one Generator coming and the load is increased suddenly more than the available capacity then non critical load shall drop out from the bus automatically through DG controller and same shall come on automatically if other Generator shall start and synchronize on the same bus.
Auto Synchronizing system shall verify the phase angle of all the sets and also compensate for ACB closing time by initiating closing of the breaker ahead of the actual predictable synchronism hereby ensuring a phase difference of zero degree. The breaker closing command shall not be given at a phase angle difference of $\pm$ 4% in any circumstances.
The synchronizing system shall operate the generator ISOCHRONOUS mode by setting Droop to Zero. The system shall have a direct analogue interface with the

AVR & Governor for direct bias control. No motorized potentiometers shall be acceptable.

-Failure of any synchronizing module shall not disturb the synchronizing of other generator.

-Failure of any one DG controller shall not affect the synchronizing system which shall be independent of each other.

System shall also monitor the slip frequency and the Beat Voltage of the machine or system.

NIC of First generator shall remain in Ckt. In the event of shutting OFF of First Set, NIC of any other generator shall close first before tripping NIC of first set. It shall be possible to alter sequence of generator starting through, manual selection or through, Man Machine interface.

Active and reactive power shall be made equal on all the machines automatically with the help of ACTIVE LOAD BALANCING System through Governor Control.

In event of set failing to Synchronize, Alarm from annunciator shall invite attention of OPERATOR for manual intervention.

LOAD MANAGEMENT SYSTEM shall have 64 output contacts for tripping various loads by field wiring and also trip the ACB of different generator and give ALARM for shutting OFF generator in accordance with predefined parameters to avoid under-loading, overloading, cascading effect of tripping and unnecessary FUEL WASTAGE.

On the removal of load, generator ACB's & Bus Coupler ACB's shall be switched OFF in preset sequence with time delays to cover DIPS. Generator shall continue to run for 3 Minutes at reduced speed after generator ACB has been switched OFF.

DG controller System shall have compatibility for interface with PC (for Graphic Displays / Report Generation).

All auxiliaries (Cooling tower fan, pumps supply air fans etc) to come on Automatically.

Engine start stop control system shall be mounted on the generator panel.

Note :

2.0 KVA on-line single phase input / single phase output (230 V) UPS with 30 minutes battery backup to be provided along with the synchronizing panel..

B. Sequence of Operation in Manual Mode

(Through DG controller)

- In the manual mode master generator set shall be started by pressing 'Engine Start' Push Button (PB)
- When Engine starting push button is pressed cranking relay shall be energized and give starting signal to the engine.
- After full voltage is build up, breaker of the Master generator shall close manually with the help of breaker control switch.
- When breaker Control switch is turned to 'CLOSE' position, breaker as per following sequence:
    a. DG controller /Main Selector Switch shall be in Manual Mode.
    b. Solo/Parallel Selector Switch being in 'Solo' mode.
    c. With the conditions mentioned above fulfilled and breaker control switch in 'Close' position, Neutral contactor shall be energized.

d. Closing command to the generator breaker shall be given.

- IN manual mode care shall be taken, to synchronize the follower generator sets with the 'Master' before closing its breaker.
- For synchronizing the generator in manual mode, voltage/frequency raise/low commands shall be given to Alternator/Engine with the help of 'Joy sticks' provided in the Relay/Synchronizing Panel.

  While synchronizing the generator, manually, all the parameters viz. voltage, frequency and phase rotation shall be monitored with the help of Double voltmeter, Double Frequency Meter and Synchronoscope provided in the Relay/Synchronizing Panel and breaker shall be closed only when all the three parameters are matched properly.
- Active/Reactive load sharing between all the running sets in manual mode shall be managed by raising/lowering voltage/frequency with the help of joy sticks.
- During the parallel operation of Power Generating sets in 'Manual Mode', Neutral contact of only master generator shall close. This shall be assured by inter locking the neutral contactors of all the generator.

iv SUMMARY OF FUNCTIONS

The following functions shall be performed by the controller for Synchronizing the generating sets.

- Automatic starting of generating sets.
- Automatic Synchronization of all available generating sets.
- Automatic load sharing between generators, active as well as reactive load sharing.
- Starting & stopping of generators as per load requirement.
- Monitoring of engine & alternator condition and protections.
- Complete load management as per requirement.

The control functions shall be as follows :

<u>Engine Control</u>

- Engine pre-glow control
- Fuel solenoid control
- Engine starter control
- KVA controlled cool-down timer
- Speed monitoring
- Over-speed protection
- Oil pressure monitoring
- Water temperature monitoring
- Battery voltage monitoring.

<u>Engine Protective Features</u>

- High / Low coolant temperature
- High / Low oil pressure
- Over-speed

- Start Failure

Generator Protective Features

- Over / Under voltage.
- Over / Under Frequency
- Reverse Power (Inverse time delay)
- Loss of Excitation
- Over Current (Inverse time delay)
- Loss of Utility power detection
- Load Surge
- Current Unbalance
- Voltage Unbalance

Real (KW) Load Control

- True RMS power calculations accurate control
- Configurable loading / unloading ramp rates.
- Isochronous load sharing
- Soft Utility transfer function
- Externally adjustable base load of process reference levels with independent ramp rates.

Dynamic Synchronizing (Mandatory Features)

- Digital signal processing to eliminate harmonic issues
- Adjustable phase window, voltage window, dwell times
- Safe dead bus closing logic internal to the control
- Multiple shot re-closing with adjustable time delays
- Manual voltage & speed adjusts for manual synchronizing

Control System

- All the electrical parameters are monitored centrally through DG controller. All the electrical data is brought to the DG controller & then DG controller controls the complete Synchronizing, Load Control & Management system.
- No motorized potentioners are used. AVR & Governor are given direct bias control (Analog / Plum Commands).
- There are two options provided for control, monitoring & data logging functions.
  a. Graphic display terminal with printer option
  b. IBM PC based complete SCADA station (PC-PLC connection over Ethernet-100 Mbps).
- Min PC requirements :

  i. Windows NT or 2000 professional
  ii. P-IV, 256 MB, 40 GB, FDD, 52 X CD ROM, MM Speakers, LAN (Ethernet Port), 2 x USB ports, 2 x COM ports, 1 x Parallel port.
  iii. 15” colour monitor

iv. 132 Col. Dot matrix printer

v SYNCHRONISING LOGIC

The system shall be capable of a dynamic synchronization as described above, where the generator frequency is controlled to be slightly higher than the bus bar frequency, when the breaker closes. This shall ensure that the generator will start to take load the moment the generator breaker is closed. The frequency difference between generator & bus bar at the moment of synchronization shall be programmed. Breaker time shall be adjusted to ensure breaker closure at the exact point of synchronization. System shall control the voltage under synchronization if necessary.

During synchronization system shall supervising the frequency of the generator voltage to make sure that the genset is not unstable due to a cold fuel / genset or an uneven fuel supply. The two frequencies must be within the accepted slip-frequency in 200 mili sec before synchronization.

The system shall synchronize the generator to the bus, when all below conditions are fulfilled :

- A control order is given by setting the input "start synchronizing / regulating"
- Feedback signal from breaker "GCB open" is present.
- Bus bar voltage is present
- Generator voltage is present

The voltage regulator in the system shall start when the frequency is within 90% of nominal frequency.

System shall close the breaker without synchronization, when all the following conditions are fulfilled :

- Display setting "Black busbar operation is ON.
- A control order is given by setting the input "start synchronizing / regulating"
- Feedback signal from breaker "GCB open" is present.
- Bus bar voltage is not present (Black bus bar)
- Generator voltage is present.

<u>Monitoring</u>

Following electrical parameters shall be monitored by DG controller based system, which shall be connected through set of CT / PT's & shall indicate the following:

i. Voltage – all phases (Line & Phase both)
ii. Current – all phases.
iii. Frequency
iv. Power factor
v. KVAR
vi. KVARH
vii. KW
viii. KWH

All these parameters shall be displayed & shall be used for Load Management & Safety functions. Limits can be assigned to each parameter in the PLC for alarm & recording / logging purposes.

System shall include the following features:

- The system shall work on **Isochronous** principle thus avoiding the problem of **Droop** adjustment. The frequency shall remain constant at all loads.
- Automatic dead bus closing.
- Active & reactive load sharing.
- Modular system & each module shall be independent of the other. The breakdown of one section shall not effect the other.
- The synchronizing module shall directly communicates with the electronic governors and shall connect to the load control lines of governor directly.

vi SOLID STATE ANNUNCIATOR FOR AUTO SYNCHRONIZING PANEL

Channel No.	**Inscription**
01	G-1 Fails to Synchronize
02	G-1 Fails to Start
03	G-1 Neutral Discrepancy
04	G-1 ACB Fails to Close
05	G-2 Fails to Synchronize
06	G-2 Fails to Start
07	G-2 Neutral Discrepancy
08	G-2 ACB Fails to Close
09	G-3 Fails to Synchronize
10	G-3 Fails to Start
11	G-3 Neutral Discrepancy
12	G-3 ACB Fails to Close
13	Bus Coupler ACB-1 Fails to close
14	Bus Coupler ACB-2 Fails to close

INDICATION : 1 No. Spring charged Indicating Light.
: 1 No. Neutral ON Indicating Light.
: 1 No. Neutral OFF Indicating Light
: 1 No. Trip Indicating Light
: 3 Nos. Ph. Indicating Light
: 1 No. ACB ON Indicating Light
: 1 No. ACB OFF Indicating Light
: 1 Set Control MCB.
: 1 set push buttons for generator start / stop, master changing, speed decrease / speed increase, voltage decrease / voltage increase.

PROTECTION THROUGH RELAYS

Over voltage and under-voltage relay shall be provided.

In addition to above, following relays to be provided

- Master Trip Relay
- Trip Circuit Supervision Relay
- Engine Cranking Relay

METERING FOR EACH GENERATOR

As mentioned in the schedule of works.

ANNUNCIATION

Annunciation with Hooter, Test, Accept and Reset P.B. and Annunciator.

16 Window Solid State Annunciator for each DG sets.

Channel No.	**Inscription**
01	Set fails to start (only alarm)
02	Over current (breaker trip)
03	Earth Fault (Breaker trip)
04	Excitation Failure (Engine should be stop with breaker trip)
05	Reverse Power (Breaker trip)
06	Emergency Shutdown (Breaker will trip with engine stop command)
07	Over speed (Breaker will trip with engine stop command)
08	Low Lube Oil pressure (Breaker will trip with engine stop command)
09	High Water Temperature (Breaker will trip with engine stop command
10	Under Voltage (Breaker trip)
11.	Over Voltage (Breaker trip)
12	Bearing Temperature high (breaker will trip with engine stop command)
13.	Under Frequency (Breaker trip)

14 Over Frequency (Breaker trip)

15. Winding Temperature High Breaker with trip with engine stop command)

16. Low fuel oil level (only alarm at preset level.

1.5 BATTERY CHARGER

GENERAL

The battery charger shall be Float cum Boost type IGBT controlled. The charger shall have selector switch for Auto Float – Boost / Manual Float / Manual Boost Mode of operation. During Auto Float – Boost Mode, Automatic Changeover shall take place from Float Mode to Boost mode and Vice-Versa. This means that when the Batteries are fully charged the charging shall automatically change from Boost charge to trickle charge.

CONSTRUCTION FEATURE

The battery charger shall be housed in sheet steel cubicle of Angle Iron frame work with sheet steel panels of 1.6 mm thickness. Louvers shall be provided in the cabinet for the ventilation. The cubicle shall be painted in Siemens Grey shade RAL7032 of IS-5. Four wheels shall be provided at the base.

PERFORMANCE

The D.C output voltage of Float / Boost charger shall be stabilized within $\pm$ 2% for AC input variation of 230 V $\pm$ 10%, frequency variation of 50 Hz $\pm$ 5% and DC load variation of 0-100%. The voltage regulation shall be achieved by a constant voltage regulator having fast response IGBT control. The ripple content will be within 3% of DC output nominal voltage.

