AN ISO 9001 & 14001 COMPANY

TENDER DOCUMENT

TENDER No: DLI/CON/710/563

FOR


VOLUME – II

ADDITIONAL CONDITIONS OF CONTRACT (ACC)

TECHNICAL SPECIFICATION

DRAWINGS
ADDITIONAL CONDITIONS OF CONTRACT (ACC)

1.0 The following Additional Conditions of Contract shall be read in conjunction with General Conditions of Contract. If there are any provisions in these Additional Conditions of Contract, which are at variance with the provisions of General Conditions of Contract, the provisions in these Additional Conditions of Contract shall take precedence.

2.0 INTRODUCTION

New Town Kolkata Development Authority, intends to undertake the construction of Administrative Building, at Plot No. DG/13, AA-1D Premises No.04-3333, Action Area – 1D, New Town Kolkata.

New Town Kolkata Development Authority (NKDA) is keen to develop their own office in the heart of this township which is eventually become a multiple/corporation office. The Authority has a dream that this multifunctional city will get a unique landmark building as its office with good aesthetics, which will enhance urbanscape.

In addition to providing of office facilities along with Conference room & Cafeteria, the building will also have landscaping features like foundation, water bodies, terrace garden etc. Internal roads & pathway area lighting will be of standard with good architectural views. Within the project area there will also be security & management staff room.

3.0 Description of the Project and scope of work:

- The project site is located at Premises no: 04-3333, DG-13, Action area-1D, New Town, Kolkata
- The area of the plot is approximately 7001.888 Sq.m.
- Total Built up Area is 14009.016 Sq.m The first phase built up area is 9619.269 Sq.m.
- Proposed FAR to be consumed is 2.001. The first phase FAR will be 1.37
- Proposed Ground Coverage is 19.71%.

4.0 Scope of Work:

The brief scope of work as mentioned below included in this tender shall include External & Internal Electrical works including Supply, Installation, Testing & Commissioning of Transformers, Electrical HT/LT Panels, Air-conditioning & Fire Fighting works including of fire detecting & fire-Hydrant etc. for Construction of Administrative Building, at Plot No. DG/13, Premises No. 04-3333, Action Area – 1D, New Town, Kolkata.

Apart from above, any other services not covered above but required as per direction of EPI are deemed to be included in the scope of work. The work is to be carried out on item rate basis as per bill of quantities and tender conditions.
The major buildings/ spaces (with all services) under design scope are as follows:

A. **Buildings/ Structures:**

   a) Reception lounge.
   b) Workstations.
   c) Conference room.
   d) Bank facilities.
   e) Archive.
   f) Cafeteria
   g) Gymnasium.
   h) Kitchen and pantry.
   i) Toilet Block (Ladies & Gents)
   j) Security & Manager’s Office
   k) Security Block
   l) Electrical Substation
   m) Pump room.
   n) UG & OH water tank

B. **Outdoor Areas:**

   a) Boundary Wall & Gate
   b) Roads, & Pathways
   c) Grass paver / Green Areas
   d) Planter box
   e) Fountains
   f) Water bodies
   g) Outdoor Illumination & DG
   h) Infrastructural Services

5.0 **QUALIFICATION OF TENDERERS**

To be eligible for this tender the bidders should fulfill the requirements for eligibility as mentioned in the Notice Inviting Tender (NIT) and should submit detailed data and credentials set out in Cl 19.0 of ITT (Vol-I) of the Tender. The Tenderers are required to fulfill all the eligibility criteria as stipulated in NIT and elsewhere in the Tender documents. The price bid of tenderers who fulfill the eligibility criteria as per evaluation of EPI shall only be opened. The decision of EPI in this regard shall be final & binding on the tenderers.

The set of tender document shall contain one set of hard copy of tender drawings the original hard copy of tender drawing shall be returned alongwith the tender document duly signed and stamped by the tenderer and shall form part of agreement.
6.0 DISQUALIFICATION

The tenderers may note that they are liable to be disqualified and not considered for the opening of Price Bid if;

a) Representation in the forms, statements and attachments submitted in the pre-qualification document are proved to be incorrect, false and misleading.

b) They have record of poor performance during the past 10 (ten) years such as abandoning the work, rescinding of contract for which the reasons are attributable to the non-performance of the contractor, inordinate delay in completion, consistent history of litigation / arbitration awarded against the contractor or any of its constituents or financial failures due to bankruptcy etc. in their ongoing / past projects.

c) They have submitted incompletely filled in formats without attaching certified supporting documents and credentials to establish their eligibility to participate in the Tender.

d) If the tenderers attempt to influence any member of the selection committee.

EPI reserves its right to take appropriate action including disqualification of tenderer(s) as may be deemed fit and proper by EPI at any time without giving any notice to the contractor in this regard. The decision of EPI in the matter of disqualification shall be final and binding on the Tenderers.