There shall be provision to select Auto Float / Manual Float / Manual Boost modes. During Auto Float Mode the battery charging shall automatically changeover from Boost Mode to Float Mode and Vice Versa. During Manual Float / Boost modes it shall be possible to set the output volts by separate potentiometers.

The battery charger shall have automatic output current limiting feature.

COMPONENTS

The battery charger shall essentially comprise of the following

- 1 No. double pole ON/OFF MCB at AC input.
- 1 No. pilot lamp to indicate charger ON.
- 1 No. Main Transformer : Double wound, naturally air cooled, having copper winding.

- 1 set single phase full wave bridge rectifier consisting of 4 Nos. IGBTs, liberally rated, mounted on heat sinks and complete with resistor / condensor network for surge suppression.

- 1 No. rotary switch to select auto float / manual float / manual boost. During auto float mode automatic changeover shall take place from float mode to boost mode and vice versa.
- 1 set solid state constant potential controller to stabilize the DC output voltage of the float cum boost charger at $\pm$ 2% of time set value for AC input voltage variation of 230 V $\pm$ 10%, frequency variation of $\pm$ 5% from 50 Hz and simultaneous load variation of 0-100% and also complete with Current Limiting Circuit to drop the Float Charger output voltage upon overloads to enable the battery to take over.

- 1 No. electronic controller to automatically changeover battery charging from boost to float and vice versa..

- 1 No. DC ammeter and toggle switch to read charger output current and battery charge / discharge current.

- 1 No. moving coil DC voltmeter to read the DC output voltage.

- 2 set potentiometer to adjust the output voltage during manual /auto float and boost modes.

- 2 No. double pole ON/OFF MCB at DC output, 1 No. at charger output and the other at load.

- 2 set DC output terminals. 1 set for the load and the other set for the battery.

- Alarm Annunciation : Visual and audible alarm with manual accept reset facility shall be provided for the following for BMS Connectivity

  a. AC mains fail
  b. Charger Fail
  c. Load / Output over-volt.

Rating

AC Input	:	230 V + 10% AC 50 Hz single phase.
DC Output	:	To float / boost charge batteries and also supply a continuous load.

Current Rating	:	30.0 Amps
Float Mode	:	27.0 V nominal (Adjustable) between 24-28.0 V.
Boost Mode	:	29.0 V nominal (Adjustable) between 24-32.0 V.
Voltage Regulation	:	± 2% for AC input variation of 230 V ± 10%. Frequency Variation of 50 Hz ± 5% and DC load variation 0-100%

Performance Tests

Performance tests shall be carried out on all DG Sets in phases. Test as per schedule of the OEM and to 110% of capacity at unit P.F.

The schedule of tests to be performed in the Factory Acceptance Test shall include the following:

On each of three separate days and before any other operation of the diesel-alternator on that day three successful manual start-up operations to be accomplished.

Three separate manual start-up operations each within one minute of the diesel-alternator being shut down after running continuously for not less than one hour and attaining normal engine running temperatures.

Three separate automatic start-up operations with simulation of "mains failure". In all or any of these tests the diesel-alternator may be out on load by the automatic closing of the emergency power supply circuit breaker.

Three separate automatic shutdown operations, each initiated by mechanical simulation of a "low pressure" condition.
Three separate automatic shutdown operations, each initiated by manual instigation of an "over-speed" condition.
Three separate abortive start-up operations, each inducing "failure to start" shut-down.
The load tests shall be carried out as follows:

25% of full load at 1.0 pf	For half hour
50% of full load at 1.0 pf	For one hour
100% of full load at 1.0 pf	For two hours
110% of full load at 1.0 of	For one hour

At the completion of the test, readings shall be taken of Voltage, Frequency, Current, Temperature, Vibration, Fuel ratio to Unit produced, Flue analysis and the following:
Insulation resistance – rotor, stator, exciter – to earth;

Insulation resistance – between stator windings;
Alternator rotor and exciter armature temperature

Site Test

Site load artificial facility to be generated by supplier and all commissioning, testing and other perameters related to safety to be checked and verified.

Upon the delivery to the site and if the generator set is required to re-assemble on site, similar tests shall be carried out by the CONTRACTOR to ensure that the performance is not degraded.

The tests, but not limited to are:

Diesel engine-Generator coupling and shafts alignment.
On load 'mains failure' simulation test
Safety devices test
Remote monitoring
Auxiliary contacts etc.
Load tests.

Painting of pipe work

All pipe work, other than buried pipes, shall be painted immediately after installation with at least one coat of red primer and two (2) finishing coats of best quality aluminum paint. The colour will be determined by the Consultant at site.

Vibration Control

The complete generator assembly shall be isolated on static deflection un-housed spring-neoprene in series isolator with non-skid neoprene pads. Start-up and shut down rocking restraint snuffers shall be provided at four corners of base frame.

All fuel line pipes shall be cushioned with a layer of harnesss and neoprene pad at attached points.

All pipe work and engine silencers shall be suspended on static deflection spring-neoprene in-series hangers.

Detail calculation and proposal for justifying the size and provision shall be provided for review to Consultant /Project Director prior to the installation.

2. MEDIUM VOLTAGE 1.1 KV GRADE XLPE / PVC CABLES

2.1 GENERAL

The MV cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, Specifications, relevant Standard Specifications and cable manufacturer's instruction. These cables shall be laid in excavated trenches or RCC pipes of required dia as shown on drawing and as approved by the Consultant and Project Director.

2.2 MATERIAL

The MV cables shall be cross linked polyethylene (XLPE) insulated PVC sheathed of 1100 volts grade as asked for in the schedule of quantities. Cables upto 16 sq.mm shall be with copper conductor and 25 sq.mm and above shall be with aluminium conductor.

2.3 TECHNICAL REQUIREMENTS :

2.3.1 All XLPE Aluminium/Copper Power cables shall be 1100 Volts grade, multi core constructed as per IS : 7098 Part-I of 1988 as follows :

a) Stranded Aluminium /Copper conductor in case of 10 sq.mm. and above and solid conductor in case of 10 sq.mm. and below.

b) Cores laid up

c) The inner sheath should be bonded over with thermo-plastic material for protection against mechanical and electrical damage.

d) Armoring should be provided over the inner sheath to guard against mechanical damage. Armouring should be Galvanised steel wires or galvanised steel strips. (In single core cables used in A.C. system armouring should be non-magnetic hard aluminium Wires/Strips. Round steel wires should be used where diameter over the inner sheath does not exceed 13 mm; above 13 mm flat steel armour should be used. Round wire of different sizes should be provided against specific request.)

e) The outer sheath should be specially formulated heat resistant black PVC compound conforming to the requirement of type ST2 of IS : 5831-1984 extruded to form the outer sheath.

2.3.2 Conductor shall be of electrolytic Aluminium/Copper conforming to IS : 8130 and are compact circular or compact shaped.

2.3.3 Insulation shall be of XLPE type as per latest IS general purpose insulation for maximum rated conductor temperature 70 degree centigrade.

2.3.4 In Inner sheath laid up cores shall be bonded over with thermoplastic material for protection against mechanical and electrical damage.

2.3.5 Insulation, inner sheath and outer sheath shall be applied by extrusion and lapping up process only.

2.3.6 Armouring shall be of galvanised steel wire/flat.

2.3.7 Repaired cables shall not be used any where in the project.

2.3.8 Current ratings of the cables shall be as per IS : 3961.

2.3.9. The XLPE insulated cables shall conform to latest revision IS read along with this specifications. The Conductor shall be stranded Aluminium/Copper circular/ sector shaped and compacted. In multi core cables the core shall be identified by red, yellow, blue and black coloring of insulation.

2.3.10 The XLPE insulated 1100 Volts grade power cables shall conform to latest IS and shall be suitable for a steady conductor temperature of 70 degree centigrade. The conductor shall be stranded Aluminium/Copper as called for in the Schedule of quantities. The outer sheath shall be as per the requirement of type ST-2 of IS:5831 of 1984.

2.3.11 The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.

2.3.12 Progressive automatic in line sequential marking of the length of cables in meters at every one meter shall be provided on the outer sheath of all cables.

2.3.13 Cables shall be supplied in non returnable wooden drums as per IS : 10418.

Both ends of the cables shall be properly sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation, storage and erection.

2.3.14 The product should be coded as per IS :- 7098 Part-I as follows :-

Aluminium Conductor	A
XLPE Insulation	2X
Steel round wire armour	W
Steel strip armour	F
Steel Double round wire armour	WW
Steel Double strip armour	FF
Non-magnetic (Al.) round wire armour	Wa
Non-magnetic (Al.) strip armour	Fa
PVC outer sheath	Y

2.4 INSPECTION

All cables shall be inspected by the CONTRACTOR upon receipt at site and checked for any damage during transit. Any material found damaged while laying shall be out rightly rejected.

2.5 JOINTS IN CABLES

The CONTRACTOR shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoidance of cable jointing. This apportioning shall be got approved by the Consultant/Project Director before the cables are cut to lengths. Where joints are unavoidable heat shrinkable type joints shall be made. The location of such joints shall be got approved from the Consultant/Project Director and shall be identified through a marker.

2.6 JOINTING BOXES FOR CABLES

Cable joint boxes shall be installed with heat shrinkable sleeve of appropriate size, suitable for XLPE armoured cables of particular voltage rating.

2.7 JOINTING OF CABLES

All cable joints shall be made in suitable, approved cable joint boxes the filling in of compound shall be done in accordance with manufactures' instructions and in an approved manner. All straight joints shall be done in epoxy mould boxes with epoxy resin.

All cables shall be joined colour to colour and tested for continuity and insulation resistance before jointing commence. The seals of cables must not be removed until preparations for jointing are completed. Joints shall be finished on the same day as commenced and sufficient protection from the weather shall be arranged. The conductors shall be efficiently insulated with high voltage insulating tape and by using of spreaders of approved size and pattern. The joints shall be completely topped up with epoxy compound so as to ensure that the box is properly filled.

2.8 CABLE TERMINATIONS

Cable termination shall be done in cable terminal box using crimping sockets and proper size of glands of double compression type with earthing facility.

2.9 BONDING OF CABLES

Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armour clamp and gland. The clamps must grip the armouring firmly to the gland or casing, so that no undue stress is passed on to the cable conductors.

2.10 LAYING OF CABLES ON CABLE TRAYS

Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming kinks. The relative position of the cables, laid on the cable tray shall be preserved and the cables shall not cross each other. At all changes in direction in horizontal and vertical planes, the cable shall be bent smooth with a radius as recommended by the manufacturer. All cables shall be laid with minimum one diameter gap and shall be clamped at every metre to the cable tray and shall be tagged for identification with aluminum tag and clamped properly. Tags shall be provided at both ends and all changes in directions both sides of wall and floor crossings. All cable shall be identified by embossing on the tag the size of the cable, place of origin and termination.

All cables passing through holes in floor or walls shall be sealed with fire retardant Sealant and shall be painted with fire retardant paint upto one meter on all joints, terminations and both sides of the wall crossings by "VIPER CABLE RETARD".

2.10.1 LAYING OF CABLES IN GROUND

The minimum width of trench for laying single cable shall be 350 mm. Where more than one cable is to be laid in horizontal formation, the width of the trench shall be worked out by providing 200 mm gap between the cables, except where otherwise specified. There shall be clearance of 150 mm between the end cable and the side wall of the trench. The minimum dept of the cable trench shall not be less than 750 mm for single layer of cables. When the cables are laid in more than one tier the depth of the trench shall be increased by 300 mm for each additional tier.