7.0 (a) The set of tender documents shall contain one set of hard copy of tender drawings. The original hard copy of tender drawings shall be returned along with the tender documents duly signed and stamped by the tenderer and shall form part of agreement.

(b) The tenderer who have downloaded the tender documents and drawings from EPI’s website shall also submit one set of hard copy of tender documents along with set of tender drawings duly signed and stamped by the tenderer and shall form part of agreement.

8.0 SPECIFICATIONS

i) All works are to be carried out in accordance with the General Conditions of Contract and Specifications including mode of measurement of West Bengal P.W.D Schedules in force at the time of acceptance of the tender.

ii) The specification for work not covered by the specifications laid down in the PWD (WB) Schedules, DSR or Schedule of MES, CPWD shall be followed.

iii) Items of Works not covered in the above schedules should be governed by I.S.I code of Practice, National Building Code, Technical specifications as laid in this tender document, and as per best practice according to the Engineer-in-Charge and the Consultant.
iv) In addition to the above, the Technical specifications as mentioned in the Tender documents shall be applicable.

v) This contract shall be governed by the Indian Laws for the time being in force. The contract is confidential and must be strictly confined to the purposes of the contract.

vi) The contractor shall provide everything necessary for the proper execution of the works according to the intent and meaning of the specifications and drawings taken together whether the same may or may not be particularly shown or described therein provided that the same can be reasonably be inferred there from and if the contractor finds any discrepancy in the specifications & drawings and between the drawings, he shall immediately and in writing refer the same to the employer who shall decide which is to be followed.

vi) The Work Order / LOI will be issued by EPI and handing over of the site and date of commencement of the contract shall be within 10 (ten) days of issue of such letter.

9.0 PRICE ESCALATION

No price escalation is payable.

10.0 MOBILIZATION ADVANCE – Clause no. 8.0 (8.1 – 8.6) of General Conditions of Contract (GCC) stands deleted.

11.0 RETENTION MONEY - Clause no. 10.0 of GCC shall be modified as under:-

The retention money shall be deducted from each running bill of the Contractor at 8% (eight percent only) of the gross value of the Running Account. The Earnest Money Deposited by the tenderer in the form of Demand Draft will be treated as part of the Retention Money. The retention money will be paid in two equal installments in twelve months after completion. After completion, First installment will be paid after six months from the date of completion. The second installment will be paid after 12 months from the date of completion.

12.0 TAXES AND DUTIES – Sub-clause no. 13.1 of Clause 13.0 of GCC shall be modified as under. Sub-clauses no. 13.2, 13.3, 13.4 & 13.5 of clause no.13.0 stand good.

“The contractor shall be responsible for the payment, wherever payable, at his own cost of all taxes such as excise duty, custom duty, sales tax, including the purchase tax, consignment tax, work contract tax, service tax, VAT or any other similar tax in the state concerned, turnover tax, toll tax, octroi charges, royalty, cess, labour cess, professional taxes, levy and other tax (es) or duty (ies) which may be specified by Local / State / Central Government from time to time on all materials, articles which may be used for this work. The rates quoted by him in the Tender in Bill of Quantities shall be inclusive of all such taxes, duties, etc. The imposition of any new and / or increase in the aforesaid taxes, duties, levies (including fresh imposition of work
contract tax, turnover tax, sales tax on work contract, VAT or any other similar tax) etc. during the currency of the contract shall be borne by contractor and shall not be paid or reimbursed to the contractor by EPI. In the event of non-payment / default in payment of any octroi, royalty, cess, labour cess, professional taxes, turnover tax, sales tax, including the purchase tax, consignment tax, work contract tax, VAT, service tax or any other similar tax in the state concerned, customs, excise or any other levy / tax including labour dues etc. by contractor, EPI reserves the right to withhold the dues / payments of contractor and make payment to Local / State / Central Government authorities or to labourers as may be applicable. The contractor should submit along with the Tender Registration Certificates with Sales Tax on works contract authority etc. otherwise appropriate recovery shall be made from his bills”.

Income tax and vat will be deducted as per govt. order issued from time to time and would be applicable on the date of making payment of the bills. Building and other construction workers cess @1% will be deducted from the progressive bill in pursuance with GO no. 599A/4M-28/06 dated 27.09.2006

13.0 **SECURED ADVANCE AGAINST NON-PERISHABLE MATERIALS** – Clause no. 35.0 of GCC stands deleted.

14.0 **EXTRA OR DEVIATION ITEMS**

The rates of extra or deviation items for EPI are to be derived from PWD (WB) current schedule of rates or DSR or MES or item rate analysis. If not possible, derived as cost as per market analysis. After the rates approved by client (NKDA), EPI will keep margin of 7% and pay 93% of the approved cost to the tenderer.