Excavation of trenches : The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided. Where gradients and changes in depth are unavoidable, these shall be gradual. The excavated soil shall be stacked firmly away from the trench so that it may not fall back into the trench. The bottom of the trench shall be level and free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 100 mm in depth. Prior to laying of cables, the cores shall be tested for continuity and insulation resistance. The cable drum shall be properly mounted on jacks, at a suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum and the spindle is horizontal. Cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire drum length shall be laid in one stretch. However, where this is not possible the remainder of the cable shall be removed by `Flaking' i.e. by making one long loop in the reverse direction. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted off the rollers beginning from one end by helpers standing about 10 meters apart and laid in a reasonably straight line. Cable laid in trenches in a single tier formation shall have a cover of clean, dry sand of not less than 150 mm. above the base cushion of sand before the protective cover is laid. In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 300 mm shall be provided over the initial bed before the second tier is laid. Finally the cables shall be protected by second class bricks before back filling the trench.

Back Filling : The trenches shall be back filled with excavated earth free from stones or other sharp edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 300 mm. Unless otherwise specified, a crown of earth not less than 50 mm in the centre and tapering towards the sides of the trench shall be left to allow for subsidence.

2.10.2 Cables crossing Road: All the cables crossing road shall be laid in 200/150 mm dia RCC pipes as shown on drawing. The pipes shall be laid in excavated trenches of required width including excavation of sockets, dressing of sides ramming of bottoms, depth upto 2.00 mts including getting out excavated soil and then returning the soil as required, in layers not exceeding 20 cm in depth including consolidating, ramming & watering etc. and disposal of surplus soil as directed by the Project Director and Consultant. The RCC pipes shall be laid over a bed of CC 1:5:10 (1 cement: 5 coarse sand: 10 graded stone aggregate 40 mm nominal size) alround of RCC Pipe as per standard design. The pipes shall be jointed together with collers with stiff mixture of cement mortar in the proportion of 1:3 (1 cement:3 find sand).

2.10.3 Inspection chambers: Brick masonry inspection chambers of size and location as shown on drawing shall be provided in 75 class designation bricks in cement mortar 1:4 (1 cement:4 coarse sand) SRFC cover and frame (medium duty), RCC top slab in 1:2:4 mix (1 cement : 2 coarse sand: 4 graded stone aggregate 20 mm nominal size), foundation concrete 1:5:10 (1 cement:5 fine sand: 10 graded stone aggregate 40 mm nominal size) including plastering 12 mm thick with cement mortar 1:3 (1 cement: 3 coarse sand) finished smooth with a floating coat of neat cement on walls and bed concrete etc. complete as per standard design

2.11 CABLES INSIDE BUILDING

Cables inside buildings shall be laid on the cable trays. All cables passing through walls shall run through GI Pipes of adequate diameter 50 mm apart maintaining the relative position over the entire length.

2.12 ROUTE MARKER

Route marker shall be provided along straight runs of the cables not exceeding 100 meters also for change in the direction of the cable route and underground joints.

Route marker shall be o2f cast iron painted with aluminum paint. The size of marker shall be 100 mm dia with “Cable” and voltage grade inscribed on it.

2.13 CABLE TRAYS

Cable Trays shall be Galvanized and factory fabricated out of MS channels, angle iron, tee, bends, sections, flats and perforated sheet for different loads and number and size of cables as given below :

Cable trays shall be galvanized as per Specification given elsewhere.

a. 1500 mm wide

Runners 25 x 100 x 25 x 3 mm
Rungs 20 x 40 x 20 x 3 mm 250 mm C/C
Suspenders 2 Nos. 40 x 40 x 5 mm GI angle 1500 mm C/C

b. 1200 mm wide
Runners 25 x 100 x 25 x 3 mm
Rungs 20 x 40 x 20 x 3 mm 250 mm C/C
Suspenders 2 Nos. 40 x 40 x 5 mm GI angle 1500 mm C/C

c. 1000 mm wide
Runners 25 x 100 x 25 x 3 mm
Rungs 20 x 40 x 20 x 3 mm 250 mm C/C
Suspenders 2 Nos. 40 x 40 x 5 mm GI angle 1500 mm C/C

d. 750 mm wide
Runners 20 x 75 x 20 x 2.5 mm
Rungs 20 x 30 x 20 x 2.5 mm 250 mm C/C
Suspenders 2 Nos. 32 x 32 x 5 mm GI angle 1800 mm C/C

e 600 mm wide
Runners 20 x 75 x 20 x 2.5 mm
Rungs 20 x 30 x 20 x 2.5 mm 250 mm C/C
Suspenders 2 Nos. 32 x 32 x 5 mm GI angle 1800 mm C/C

f. 450 mm wide
Runners 20 x 75 x 20 x 2.5 mm
Rungs 20 x 30 x 20 x 2.5 mm 250 mm C/C
Suspenders 2 Nos. 25 x 25 x 4 mm GI angle 1800 mm C/C

g. Supply and fixing of perforated type cable trays of the following sizes of pre-galvanized iron.

i. 600 x 40 x 40 x 2 mm thick

i. 450 x 40 x 40 x 2 mm thick

i. 300 x 40 x 40 x 2 mm thick

ii. 150 x 40 x 40 x 2 mm thick

Note : Suitable length of 8 mm dia GI rod suspenders at 2000 mm intervals shall be included in the item for perforated type cable tray.

2.14 SPECIFICATION FOR HOT DIP GALVANIZING PROCESS FOR MILD STEEL USED FOR EARTHING, CABLE TRAYS OR JUNCTION BOXES FOR ELECTRICAL INSTALLATION.

GENERAL REQUIREMENTS

I. Quality of Zinc

Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS:209-1992.

II. Coating Requirement

Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square metre shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs, rust stains bulky white deposits, blisters.

Mild steel flats / wires shall undergo a process of degreasing pickling in acid, cold rinsing and then galvanizing.

2.15 TESTING OF CABLES

Cables shall be tested at works for the following tests before being dispatched to site by the project Director/Consultant if they so desire.

a) Insulation Resistance Test.
b) Continuity resistance test.
c) Sheathing continuity test.
d) Earth test.(in armoured cables)
e) Hi Pot Test.

Test shall also be conducted at site for insulation between phases and between phase and earth for each length of cable, before and after jointing. On completion of cable laying work, the following tests shall be conducted in the presence of the Consultant/Project Director or their authorized representative

a) Insulation Resistance Test(Sectional and overall)
b) Continuity resistance test.
c) Sheathing continuity test.
d) Earth test.

All tests shall be carried out in accordance with relevant Standard Code of Practice and Electricity Rules. The CONTRACTOR shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests.

3 DISTRIBUTION PANELS/BOARDS

Main Distribution Panels, Sub-Distribution Panels and Final Distribution Panels/Boards shall be suitable for operation on 3 Phase/single phase, 415/240 volts, 50 cycles, 4 wire system, neutral grounded at transformer. The degree of protection for enclosure shall be IP-55(Double door construction with canopy) suitable for outdoor application. All Distribution panels shall be CPRI approved and manufactured by a approved manufacturer.

Distribution panels shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per IS-13947-1993.

3.1 CONSTRUCTION FEATURES

Distribution panels shall be 2 mm thick sheet steel cabinet for indoor installation, dead front, floor mounting/wall mounting type and shall be from 3b construction. The Distribution panels shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors, Neoprene gasket, padlocking arrangement and bolted back. All removable/ hinged doors and covers shall be grounded by flexible standard connectors. Distribution panel shall be suitable for the climatic conditions as specified in Special Conditions.
Steel sheets used in the construction of Distribution panels shall be 2 mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to IS-8623-1977 (Part-1) for factory built assembled switchgear & control gear for voltage upto and including 1100 V AC.

All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self threading screws shall not be used in the construction of Distribution panels. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panels. Minimum clearance of 275 mm shall be provided between the floor of Distribution panels and the lowest unit.

Distribution panels shall be of adequate size with a provision of spare switchgear as indicated on the Single Line Diagram. Switches shall be arranged in multi-

tier. Knockout holes of appropriate size and number shall be provided in the Distribution panels in conformity with the location of cable/conduit connections. Removable sheet steel plates shall be provided at the top to make holes for additional cable entry at site if required.

Every cabinet shall be provided with Trifoliate or engraved metal name plates. All panels shall be provided with circuit diagram engraved on PVC sheet. All live accessible connections shall be shrouded and shall be finger touch proof and minimum clearance between phase and earth shall be 20 mm and phase to phase shall be 25 mm.

3.2 BUS BAR CONNECTIONS

Bus bar and interconnections shall be of high conductivity electrolytic grade aluminium / copper as indicated in the bill of quantities complying with requirement of IS : 5082 – 1981 and of rectangular cross section suitable for carrying the rated full load current and short circuit current and shall be extendable on either side. Bus bars and interconnections shall be insulated with heat shrinkable sleeve of 1.1 KV grade and shall be colour coded. Bus bars shall be supported on glass fiber reinforced thermosetting plastic insulated supports at regular intervals to withstand the force arising from in case of short circuit in the system. All bus bars shall be provided in a separate chamber and all connections shall be done by bolting. Additional cross sectional area to be added to the bus bar to compensate for the holes. All connections between bus bars and breakers shall be through solid copper / aluminium strips of proper size to carry full rated current and insulated with insulating sleeves.

3.2.1 TEMPERATURE - RISE LIMIT

Unless otherwise specified, in the case of external surface of enclosures of bus bar trunking system which shall be accessible but do not need to be touched during normal operation, an increase in the temperature rise limits of 25° C above ambient temperature shall be permissible for metal surface and of 15° C above ambient temperature for insulating surfaces as per IS 8623(Part-2) 1993.

All main distribution panels and sub distribution panels shall be provided with MCCB of appropriate capacity as per Single Line Diagram. All final Distribution boards shall be provided with Miniature Circuit Breakers. Final Single Phase Distribution boards shall be connected to the incoming supply through double pole MCB units & earth leakage circuit breakers. All wiring for final distribution boards shall be concealed behind 5 mm thick bakelite sheet or M S sheet cover. All Distribution boards shall be completely factory wired, ready for connection. All the terminals shall be of proper current rating and sized to suit individual

feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram.

All the switches and circuits shall be distinctly marked with a small description of the service installed.
Continuous earth bus sized for prospective fault current shall be provided with arrangement for connecting to station earth at two points. Hinged doors/ frames shall be connected to earth through adequately sized flexible braids.

3.3 CABLE COMPARTMENTS

Cable compartment of adequate size shall be provided in the Distribution panels for easy clamping of all incoming and outgoing cables entering from the top/bottom. Adequate supports shall be provided in cable compartment to support cables.

3.4 LOW VOLTAGE AIR CIRCUIT BREAKER

1. GENERAL

Air circuit breakers shall be incorporated in the panels wherever specified. ACB shall conform to IEC 947-II or IS: 13947-II in all respects. ACBs shall be suitable for operation upto 500 volts, 3 phase, 50 Hz, AC supply. All air circuit breakers using in the panel will be mounted in separate cubicles and will be of the same make to maintain the uniformity.

2. TYPE AND CONSTRUCTION

Air circuit breakers shall be of enclosed pattern, dead front air break type with trip free operating mechanism. All ACBs will be microprocessor type. Air Circuit breakers shall be of draw out type and will be mounted on a rigid steel frame. The ACBs shall be strong and robust in construction with suitable arrangement for anchoring when in fully engaged or fully drawn out positions. There shall be no dependence upon the panel board frame for any critical alignment. The draw out arrangement shall be such as to allow smooth and easy movement. The ACB shall have minimum four positions service, test , isolated and maintenance.

All the current carrying parts of the circuit breakers shall be of Silver-Copper alloy. Suitable arcing contacts shall be provided to protect the main contacts. The contacts shall be of spring loaded design. The contact tips and 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 for 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 supplier shall clearly indicate both nominal rating and de-rated rating at 50°C for each ACB inside the enclosure.

In case of 4Pole ACBs the fourth pole must be 100% rated.