15.0 **Security Deposit cum Performance Guarantee**

Clause No.09 is stands modified as under

The Security Deposit cum Performance Guarantee is the 2% of the contract value, However earnest Money already deposited may be converted as security Deposit Cum Performance guarantee.

16.0 A final certificate of rectification of all defects pointed out by the handing over taking board detailed by NKDA/EPI and / or during defect liability period shall be obtained from the nominated officer of NKDA/EPI prior to releasing of the Security deposit by EPI.

17.0 **Clause No. 72.4.1 of GCC stands modified as under** :

Within 10 (Ten) days of date of Letter of Intent, the contractor shall submit a Time and Progress Chart (CPM/PERT/Quantified Bar Chart) and get it approved by the Engineer-in-Charge. The Chart shall be prepared in direct relation to the time stated in the contract documents for completion of items / scope of the works. It shall indicate the forecast (mile stones) of the dates of commencement and completion of various items trades, sections of the work and may be amended as necessary by agreement between the Engineer-in-Charge and the Contractor within the limitations of time
imposed in the contract documents, to ensure good progress during the execution of
the work. The physical report including photographs shall be submitted by the
contractor on the prescribed format & the intervals (not later than a month) as decided
by the Engineer-in-Charge. The compensation for delay as per clause 72.1 (revised as
per ACC) shall be leviable at intermediate stages also, in case the required progress
is not achieved to meet the time deadlines of the completion period and / or
milestones of time and progress chart provided always that the total amount of
compensation for delay to be paid under this condition shall not exceed 10% of the
tendered value of work.

In case entire work is completed within the total time period of completion or extended
period of completion allowed, the compensation for delay due to not achieving
progress at intermediates stage, if any, shall be refunded without any interest charges.

18.0 ARBITRATION: Modification of arbitrations clause no 76.0 of

General Conditions of Contract (GCC) Sub Clause no.76.1 and 76.3 of Arbitration Clause
no.76.0 are amended as given below. Sub Clause no.76.2 will remain the same.

76.0 ARBITRATION

76.1 Before resorting to arbitration as per the clause given below, the parties if they so
agree may explore the possibility of conciliation as per the provisions of Part III of the
Arbitration and Conciliation Act, 1996 as amended by Arbitration and Conciliation
(Amendment) Act, 2015. When such conciliation has failed, the parties shall adopt the
following procedure for arbitration:

i) Except where otherwise provided for in the contract, any disputes and differences
relating to the meaning of the Specifications, Design, Drawing and Instructions
herein before mentioned and as to the quality of workmanship or materials used in the
work or as to any other questions, claim, right, matter or things whatsoever in any way
arising out of or relating to the Contract, Designs, Drawings, Specifications, Estimates,
Instructions, or these conditions or otherwise concerning the works of the execution or
failure to execute the same whether arising during the progress of the work or after the
completion or abandonment thereof shall be referred to the Sole Arbitrator appointed by
the Chairman & Managing Director (CMD) of Engineering Projects (India) Limited (EPI) or
any other person discharging the functions of CMD of EPI. The person approached for
appointment as Arbitrator shall disclose in writing circumstances, in terms of Sub-Section
(1) of Section (12) of the Arbitration and Conciliation Act, 1996 as amended by Arbitration
and Conciliation (Amendment) Act, 2015 as follows:

a) such as the existence either direct or indirect, of any past or present
relationship with or interest in any of the parties or in relation to the subject-matter
in dispute, whether financial, business, professional or other kind, which is
likely to give rise to justifiable doubts as to his independence or impartiality; and

b) which are likely to affect his ability to devote sufficient time to the arbitration and in
particular his ability to complete the entire arbitration within a period of twelve
months.
The Arbitrator shall be appointed within 30 days of the receipt of letter of invocation of arbitration duly satisfying the requirements of this clause.

ii) if the arbitrator so appointed resigns or is unable or unwilling to act due to any reason whatsoever, or dies, the Chairman & Managing Director aforesaid or in his absence the person discharging the duties of the CMD of EPI may appoint a new arbitrator in accordance with these terms and conditions of the contract, to act in his place and the new arbitrator so appointed may proceed from the stage at which it was left by his predecessor.

iii) It is a term of the contract that the party invoking the arbitration shall specify the dispute/differences or questions to be referred to the Arbitrator under this clause together with the amounts claimed in respect of each dispute.

iv) The Arbitrator may proceed with the arbitration ex-parte, if either party, in spite of a notice from the arbitrator, fails to take part in the proceedings.

v) The work under the contract shall continue as directed by the Engineer-In-Charge, during the arbitration proceedings.

vi) Unless otherwise agreed, the venue of arbitration proceedings shall be at the venue given in the „Memorandum to the „Form of Tender“.

vii) The award of the Arbitrator shall be final, conclusive and binding on both the parties.

viii) Subject to the aforesaid, the provisions of the Arbitration and Conciliation Act, 1996 as amended by Arbitration and Conciliation (Amendment) Act, 2015 or any statutory modifications or re-enactment thereof and the Rules made there under and for the time being in force shall apply to the arbitration proceedings and Arbitrator shall publish his Award accordingly.