In order to plan the maintenance activity, the breaker shall have a mechanical indication for indicating the erosion of main contacts.

The circuit Breaker shall be suitable for operation voltage upto 500 V at 50/60Hz and the tripping time of ACB shall be in between 30-35milliseconds.

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 system will have horizontal, self aligning, isolating pairs of moving and stationary power and control contracts. The unit will have three horizontal positions corresponding to:

a) Plugged in Position

Here both the power and control contacts are in made position and the breakers gets mechanically locked in this position. The breaker can go in ON position only after being locked in this position.

b) Test Position

Here the power contacts gets isolated where as the control contacts can be kept in made status. The breakers can be mechanically locked in this position and made ON and off for testing purposes.

c) Draw out Position

In this position the power and control connections are in isolated status and the moving portion of the breaker can be dismantled from the panel.

An isolating shutter or set of shutters are to be provided for the automatic coverage of live power and control fixed isolating contacts in the draw out position.

All the breakers with remote closing arrangement will have a spring charging motor of single phase 230 V and a closing coil. In case of power failure the spring charging can be done manually with the help of button or lever. The circuit breaker should switch on only when the spring is

charged fully which should be able to store energy for one closing and one tripping operation. The spring will also get fully charged when the breaker is in closed position. In this case the spring should store enough energy to make first tripping, one re-closing and the second tripping. The ACB should have an anti pumping feature.

The breaker will have quick making trip free closing mechanism. The operation of the mechanism will be independent of the speed of the closing lever or the duration of the closing signal.

The breaker will have following indications distinctly noteable from outside :-

- Mechanical indicator for spring fully charged.
- Mechanical indicator for spring discharged.
- Electrical indication of trip circuit healthy.
- Separate trip indication for overload and short circuit trip.
- Connected /Test/ Disconnected Position.

All breakers will have switching ON and OFF time of less than 4 cycles and will have the following interlocks for the safe operation of the equipment.

Breakers to ON only when mechanically locked many of the three horizontal isolation position.

When the breaker is in plugged in position it will ON only with the front door closed.

The breakers shall be provided with 2 Nos. each of type NO and NC auxiliary contacts rated for 10 Amps AC at 415 V and 6 Amps DC at 48 V. These contacts are in addition to the ones already in use for the operation of the breaker and will be required for subsequent interlocks incorporated in near future.

The breakers shall be provided with trip signaling contact.

When ever requested mechanical positive inter locks will be provided between the operation of different breakers with the help of individually unique and matched castle key locks.

<u>Safety Interlocks:</u>

The ACB compartment door shall be interlocked to prevent access when in connected position. It shall however be possible to defeat the interlock in an emergency.

Interlock shall be provided to prevent plugging in or withdrawal of ACB trolley unless it is open. Any attempts to do so shall trip the circuit breaker instantly.

Interlock shall be provided to ensure closing of ACB only in 'Connected' 'Test' and Disconnected position of draw out ACB.

Mechanical 'ON' pushbutton shall have suitable locking arrangements for carrying out maintenance of downstream load.

Mechanical and electrical anti-pumping devices shall be incorporated in the ACB's as required

Ready to close Interlocking to ensure the breaker shall get closed only when vital interlocking are checked & found OK.

Rating

The rating of the circuit breaker shall be as per the drawings and specifications. The rated breaking capacity of the breakers shall be minimum Ics 50 KA for ACBs up to 1600A and 65KA in case of ACBs of 2000A and above as specified at 415 volts AC. The rated making capacity shall be as per relevant standard.

Accessories

Circuit breakers shall be provided with the following Accessories.

a) Under-voltage release for the incoming ACB.

b) The ACB must have the front accessible control contacts and accessories.

c) The accessories such as Shunt/Under voltage shall be suitable for continuous duty on AC/DC supply

d) Auxiliary switches .

Testing

Testing of each circuit breaker shall be carried out at the works as per IS:13947-II and the original type test certificate of neutral authority of India (CPRI/ERDA) shall be furnished in triplicate. The tests shall incorporate at least the following:

a) Impulse withstand test

b) Power frequency withstand test

c) Short circuit test

d) Temperature-rise test under rated conditions.

Protection Release

The ACB shall be with an integral self powered microprocessor based release 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 standards.

Online Fault Test

On line test facility to test healthiness of release of Air circuit Breaker shall be provided.
It shall be possible to test the healthiness of the Air Circuit Breaker's release without tripping the circuit breaker or taking a shut down

Trip Indicators

Shall be provided to show the exact reason of fault (O/L ,S/C or E/F) that caused tripping of ACB and It shall have individual fault indication through LEDs only. The ACB have to be necessarily with mechanical reclosing lockout.

In order to ensure faster diagnosis, It shall be possible to identify the exact nature of fault (O/L, S/C, or E/F) that caused the circuit breaker tripping. The ACB have to be necessarily with mechanical reclosing lockout.

In addition to above, it shall be also possible to check the healthiness of the trip circuitry by tripping the circuit breaker through the release

Setting range of release

a) Overload Protection shall have adjustable setting from 40% to 100% of rated current.
b) Short circuit protection shall have adjustable current setting from 1.5 times to 12 times of the overload setting for fault discrimination from 0-400 milliseconds.
c) E/F protection if specified will have adjustable current setting from 20% to 60% of ACBs rated current and adjustable time setting 100-500milliseconds.
d) It shall be possible to change the release setting on load.

3.5 MOULDED CASE CIRCUIT BREAKERS

1. GENERAL

Moulded case circuit breakers shall be incorporated in the switch board wherever specified. MCCB shall conform to IEC:60 947-II or IS:13947-II in all respects. MCCB shall be suitable for an operation voltage upto 500V three phase AC.. All MCCBs will have earth fault module (if specifically asked) and rotary operated handle . All four pole MCCB shall be suitable for three phase four wire system, with the neutral clearly identified and neutral protection available.

The MCCBs shall carry its rated current at an ambient temperature of 50 Deg C

2. CONSTRUCTION

The MCCB shall be of Current Limiting Type and have Trip-Free mechanism and the 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. All MCCBs shall have a common operating handle for simultaneous operation and tripping of all the three phases. The MCCB should be suitable for disconnection and isolation with marking on front name plate as per IEC 60947 & IS 13947

The MCCB shall be suitable for Line-Load reversibility for greater flexibility

Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be thermal-magnetic type 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. Thermal magnetic 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

MCCB shall be provided with the following accessories ,if specified in specifications.

i) Under Voltage trip release.
ii) Shunt Trip release.
iii) Alarm switch.
iv) Auxiliary switch
v) Extended door operating mechanism with door interlock.
vi) Moterised operating mechanism.

5. INTERLOCKING

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

a) Padlocking facility 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 415V .Whenever required ,higher rupturing capacity breakers to meet the system short circuit fault level shall be used upto 160 amps 25 KA upto 315 amps 35 KA and above 50 KA.

The MCCB shall be current limiting type and comprise of quick make-break switching mechanism.. All MCCBs shall have adjustable settings. Overload adjustable from 80 % to 100 % of the rated current. Short Circuit setting adjustable from 5 to 10 times the rated current.

7. TESTING

a) Original type test certificate of neutral authority of India (CPRI/ERDA) shall be furnished in triplicate.

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

3.6 MOTOR PROTECTION CIRCUIT BREAKER (MPCB)

Motor circuit breakers shall conform to the general recommendations of standard IEC 947 -1,2 and 4 (VDE 660, 0113 NF EN 60 947-1-2-4, BS 4752) and to standards UL 508 and CSA C22-2 N°14.

The devices shall be in utilization category A, conforming to IEC 947-2 and AC3 conforming to IEC 947-4.MPCB shall have a rated operational and insulation voltage of 690V AC (50 Hz) and MPCB shall be suitable for isolation conforming to standard IEC 60947-2 and shall have a rated impulse withstand voltage (Uimp) of 6 kV. The motor circuit breakers shall be designed to be mounted vertically or horizontally without de-rating. Power supply shall be from the top or from the bottom. In order to ensure maximum safety, the contacts shall be isolated from other functions such as the operating mechanism, casing, releases, auxiliaries, etc, by high performance thermoplastic chambers. The operating mechanism of the motor circuit breakers must have snap action opening and closing with free tripping of the control devices. All the poles shall close, open, and trip simultaneously. The motor circuit breakers shall accept a padlocking device in the "isolated" position.

The motor circuit breakers shall be equipped with a "PUSH TO TRIP" device on the front enabling the correct operation of the mechanism and poles opening to be checked. The auxiliary contacts shall be front or side mounting, and both arrangements shall be possible. The front-mounting attachments shall not change the breaker surface area. Depending on its mounting direction the single pole contact block could be NO or NC. All the electrical auxiliaries and accessories shall be equipped with terminal blocks and shall be plug-in type. The motor circuit breakers shall have a combination with the downstream contactor enabling the provision of a perfectly coordinated motor-starter. This combination shall enable type 1 or type 2 co-ordination of the protective devices conforming to IEC 60947-4-1.Type 2 co-ordination shall be guaranteed by tables tested and certified by an official laboratory: LOVAG (or other official laboratory).The motor circuit breakers, depending on the type, could be equipped with a door-mounted operator which shall allow the device setting. The motor circuit breakers shall be equipped with releases comprising a thermal element assuring overload protection and a magnetic element for short-circuit protection. In order to ensure safety and avoid unwanted tripping, the magnetic trip threshold (fixed) shall be factory set to an average value of 12 Ir.

All the elements of the motor circuit breakers shall be designated to enable operation at an ambient temperature of 60°C without de-rating. The thermal trips shall be adjustable on the front by a rotary selector. The adjustment of the protection shall be simultaneous for all poles. Phase unbalance and phase loss detection shall be available. Temperature compensation (-20°C to +60°C)

3.7 MINIATURE CIRCUIT BREAKER (MCB)

Miniature Circuit Breaker shall comply with IS-8828-1996/IEC898-1995. Miniature circuit breakers shall be quick make and break type for 240/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall be classified (B,C,D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values.MCB shall ensure complete electrical isolation & downstream circuit or equipment when the MCB is switched OFF.

The housing shall be heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP, TPN and 4 Pole miniature circuit breakers shall have a common trip bar independent to the
external operating handle.

- **Coordination Study In LV Network**

LV Switchgear Manufacturer shall submit coordinated & Discriminated solution for LV Network protection devices i.e. **ACB, MCCB, MPCB &** MCB for all incoming and outgoing devices for all Panels/ DB`s as per BOQ with the help of published discrimination tables. Total discrimination shall be provided up to the short circuit breaking capacity of down stream circuit Breakers .

3.8 RESIDUAL CURRENT CIRCUIT BREAKER CURRENT OPERATED TYPE (RCCB)

I. System of Operation

Residual Current Circuit Breaker shall confirm to IEC 61008.RCCB shall work on the principle of core balance transformer. The incoming shall pass through the 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 predetermined critical value. RCCB shall be current operated independent of the line voltage, current sensitivity shall be of 30 mA at 240/415 volts AC and shall have a minimum of 20,000 electrical operations.

II. 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 the three phases shall occur simultaneously. This also shall ensure simultaneous opening of all the contacts under tripping conditions.

III. 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 breaks last after allowing the phases to open first. This is an important safety feature which is also required by regulations.

IV. Testing Provision

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

3.9 EARTHING

Earthing shall be provided as per IS:3043-1987.

3.10 PAINTING

All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivaiting (seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be as per BOQ confirming to IS Code No.5.

3.11 LABELS

Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the distribution panels shall be pasted on inside of the panel door and covered with transparent plastic sheet.

3.12 METERS

i. All voltmeters and indicating lamps shall be through MCB’s.

ii. Meters and indicating instruments shall be flush type.

iii. All CT's connection for meters shall be through Test Terminal Block (TTB).

iv. CT ratio and burdens shall be as specified on the Single line diagram.

3.13 CURRENT TRANSFORMERS

Current transformers shall be provided for Distribution panels carrying current in excess of 60 amps. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondaries for operation of associated metering.

The CTs shall confirm to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class I.

3.14 POTENTIAL FREE CONTACTS

Potential free contacts shall be provided for connection to Building Automation System in panels indicated in Schedule of Quantities and as directed by the Consultant.

3.15 INDICATING PANEL

All meters and indicating instruments shall be in accordance with relevant Indian Standards. Meters shall be flush mounted type. Indicating lamps shall be of low burden, and shall be backed up with 2 amps MCB/MPCB as per relevant fault level and toggle switch.

3.16 POWER FACTOR IMPROVEMENT

3x 25 KVAR capacitor bank as indicated in drawing / schedule of item shall be provided in each Main LT Panel. The capacitor bank shall be conforming to IS: 13341-1992, 13340-1993. Metalised Poly propylene (MPP) capacitors shall be manufactured using Poly propylene film placed between 2 layers of metal foil and winding or using wave cut MPP film. The MPP Capacitors shall be self-healing type and soft resin or oil impregnated for longer life. The impregnate shall be non-PCB, biodegradable type and must be properly treated and de-gasified, so as not to have any degeneration properties and shall be non-oxidizing.

MPP type capacitors filled with inert gas shall be used. The MPP capacitors shall be in cylindrical Aluminium can.

Microprocessor based APFC relay (Intelligent VAR controller) shall sense the existing power factor and automatically switch ON/ OFF the capacitor unit or stage to achieve the preset target Power Factor. APFC relay shall be provided for each 3x 25 KVAR capacitor banks.

4. EARTHING

4.1 EARTHING

The system shall be TNS with four wire supply system (R,Y,B,N and 2 Nos. E) brought from the main L T Panel. All the non-current carrying metal parts of electrical installation and all metal conduits trunking, cable sheaths, switchgear, distribution panels, light fittings and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All metal work such as pipe lines, ducts, cable trays, stair case railing etc shall be bonded to earth.

All earthing shall be in conformity with IS:3043 1987, and the basic system of earthing shall be TNS.

4.2 EARTHING CONDUCTORS

Earthing conductors shall be of copper / GI as mentioned in schedule of quantities and shall be protected against mechanical injury and corrosion.

4.3 SIZING OF EARTHING CONDUCTORS

The cross sectional area of earthing conductor shall not be smaller than half of the largest current carrying conductor subject to an upper limit of 80 Sq.mm. If the area of the largest current carrying conductor or bus bar exceeds 160 sq.mm then two or more earthing conductors shall be used in parallel, to provide at least half the cross sectional area of the current carrying conductor or bus bars. All fixtures, outlet boxes, junction boxes and power circuits upto 15 amps shall be earthed with PVC insulated copper wire.

All 3 phase switches and distribution panels upto 60 amps rating shall be earthed with 2 Nos. distinct and independent 4 mm dia copper / GI wires. All 3 phase switches and distribution panels upto 100 amps rating shall be earthed with 2 Nos. distinct and independent 6 mm dia copper / GI wires. All switches, bus bar, ducts

and distribution panels of rating 200 amps and above shall be earthed with minimum of 2 nos separate and independent 25 mm x 3 mm copper / GI tape.

4.4 CONNECTION OF EARTHING CONDUCTORS

Main earthling conductors shall be taken from the earth connections at the main L T panel to an earth electrode with which the connection is to be made. All joints in tapes shall be with four rivets and shall be brazed in case of copper and by welding bolting in case of GI, wires shall be connected with crimping lugs, all bolts shall have spring washers. Sub- mains earthling conductors shall run from the main distribution panel to the sub distribution panel. Final distribution panel earthing conductors shall run from sub-distribution panel.

Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthling conductor, or its distribution panel. Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to distribution panel at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of the equipment shall be earthed by means of an earthing conductor enclosed with the current carrying conductors within the flexible cord. Switches, accessories, lighting fitting etc. which are rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered as a part of the earthing conductor for earthing purposes, even though the run of metallic conduit is earthed.

4.5 PROHIBITED CONNECTIONS

Neutral conductor, sprinkler pipes, or pipes conveying gas, water or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lightning protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system. The electrical resistance measured between earth connection at the main L T panel and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate or circuit breakers, and shall not exceed 1 ohm. All switches carrying medium voltage shall be connected with earth by two separate and distinct connections. The earthing conductors inside the building wherever exposed shall be properly protected from mechanical injury by running the same in G I pipe of adequate size. The overlapping in strips at joints where required shall be minimum 75 mm. The joints shall be riveted and brazed in case of copper and by welding / bolting in case of GI in an approved manner. Sweated lugs of adequate capacity and size shall be used for termination of all conductor wires above 6 sq.mm size. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substances and properly tinned. Equipotential bonding of all metallic structures shall be done.

4.6. EARTHING

The following must always be ensured in earthing system.

- All earths must be interconnected at the earth pits. This includes generator neutrals, transformer neutrals, transformer body, lightning protection system earths, UPS earths etc.

- Extraneous conductive parts such as gas pipes, other service pipes and ducting risers and pipes of fire protection equipment and exposed metalic parts of the building structure.

4.7 The CONTRACTOR shall get the soil resistivity test done at his own cost of the area where earthing pits are to be located before starting the installation.

4.8 RESISTANCE TO EARTH

The resistance of earthing system shall not exceed 1 ohm.

4.9 SPECIFICATION FOR HOT DIP GALVANIZING PROCESS FOR MILD STEEL USED FOR EARTHING FOR ELECTRICAL INSTALLATION

GENERAL REQUIREMENTS

I. Quality of Zinc

Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS:209-1992.

II. Coating Requirement

Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square metre shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs, rust stains bulky white deposits, blisters.

Mild steel flats / wires shall undergo a process of degreasing pickling in acid, cold rinsing and then galvanizing. Jointing of earthing tape shall be by welding. All joints and cut ends shall be properly painted with aluminium paint.

5. EXTERNAL / STREET LIGHTING POLES

5.1 4.5 Meter High Pole

4.5 meter high (3.6 meter above and 0.9 meter below ground) shall be 75 mm dia, 3.5 mm wall thickness galvanized Iron straight pole with a cast aluminium adaptor for post top mounting. Pole shall be provided with 200 mm x 200 mm x 10 mm thick MS base plate. Foundation for the pole shall be of cement concrete in 1:2:4 rates (1 part cement, 2 parts coarse sand and 4 parts stone aggregate) IP-55 weather proof junction box shall also be provided to accommodate 1 No. 3 phase and neutral terminal block and 1 No. 6 amps SP MCB including 2.5 sq.mm PVC insulated copper conductor wires from the terminal block to the fixture and 2 Nos. 32 mm dia GI sleeves of suitable length shall be provided to the junction box.

5.2 Galvanized Octagonal Poles

Design

The Octagonal poles shall be designed to withstand the maximum wind speed of 169 KM / Hr. as per IS 875. The top loading i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BS : 5649 Part VI 1982.

Pole Shaft

The pole shaft shall have octagonal cross section and shall be continuously tapered with single longitudinal welding. There shall not be any circumferential welding. The welding of pole shaft shall be done by submerged Arc Welding (SAW) process.

All octagonal pole shafts shall be provided with the rigid flange plate of suitable thickness with provision for fixing 4 foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside.

Door opening

The octagonal poles shall have door of approximate 500 mm length at the elevation of 500 mm from the Base plate. The door shall be vandal resistance and shall be weather proof to ensure safety of inside connections. The door shall be flush with the exterior surface and shall have suitable locking arrangement. There shall also be suitable arrangement for the purpose of earthing.

The pole shall be adequately strengthened at the location of the door to compensate for the loss in section.

Material

Octagonal Poles	HT Steel Conforming to grade S355JO
Base Plate	Fe 410 conforming to IS 226 / IS 2062
Foundation Bolts	EN.8 grade

Welding

The welding shall be carried out confirming to approved procedures duly qualified by third party inspection agency. The welders shall also be qualified for welding the octagonal shafts.

Pole sections

The Octagonal Poles shall be in single section of 9 mtr. There shall not be any circumferential weld joint.

Galvanization

The poles shall be hot dip galvanized as per IS 2629 / IS 2633 / IS 4759 standards with average coating thickness of 70 micron. The galvanizing shall be done in single dipping.

Xing type

The Octagonal Poles shall be bolted on a pre-cast foundation with a set of four foundation bolts for greater rigidity.

Top Mountings

The galvanized mounting bracket shall be supplied along with the Octagonal Poles for Installation of the luminaries.

Manufacturing

The pole manufacturing & galvanizing unit shall be ISO 9001 : 2000 & ISO 14001 certified to ensure consistent quality & environmental protection.

Service window

A service window of the size 150 mm x 100 mm shall be provided in the base of the pole to allow access to electrical connections and terminations. It shall be covered with MS plate and proper rubber gaskets shall be provided to prevent any ingress of water etc..

Electrical connections

Four way connectors shall be provided along with Slide lock and 1 no. 6 amps SP MCB including 2.5 sqmm PVC insulated copper conductor wires from the terminal block to the fixture and 2 nos. 32 mm dia GI sleeves of suitable length shall be provided upto the service window. An earth boss is provided on the control plate along with connectors and interrupters.

Galvanized Octagonal Poles Dimensions

					FOUNDATION BOLT

HEIGHT	TOP DIA (A/F)	BOTTOM DIA (A/F)	SHEET THICKNESS	BASE PLATE DIMENSIONS (LxBxT)	BOLT SIZE (NO. x DIA)	PITCH CIRCLE DIA (PCD)	BOLT LENGTH (MM)	PROJECTED BOLT LENGTH
(mtr)	**(mm)**	**(mm)**	**(mm)**	**(mm)**	**(mm)**	**(mm)**	**(mm)**	**(mm)**
9	70	155	3	260 x 260 x 16	4 x 24 Dia	250	750	125

5.3 LAYING OF CABLES IN GROUND

The minimum width of trench for laying single cable shall be 350 mm. Where more than one cable is to be laid in horizontal formation, the width of the trench shall be worked out by providing 200 mm gap between the cables, except where otherwise specified. There shall be clearance of 150 mm between the end cable and the side wall of the trench. The minimum dept of the cable trench shall not be less than 600 mm for single layer of cables. When the cables are laid in more than one tier the depth of the trench shall be increased by 300 mm for each additional tier.

Excavation of trenches : The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided. Where gradients and changes in depth are unavoidable, these shall be gradual. The excavated soil shall be stacked firmly away from the trench so that it may not fall back into the trench. The bottom of the trench shall be level and free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 100 mm in depth. Prior to laying of cables, the cores shall be tested for continuity and insulation resistance. The cable drum shall be properly mounted on jacks, at a suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum and the spindle is horizontal. Cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire drum length shall be laid in one stretch. However, where this is not possible the remainder of the cable shall be removed by `Flaking' i.e. by making one long loop in the reverse direction. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted off the rollers beginning from one end by helpers standing about 10 meters apart and laid in a reasonably straight line. Cable laid in trenches in a single tier formation shall have a cover of clean, dry sand of not less than 150 mm. above the base cushion of sand before the protective cover is laid. In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 300 mm shall be provided over the initial bed before the second tier is laid. Finally the cables shall be protected by second class bricks before back filling the trench.

Back Filling : The trenches shall be back filled with excavated earth free from stones or other sharp edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 300 mm. Unless otherwise specified, a crown of earth not less than 50 mm in the centre and tapering towards the sides of the trench shall be left to allow for subsidence.

5.4 Cables crossing Road: All the cables crossing road shall be laid in 200/150 mm dia RCC pipes as shown on drawing. The pipes shall be laid in excavated trenches of required width including excavation of sockets, dressing of sides ramming of bottoms, depth upto 2.00 mts including getting out excavated soil and then returning the soil as required, in layers not exceeding 20 cm in depth including consolidating, ramming & watering etc. and disposal of surplus soil as directed by the Project Director and Consultant. The RCC pipes shall be laid over a bed of CC 1:5:10 (1 cement: 5 coarse sand: 10 graded stone aggregate 40 mm nominal size) upto haunches of RCC pipes as per standard design. The pipes shall be jointed together with collers with stiff mixture of cement mortar in the proportion of 1:2 (1 cement:2 find sand).

5.5 Inspection chambers: Brick masonry inspection chambers of size and location as shown on drawing shall be provided in 75 class designation bricks in cement mortar 1:4 (1 cement:4 coarse sand) SRFC cover and frame (medium duty), RCC top slab in 1:2:4 mix (1 cement : 2 coarse sand: 4 graded stone aggregate 20 mm nominal size), foundation concrete 1:5:10 (1 cement:5 fine sand: 10 graded stone aggregate 40 mm nominal size) including plastering 12 mm thick with cement mortar 1:3 (1 cement: 3 coarse sand) finished smooth with a floating coat of neat cement on walls and bed concrete etc. complete as per standard design

6 FEEDER PILLAR:

The CONTRACTOR shall have to get the control panels fabricated from one of the approved vendors of panels in the contract. For cubical panels. The copy of the type test certificate shall also have to be produced failing which feeder pillar shall not be accepted.

a) Enclosure shall confirm to IS -8623/93 with upto date amendment .

b) All material used for the fabrication of feeder pillars shall be got approved from the Project Director before fabrication. No claim for defective materials not approved by the Project Director shall be entertained.

c) The feeder pillars shall have sloping canopy projecting out on all sides with suitable sloping channel on front for drainage of water.

d) Angle iron legs shall be suitably shaped at the bottom for anchoring in concrete base.

e) The feeder pillars shall be provided with ventilation window covered with wire net in double fold from inside. The window shall be provided on both the side panels of feeder pillars.

f) The feeder pillars shall be provided with a danger notice plate .

g) Interconnections of the various mountings on the feeder pillar shall be done using PVC insulated conductors , or solid strips with PVC taping/ sleeving of appropriate sizes. Termination shall be made such that local heating is avoided, suitable lugs shall be used for connections.

h) All the metal work of feeder pillar shall be painted prior to erection with one coat of antirust primer. After erection, they shall be painted with two coats of enamel paint as require, on all sides wherever accessible .

i) Protection level of IP-54 shall be applicable.

7. TESTING

7.1 GENERAL

At the completion of the work, the entire installation shall be subject to the following tests in the presence of the Consultant/Project Director or their authorized representative.

Wiring continuity test.
Insulation resistance test.
Earth continuity test.
Earth resistivity test.
Test as per Appendix `E' of IS:732 -1989

Besides the above, any other test specified by the local authority shall also be carried out. All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the CONTRACTOR at his own cost.

72 TESTING OF WIRING

All wiring systems shall be tested in the presence of Consultant/Project Director or their authorized representative for continuity of circuits, and earthing after wiring is completed and before installation is energized.

7.3 INSULATION RESISTANCE TEST

The insulation resistance shall be measured between earth and the whole system of conductors, or any section thereof, with all switches closed and except in concentric wiring all lamps in position of both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 660 volts for medium voltage circuits. Where the supply is derived from AC three phase system, the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 divided by the number of points provided on the circuit, the whole installation shall have an insulation resistance greater than one megaohms. The insulation resistance between the frame work of housing of power appliances and all live parts of each appliance shall not be less than that specified in the relevant standard specification or where there is no such specification, shall not be less than one a megaohms. All equipments, cables shall be inspected at works by the Consultant as per relevant IS and testing commissioning of

installation as per Appendix `E' of IS:732-1989 shall be done and all record to be maintained.

7.4 TESTING OF EARTH CONTINUITY PATH

The earth continuity conductor metallic envelopes of cables shall be tested for electric continuity and the electrical resistance of the same, along with the earthing lead but excluding any added resistance or earth leakage circuit breaker, measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation, shall not exceed one ohm.

7.5 TESTING OF POLARITY OF NON-LINKED SINGLE POLE SWITCH

In a two wire installation a test shall be made to verify that all non-lined single pole switches have been connected to the same conductor throughout, and such conductor shall be labeled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply. In the three or four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Project Director/Consultant as well as the local authorities.

FORM OF INDEMNITY BOND

(To be executed on Stamp Paper of appropriate value duly notarized)

KNOW all men by these presents that I/We _____ do hereby execute Bond in favor of National Health Systems Resource Centre, New Delhi. On this _____ day of _____ 2018.

WHEREAS the National Health Systems Resource Centre, New Delhi have appointed _____ as the CONTRACTOR for Office Complex at NHSRC, NHIFW Campus Munirka New Delhi .

DEED WITNESSES AS FOLLOWS:

I/We _____ hereby do Indemnify and save harmless the NHSRC, New Delhi against and from

1. Any third party claims, civil or criminal complaints/liabilities, site mishaps and other accidents or disputes and/or damages occurring or arising out of any mishaps at the site due to faulty work negligence, faulty construction and/or for violating any law, rules and regulations in force, for the time being while executing/executed works by me/us.

2. Any damages, loss or expenses due to or resulting from any negligence or breach of duty on the part of me/us or my sub contactor's if any, servants or agents. We shall be liable for any damage or loss that may happen to the work or any part through to NHSRC's equipment and plant from any cause, whatsoever and shall at own cost, repair and make good is conformity, in every respect with the requirement of the contract and instruction of the NHSRC.

3. We shall be responsible for all injury to persons, animals and things which may arise from carelessness, accident or any other cause, whatsoever in any way connected with the execution of the contract.

4. Any claim by an employees of mine/ours or of sub CONTRACTORs if any, under the Workmen's Compensation Act and Liability Act,1939 or any other law, rules and regulations in force for the time being and any Acts replacing and/or amending the same or any of the same as may be in force at the time and under any law in respect of injuries to persons or property arising out of and in the course of the execution of the contract work and/or arising out of and in the course of employment of any workman/employee. We shall also indemnify NHSRC against loss that may arise due to non-compliance of obligation given in contract Clause 5.6.

   I/we shall be responsible for the…….. of all employees and indemnity NHSRC of any acts/deeds attributable by/towards such FIRST PARTY.

5. Any act or omission of mine/ours of sub-CONTRACTORs if any, our / their servants or agents which may involve any loss, damage, liability, civil or criminal action. Refer Clause 5.11 & 5.12

6. payments is responsibility of the CONTRACTOR. We shall deposit the GST We shall indemnify NHSRC, if WCT is not deposited in time, as per prevailing rates during the contract period.

IN WITNESS WHEREOF THE _____
has set his/their hand on this day of _____2011.
SIGNED AND DELIVERED BY THE NAME AND ADDRESS
AFORESAID _____ (CONTRACTOR)
IN THE PRESENCE OF WITNESS :

1. 2.

A. SCAFFOLDING:

(i) Suitable double stage scaffolding should be provided for workmen for all work that cannot safely be done from the ground or from solid construction except short period work as can be done safely from ladders. When a ladder is used an extra Mazdoor shall be engaged for holding the ladder and if ladder is used for carrying materials as well, suitable footholds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper that 1 in 4 (1 horizontal and 4 vertical). Lights to protect the workers and staff from accidents to be provided . CONTRACTOR shall be bound to bear the expenses of defense of every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of laid down precautions and pay any damages and costs which may be awarded in any such suit or action or proceedings to any such person or which may with the consent or the CONTRACTOR be paid to compromise any claim by any such person.

(ii) Scaffolding or staging more than 4 metres above the ground or floor swing suspended from an over-head support or erected with stationary support shall have a guard rail properly attached, bolted, braced and otherwise secured at least 3 ft. high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

(iii) Working platform gangways and stairways should be so constructed that they should not sag unduly or unequally and if the height of the platform, of the gangway or the stairway is more than 4 meters above ground level or floor level they should be closely boarded, should have adequate width and should be suitably fastened as described in (ii) above.

(iv) Every opening in the floor or a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 1 metre.

(v) Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 metres in length while the width between the said rails in rung ladder shall in no case be less than 30 cms. for ladder upto and including 3 metres in length. For longer ladder this width should be increased atleast 5 cm for each additional foot of length. Uniform

steps spacing shall not exceed 30 cms. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any sites of work shall be so stacked or placed to cause danger or inconvenience to any person or public. The CONTRACTOR shall also provide all necessary fencing and lights to protect the workers and staff from accidents, and shall be bound to bear the expenses of defense of every suit, action or other proceedings at law that may be bought by any person for injury sustained owing to neglect of the above precautions and pay any damages and costs which may be awarded in any such suit or action or proceedings to any such person or which may with the consent of the CONTRACTOR be paid to compromise any claim by any such person.

B. EXCAVATION AND TRENCHING

All trenches 1.2 meters or more in depth shall at all times be supplied with at least one ladder for each 50 meter length or fraction thereof.

Ladder shall be extended from bottom of the trench to at least 1 meter above the surface of the ground. The sides of the trenches which are 1.5 meters in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of side collapsing. The excavated materials shall not be placed with 1.5 meters of the edge of the trench or half of the trench width whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or under cutting shall be done.

C. DEMOLITION :

Before any demolition work is commenced and also during the progress of the work.

a) All roads and open areas adjacent to the work site shall either be closed or suitably protected.

b) No electric cable or apparatus which is liable to be source of danger shall remain electrically charged.

c) All practical steps shall be taken to prevent danger to persons employed from risks of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render it unsafe.

d) Stone breakers shall be provided with protective clothing and seated at sufficiently safe intervals.

e) When workers are employed in sewers and manholes, which are in use, the CONTRACTOR shall ensure that the manhole covers are opened and

are ventilated at least for an hour before the workers are allowed to get into the manholes and the manholes so opened shall be cordoned off with suitable tailing and provided with warning signals or board to prevent accident to the public. Proper Safety Belts shall be used by the workers going in the sewers & manholes . Further before entry presence of TOXIC gases shall be tested and presence of Oxygen verified.

f) The CONTRACTOR shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 years are employed on the work of lead painting, the following precautions should be taken.

i) No paint containing lead or lead product shall be used except in the form of paste or readymade paint.

ii) Suitable face masks should be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

iii) Overalls shall be supplied by the CONTRACTOR to the workmen and adequate facilities shall be provided to enable the working painters to wash them during and on cessation of work.

D. All necessary personal safety equipment as considered adequate by the NHSRC should be kept available for the use of persons employed on the site and maintained in condition suitable for immediate use, and the CONTRACTOR shall take adequate steps to ensure proper use of equipment by those concerned.

Those engaged in mixing or stacking of cement bags or any materials which are injurious to the eyes shall be provided with protective goggles.

E. Use of hoisting machines and tackles including their attachments, anchorage and supports shall conform to laid down standard precautions.

a) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defect and shall be kept in good working order.

b) Every rope used in hoisting or lowering materials or as means of suspension shall be of durable quality and adequate strength and free from patent defects.

c) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years should be in charge of

any hoisting machine including any scaffolding winch or give signals to the operator.

d) In case hoisting machine and of every chain ring hook shackle swivel and pulley block used in hoisting or lowering or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gears referred to above shall be plainly marked with the safe working load of the conditions under which it is applicable which shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.

(e) In case of hired machine, the safe working load shall be notified to the NHSRC. As regards CONTRACTOR's machines, the CONTRACTOR shall notify the safe working load of the machine to the NHSRC/ Consultant whenever he brings any machinery to site of work and get it verified by the Project Director or its authorized representative.

F. Motors gearing transmission electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards Housing appliances should be provided with such means as to reduce to the minimum the accidental descent of the load, adequate pre-cautions should be taken to reduce to the minimum the risk of any part or any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already energized, insulation mats, wearing apparel, such as gloves, sleeves, and boots, as may be necessary should be provided. The workers shall not wear any rings, watches and carry keys or other materials which are good conductors of electricity.

G. All scaffolds ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffold, ladder or equipment shall be altered or removed while it is in use either by the CONTRACTOR or any other external agencies/ sub CONTRACTORs/associate CONTRACTORs . Adequate washing facilities should be provided at or near places of work.

H. These safety provisions should be brought to the notice of all concerned by displaying on a notice board at a prominent place at the work-spot. The person responsible for compliance of the safety code shall be named therein by the CONTRACTOR.

I. To ensure effective enforcement of the rules and regulations relating to the safety precautions, the arrangements made by the CONTRACTOR shall be open to inspection by NHSRC or its representatives.

J. Notwithstanding the above clause there is nothing in these to exempt the CONTRACTOR from the operations of any other Act or rules in force in the Republic of India. The works throughout including any temporary works shall be carried out in such a manners as not to interfere or destroy in any way whatsoever the property of the Administration or of a third party.

In addition to the above, the CONTRACTOR shall abide by the Safety code provision as per Indian Standard
Safety Code framed from time to time and any additional requirement as per local safety bye laws and as
required by the NHSRC from time to time within his quoted rates

APPENDIX - I

LIST OF INDIAN STANDARDS (IS)

IS : 374 - 1979	Ceiling fans and regulators (3rd revision)
IS : 694 - 1990	PVC insulated Electric cable for working voltage upto and including 1100 volts.
IS : 732 - 1989	Code of practice for electrical wiring and installation
IS : 1255 - 1983	Code of Practice for installation and maintenance of Power Cables upto and including 33 KV rating (Second Revision)
IS : 1258 - 1987	Bayonet lamp holders(Third revision)
IS : 1293 - 1988	Three pin plugs and sockets outlets rated voltage upto and including 250 volts and rated current upto and including 160 amps.
IS : 1554 - 1988 (Part - I)	PVC insulated (Heavy Duty) electric cables for working voltages upto and including 1100 volts.
IS : 1646 - 1982	Electrical installation fire safety of buildings (general) Code of practice.
IS : 1885 - 1971	Glossary of items for electrical cables and conductors
IS : 1913 - 1978	General and safety requirements for fluorescent lamps luminaries Tubular.
IS : 2026 - 1977 to 81/ 1171-1983 (Part I to IV)	Distribution transformers
IS : 2071 - 1974 - 76	Methods of high voltage testing
IS : 2309 - 1989	Protection of building and allied structures against lightning
IS : 2551-1982	Danger notice plate.
IS : 3043 - 1987	Code of practice for earthing.

IS : 3427 – 1997	AC Metal enclosed switch gear and control gear for rated voltages above 1 KV and upto and including 52 KV.
IS : 3480 - 1966	Flexible steel conduits for electrical wiring.
IS : 3837 - 1976	Accessories for rigid steel conduit for electrical wiring.
IS : 4146 - 1983	Application guide for voltage transformers
IS : 4615 - 1968	Switch socket outlets.
IS : 5133 - 1969 (Part -I	Boxes for the enclosure of electrical accessories.
IS : 5216 - 1982 (Part-I)	Guide for safety procedures and practices in electrical work.
IS : 5424 - 1969	Rubber mats for electrical purposes.
IS : 5578 & 11353-1985	Marking and arrangement of bus bars
IS : 7098 - 1985 (Part - II)	Cross linked polyethylene insulated PVC sheathed cables. For working voltages from 3.3 KV upto and including 33 KV
IS : 8130 - 1984	Conductors for insulated electric cables and flexible cords
IS : 8623 -1977 (Part -I)	Factory built assemblies of switchgear and control gear for voltages upto and including 1000 V AC and 1200 V D C.
IS : 8828 - 1996	Miniature Circuit Breakers
IS : 9537 - 1981	Rigid Steel Conduits for electrical wiring (Second Revisions)
IS : 10810 - 1988	Methods of test for cables.
IS : 12640 - 1988	Earth Leakage Circuit Breakers
IS : 13947-1993 (Part-II)	Air Circuit Breakers
IS : 13947-1989 (Part-)	Moulded Case Circuit Breakers
IS : 13947 - 1993 (Part-)	Degree of protection provided by enclosures for LV switchgear and control gear.

IS : 13947 - 1993 (Part-)	General requirement for switchgear and control gear for voltage not exceeding 1000 Volts.
IS : 1651 & 1652 1991	Stationary cells and batteries lead acid type.

APPENDIX - II

ABBREVIATIONS

The following abbreviations have been used in the accompanying Specifications, drawings and schedule of works

CU	stands for copper.
GI	stands for Galvanized Iron (Mild Steel)
V	stands for Volts
KV	stands for Kilo Volts
HV	stands for High Voltage (3.3 KV and above)
MV	stands for Medium Voltage (110 V ,230 V ,415 V, 600 V, 110 V)
LV	stands for Low Voltage (32 V & Below)
HT	stands for High Tension
LT	stands for Low Tension
SF6	stands for Sulphur Hexa Fluoride Gas
VCB	stands for Vacuum Circuit Breaker
PVC	stands for Polyvinyl Chloride
AMP	stands for Amperes
KWH	stands for Kilowatt Hours
KW	stands for Kilo Watts
BIS	stands for Bureau of Indian Standards
IS	stands for Indian Standards

IEE	stands for Institution of Electrical Engineers - London
NEC	stands for National Electrical Code
ACB	stands for Air Circuit Breaker
RCCB	stands for Residual Current Circuit Breaker
MCB	stands for Miniature Circuit Breaker
MCCB	stands for Moulded Case Circuit Breaker
SP	stands for Single Pole
DP	stands for Double Pole
TP	stands for Triple Pole
TPN	stands for Triple Pole and Neutral
4 Pole	stands for 3 phase and neutral of same capacity (size)
MDB	stands for Main Distribution Board
SDB	stands for Sub Distribution Board
FDB	stands for Final Distribution Board
MCC	stands for Motor Control Centre

LIST OF ACCEPTABLE MAKE OF EQUIMENTS AND MATERIALS

The following makes of materials are acceptable for use in above work.

EQUIPMENTS & CABLING.

(1)	LT Panel /	Tricolite Electric Industries / Adlec / Impact Electric Controls Pvt.Ltd/ Sterling Wilson/Vidyut Control/Shivalik/C&S
(2)	Power Contactors	L&T/ABB/Siemens/Schneider/Legrand
(3)	ACB	L&T/ABB/Siemens/Schneider/Legrand
(4)	Power Capacitor ISI Mark	Legrend/Asian/Pristine/C&S/SEL/ABB/Schneider.
(5)	Bus Trunking	Legrand/L&T/Schnieder/ABB.
(6)	MCB,MCBDB,RCBO's/ RCCB's .	Schneider Electric/Legrand/L&T/ Siemens/ABB.
(7)	MCCB 3 & 4 Pole.	Schneider Electric/ Siemens/Larsen & Toubro/ABB.
(8)	Ammeter/Voltmeter/Selector Switch,	AE/C&S/L&T/Kappa/KayCee/Schneider
(9)	HT Cable	NICCO/ICC/Havells/Gloster
(10)	LT Cable	Polycab/Universal/Havells
(11)	HT Cable end termination.	M Seal/Denson/Raychem/Cab Seal.
(12)	Electronic Thyristors	GE/Toshiba /ABB/Schneider.
(13)	7% detuned Reactors	GE/L&T/Areva/SEL/ABB/Schneider.
(14)	Battery.	Exide/Standard/Amarraja
(15)	Apfc relay	L&T/ABB/Siemens /EPCOS
(17)	Apfc Panel.	ABB/Schneider/Tricolite Electric Industries / Adlec / Control & Switch gears / Sterling Willson /Vidyut Control
(18)	PLC	Allen Bradley/ Siemens/ Honeywell

Schedule of Quantity

SITC OF MAIN LT PANEL, AMF, AUTO LOAD MANAGEMENT, FLOOR PANELS ETC AT NHSRC, NIHFW CAMPUS				
S.NO	**DESCRIPTION**	**QTY**	**UNIT**	**AMOUNT**
1	**M.V. PANEL BOARDS**			
	Design, manufacture, supply, storing, inspection, handling, assembling, installation in correct alignment, position, affecting proper connections, testing and commissioning of 14 SWG CRCA sheet steel fabricated cubical type Main L. T. Panel, floor mounting, dust & vermin proof, front operated construction, enclosure class outdoor type - IP 54, powder coated after proper treatment with 9 tank process with top/bottom removable gland plates, as required, double compression type cable glands, earth bus, hinged and lockable doors to achieve dust and vermin proof complete with all inter connections small wiring by min. 2.5 sq. mm. FRLS copper wires, ckt labels etc. The Aluminium Bus Bar shall be of suitable length, 500 volts, 3 phase 50 Hz TPN, electrolytic aluminium as per IS 8623 . The panel feeders shall be suitable for terminating suitable nos. 3.5 / 4 core armoured aluminium cable or Aluminium Bus Duct as required.			
	All MCCB shall be with Rotary handle.			
	All outgoing feeders shall be having Red & Green On/Off indicating light.			
	4 pole ACB should have 100% neutral rating.			
	Cable entry shall be as per Site conditions.			
	The following provisions shall be required to be made in the switchboard detailed below:			
	The Switchboard shall have provision for entry of all XLPE cables/bus duct from the top/bottom as required.			
	All live accessible parts shall be shrouded and all equipment shall be finger touch proof. The busbar insulation shall be with heat shrinkable sleeves. SMC/DMC shrouds and busbar supports shall be used.			
	Suitable tinned aluminium extension links for incoming/outgoing cables shall be provided wherever required.			

	Control circuits includes breaker control switch, auto manual selector switch, anti pumping relay, spring charging trip indication, TIMER, control wiring, Auxiliary contactors MCB's as required at site.			
	All the incomer breakers shall be interlocked with PLC's to avoid parallel operation.			
	All incomers 4 Pole ACBs having microprocessor based release shall have neutral CT.			
	All fault level breaking capacity indicates shall be Ics value at 415 volts.			
	All MCCB shall have variable overload settings.			
	Space Heater/ light/air filter shall be provided for each vertical compartment.			
	Padlocking facility shall be provided on all outgoing feeders.			
	All ACB's shall have all standard accessories such as CT's, Arc Chute, Safety Shutters etc.			
	All interconnecting Panel wiring from PLC to DG / Transformer / Bus Couplers as required.			
	Link and drops from ACB/MCCB shall be designed for full rated current of ACB/MCCB ratings at same current density as of Main Bus Bar.			
	The ACB release shall have LED indications to indicate each type of fault.			
	All ACB MCCB shall be Micro-Processor based (O/L, S/C & E/F protection).			
	1) All MCCBs should be Ics = Icu rated only.			
	2) All ACBs should be Icu=Ics = Icw = 35KA.			
	3) TP+N =Triple Pole and Neutral Link (Solid)			
2.1 MR	**MAIN LT PANEL SUITABLE FOR 35 KA AT 415 VOLT WITH PLC BASED INTERLOCKING LOGIC, AUTO LOAD SHARING, AUTO MAINS FAILURE & AUTO CHANGE OVER & RETAIN MAINS AFTER MAINS AVAILABE.**			
a)	**INCOMINGS FROM PSS:**			
	One (1) No. 800 Amps 415 volt 35 KA 4P EDO Type ACB complete with CT's, competable to BMS Shafty Shatters & following:			

	Microprocessor release with LCD display unit having inbuilt overload protection with time delay, short circuit protection with time delay and instantaneous alongwith earth fault protection with time delay.			
	230 V AC spring charging motor and closing coil.			
	Shunt trip coil 24 V DC and under voltage coil 230 V AC.			
	Safety shutter & 4 NO + 4 NC contacts.			
	3 nos cast resin current transformer of 2000/5 ratio class 1.0 for metering, 15 VA Burden for each			
	1 nos cast resin current transformer of 2000/5 ratio class 1.0 for APFCR , 15 VA Burden for each			
	Energy Analyzer Digital meter 415 V AC C.T.ratio 2000/5 Auxiliary 230 V AC 96 X 96 meter with RS. 485 Port to display all power parameters (V,F,I, KWh, KVAh, Pf, Harmonics & MDI etc.)			
	1 set of three R Y B indicating lamps for each			
	Red / green / amber with ON / OFF / Trip indicating lamps for each			
	3phase monitoring relay			
	Spring charge indication lamp			
	Breaker control switch			
	Illuminated Push button for healthy circuit			
	1 no. of CTs epoxy cast 2000/5, 15 VA Burden for each for APFC relay.			
	7mode spark gap surge suppressor for 200KA with appropriate fuses & FUSE base.			
	Terminal to receive 800 amp Al. XLPE cables			
b)	**DG SET-1 INCOMING - 1x 82.5 KVA**			
	One (1) No. 150 Amps 415 volt 35 KA 4P MCCB complete with CT's, Suitable contactor, competable to BMS Shafty Shatters & following:			
	Microprocessor release with LCD display unit having inbuilt overload protection with time delay, short circuit protection with time delay and instantaneous alongwith earth fault protection with time delay.			
	230 V AC spring charging motor and closing coil.			
	Shunt trip coil 24 V DC and under voltage coil 230 V AC.			
	Safety shutter & 4 NO + 4 NC contacts.			

	3 nos. cast resin current transformer of 160 / 5 ratio class 1.0 for metering , 10 VA Burden.			
	Energy Analyzer Digital meter 415 V AC C.T.ratio N/5 Auxiliary 230 V AC 96 X 96 meter with RS. 485 Port to display all power parameters (V,F,I, KWh, KVAh, Pf, Harmonics etc.).			
	1 set of three R Y B indicating lamps			
	Red / green ON / OFF indicating lamps.			
	Breaker control switch			
	3phase monitoring relay			
	Reverse power relay – 415 V AC.			
	Illuminated push button for healthy circuit.			
	Terminal to receive 160 amp AL XLPE cables.			
	1 no automatic battery charger with DC volt meter and DC ammeter.			
c)	**DG SET-2 INCOMING - 1x 160 KVA**			
	One (1) No. 400 Amps 415 volt 35 KA 4P MCCB complete with same rating contactor, CT's, competable to BMS Shafty Shatters & following:			
	Microprocessor release with LCD display unit having inbuilt overload protection with time delay, short circuit protection with time delay and instantaneous alongwith earth fault protection with time delay.			
	230 V AC spring charging motor and closing coil.			
	Shunt trip coil 24 V DC and under voltage coil 230 V AC.			
	Safety shutter & 4 NO + 4 NC contacts.			
	3 nos. cast resin current transformer of 400 / 5 ratio class 1.0 for metering , 10 VA Burden.			
	Energy Analyzer Digital meter 415 V AC C.T.ratio N/5 Auxiliary 230 V AC 96 X 96 meter with RS. 485 Port to display all power parameters (V,F,I, KWh, KVAh, Pf, Harmonics etc.).			
	1 set of three R Y B indicating lamps			
	Red / green ON / OFF indicating lamps.			
	Breaker control switch			
	3phase monitoring relay			

	Reverse power relay – 415 V AC.			
	Illuminated push button for healthy circuit.			
	Terminal to receive 400 amp AL XLPE cables.			
	1 no automatic battery charger with DC volt meter and DC ammeter.			
d)	**BUS COUPLER-1:**			
	One (1) No. 150 Amps 415 volt (35 KA) 4P MCCB with same rating contactor.			
	2 nos NO/NC contacts			
	Red / Green / amber ON / OFF indicating lamp.			
	24 V DC shunt trip coil			
	Under voltage release 240 volt AC			

e)	**INTERLOCKING**			
	The Bus section and Incoming ACB's /MCCBs shall be electrically interlocked with micro PLC's to achieve the sequence of operation as per Electrical schematic with manual override mode.			
f)	**BUSBAR**			
	One sets of Electrolytic high conductivity aluminium three phase and neutral busbars rated at 250 amps throughout having a current density of 1 amp per sq mm suitable to with stand symmetrical fault level of 35 MVA at 415 volts.The neutral busbar is to be of 100% capacity.			
	One set of Electrolytic high conductivity aluminium three phase and neutral busbars rated at 1000 amps throughout having a current density of 1 amp per sq mm suitable to with stand symmetrical fault level of 35 MVA at 415 volts.The neutral busbar is to be of 100% capacity.			

g)	**OUTGOING UNITS**			
	Four (3) No.250 Amps FP MCCB 36 KA (Ics = Icu) with microprocessor release having overcurrent and short circuit protection & Earth Fault Protection with MFM (showing V/A/F/KWHr) with mactching cast resin CT's, ON/OFF indication with control MCB.			
	Two (2) No.160 Amps (One TP and another FP MCCB), 36 KA (Ics = Icu) with microprocessor release having overcurrent and short circuit protection & Earth Fault Protection with MFM (showing V/A/F/KWHr) with mactching cast resin CT's, ON/OFF indication with control MCB.			
	Two (2) No.125 Amps FP MCCB 36 KA (Ics = Icu) with microprocessor release having overcurrent and short circuit protection & Earth Fault Protection with MFM (showing V/A/F/KWHr) with mactching cast resin CT's, ON/OFF indication with control MCB.			
	Two (2) No.100 Amps FP MCCB 36 KA (Ics = Icu) with microprocessor release having overcurrent and short circuit protection & Earth Fault Protection with MFM (showing V/A/F/KWHr) with mactching cast resin CT's, ON/OFF indication with control MCB.	1	Sets	
2.2 MR	**Capacitor Panel-75 KVAR**			
	Supply, Testing, Commissioning of Automatic Capacitor Control Panel with 75 KVAR capacitors comprising of (2 x 25 KVAR + 1 x10 KVAR+ 2 x 5 KVAR+ 1x3 KVAR + 1x2 KVAR) units in a bank formation to achieve Automatic operation. The Panel shall be fabricated out of 2 mm thick sheet steel, dust & vermin proof and channel iron frame work of cubicle construction suitable to with stand a fault level of 36KA at 415 volts, 3 phase, 50 Hz AC supply including interconnection, wiring, painting, earthing, labeling and providing danger plates etc. as per specifications and equipped as follows:-			
	Capacitor - Power capacitors (HEAVY DUTY) shall be suitable for 440volts, 3 phase, 50 Hz. Complete with discharge resistance as per IS 13340 / 41. Dielectric medium shall be MPP (Metalized Polypropylene).			

	8 Stages programmable microprocessors based APFC relay with LCD Display to sense the power factor and give phased impulses to contactor coils for switching ON &n OFF the required no. of Capacitors.			
	Capacitor bank must be designed to withstand system over voltage, increased voltage dute to series reactor and harmonics.			
	160 A TP MCCB (35 KA)- 1 No.			
	300 A TP aluminium bus bars - 1 Set.			
	Digital Voltmeter 0-500 V with 4 position selector switch - 1 Set.			
	Digital Ammeter 0-400 A with 4 position selector switch & suitable size of CTs - 1 Set.			
	One set of (3 Nos.) LED type RYB indicating lamps with 2 A SP MCBs for protection.			
	Power factor meter with Automatic P.F.C.R. & CT for unbalanced load - 1 Set.			
	Control MCCBs (Thermal Magnetic Type) :-			
	2 nos. 63 A TP MCCB 25 kA, (Ics = Icu).			
	1 nos. 32 A TP MCCB 25 kA, (Ics = Icu).			
	2 nos. 10 A TP MCCB 16 kA, (Ics = Icu).			
	2 nos. 16 A TP MCCB 16 kA, (Ics = Icu).			
	ON/ OFF push buttons (8 nos. ON & 8 nos. OFF)			
	Contactors:			
	Capacitor Duty Contactor for 25 KVAR -2 Nos			
	Capacitor Duty Contactor for 10 KVAR -1 Nos			
	Capacitor Duty Contactor for 5 KVAR -2 Nos			
	Capacitor Duty Contactor for 3 KVAR -1 Nos			
	Capacitor Duty Contactor for 2 KVAR -1 Nos			
	ON/OFF indication lights for each unit- 8 sets.			
	Auto-Manual Switch - 1 No.			
	P.F sensing cable & control MCB- Lot.			

	Time delay relay resistance, aux, relays A/M selector switch and necessary control for above.	1	Sets	
2.3 MR	**MDB PANEL- (GROUND & FIRST FLOOR)**			
a)	**INCOMING**			
	1 Nos. 250 Amps 25 kA 415 volt grade TPN MCCB with overcurrent and short circuit termal megnegic based with adjustable overload releases complete with			
	Square flush mounting 0-250 amp ammeter with 3 way and OFF selector switch			
	3 nos. cast resin current transformers of 250/5 ratio class 1.0 for metering.			
	Three phase indicating lamp (LED type) with MCB.			
	Square flush mounting voltmeter 0-500 volt with 3 way and OFF selector switch.			
b)	**BUSBAR**			
	Electrolytic high conductivity aluminium three phase and neutral busbars rated at 400 amps having a maximum current density of 1.0 amp per sq.mm suitable to with stand symmetrical fault level of 25 M.V.A at 415 volts. The neutral busbar is to be of 100% capacity.			
c)	**OUTGOING UNITS**			
	One (1) nos. 200 amps FP MCCB 25 KA with direct/CT (with suitable ratio CTs) operated digital MFM with RS-485 port.			
	Two (2) nos. 125 amps FP MCB 25 KA with direct/CT (with suitable ratio CTs) operated digital MFM with RS-485 port.			
	One (1) nos. 100 amps FP MCCB 25 KA with direct/CT (with suitable ratio CTs) operated digital MFM with RS-485 port.			
	Three (3) nos. 63 amps TPN MCCB 25 KA with direct/CT (with suitable ratio CTs) operated digital MFM with RS-485 port.	2	Sets	

2.9 MR	**LIFT PANEL**			
a)	**INCOMING :**			
	1 Nos. 63 amps 25 kA 415 volt grade TPN MCCB with overcurrent and short circuit protection thermal megnegic based with adjustable overload releases complete in all respect.			
	Three phase indicating lamp (LED type) with MCB.			
b)	**BUSBAR**			
	Electrolytic high conductivity aluminium three phase and neutral busbars rated at 100 amps having a maximum current density of 1.0 amp per sq.mm suitable to with stand symmetrical fault level of 25 M.V.A at 415 volts. The neutral busbar is to be of 100% capacity.			
c)	**OUTGOING UNITS**			
	Two (2) Nos. 25 Amps DP MCB 10 KA.			
	Two (2) Nos. 40 Amps 4P RCBO (300mA) 10 KA.	1	Set	
2.10	**UPS OUTGOING PANEL**			
a)	**INCOMING :**			
	1 Nos. 100 amps 25 kA 415 volt grade FP MCCB with overcurrent and short circuit protection thermal megnegic based with adjustable overload releases complete in all respect.			
	Three phase indicating lamp (LED type) with MCB.			
b)	**BUSBAR**			

	Electrolytic high conductivity aluminium three phase and neutral busbars rated at 150 amps having a maximum current density of 1.0 amp per sq.mm suitable to with stand symmetrical fault level of 25 M.V.A at 415 volts. The neutral busbar is to be of 100% capacity.			
c)	**OUTGOING UNITS**			
	Four (4) Nos. 40 Amps FP MCB 10			
	Three (3) Nos. 40 Amps 4P RCBO (300mA)			
	Three (3) Nos. 40 Amps DP RCCB (300mA)	1	Set	
	TOTAL OF MV PANEL BOARDS			