19.0 Clause No.76.3 of GCC, stands modified as under:

JURISDICTION:

The courts in Kolkata alone will have jurisdiction to deal with matters arising from the contract, to the exclusion of all matters.

20.0 COMPLETION SCHEDULE

<table>
<thead>
<tr>
<th>Sr.No</th>
<th>Period from the date of Start</th>
<th>Description of work to be completed during the period specified under column no.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>From the date of start of 1st month to the end of 1st month</td>
<td>Submission of all GA Drawings &amp; Schematic diagram and approval through NKDA/EPIL towards manufacturing clearance of electrical equipments.</td>
</tr>
<tr>
<td>2</td>
<td>From the mid of 2nd month up to the end of 5th month</td>
<td>Manufacturing &amp; supply of Transformer, VCB, Distribution Panel, Fabrication of piping and</td>
</tr>
</tbody>
</table>
ducting at site. All these electrical items shall be inspected by NKDA/EPI. Others work are as under:
1) Completion of internal services of Sub-station work & compound lighting
2) 50% internal services work to be completed Air conditioning with VRF & Fire fighting system.

From the start of 6th month upto the end of 8th month.

Completion of all works including testing & commissioning of all electrical equipments as well as HVAC and Firefighting equipment. as per scope of work and handing/taking over completion certificate should be taken from NKDA through EPI

21.0 PLANT & MACHINERY

All plant & machinery required for execution of work shall have to be arranged by the contractor at his own cost. However, the Contractor has to deploy following minimum plant & machinery at site immediately after award of work:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Minimum numbers required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HV set with secondary injection set towards commissioning of electrical equipments.</td>
<td>One</td>
</tr>
<tr>
<td>2.</td>
<td>Lighting Equipment</td>
<td>As per requirement</td>
</tr>
<tr>
<td>3.</td>
<td>DG Set (125 KVA)</td>
<td>As per requirement</td>
</tr>
<tr>
<td>4.</td>
<td>Hydra crane 10 tonne or more capacity</td>
<td>As per requirement</td>
</tr>
<tr>
<td>5.</td>
<td>Others tools and tackles as per latest IS/IES requirement towards testing &amp; commissioning of electrical equipments.</td>
<td>As per requirement</td>
</tr>
</tbody>
</table>

Note:

a) Any other equipment for site test as outlined in CPWD/ BIS specification and as directed by the Engineer-in-Charge.

b) The quantities of equipments indicated are tentative and can be increased as per the requirement of work OR as per the direction of Engineer-in-Charge. The above equipment list is indicative and not complete. The contractor has to deploy all the required equipment to complete all the works within stipulated specifications & time period as per contract documents.
c) The contractor will not be allowed to take out equipments from the site without the written permission of Engineer-in-Charge.

22.0 The final bill will be submitted by the contractor within 90 days from the date of acceptance of completion of work accompanied by the following documents:

a) Completion certificate issued by the Engineer-in-Charge specifying the handing over of the work including list of inventories (fittings & fixtures).

b) Computerized stage wise payment schedule.

c) No claim certificate by the contractor.

d) No claim certificate from the sub-agencies / venders engaged by the contractor.

e) ‘As built’ drawings.

f) Periodical services and measurement books.

g) Drawings for layout of underground cables and details showing location of sluice valves, electric cable joints etc.

h) All operation and maintenance manuals.

i) All statutory approvals from various state / central govt. local bodies, if required for completion & handing over of the work as included in scope of Contractor.

j) Manufacture’s guarantee of various machines / equipments installed as part of works.

23.0 FACILITIES

The sub-clause 28.3 of the clause no. 28 of General Conditions of Contract (GCC) for Furnished Office Accommodation & Mobility and Communication to be Provided by Contractor to EPI shall be replaced and read as under:-

The contractor shall make his rates in Bill of Quantities sufficiently comprehensive to cover the cost of the facilities as per details shown below and the contractor shall not be entitled for any extra payment for the same.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. OFFICE WITH FACILITIES – The contractor is to provide office with following facilities till defect liability period.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A) OFFICE ACCOMMODATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furnished Office/ Office cum Residential accommodation with furniture as per direction of EPI with basic amenities like toilets, drinking water arrangement, lights, fans etc. for exclusive use of EPI’s Engineers &amp; Staff. Maintenance of the same till Defect Liability Period shall be borne by the contractor. The Specifications and Design of accommodation shall be as approved by EPI.</td>
<td>Sq. ft.</td>
<td>500</td>
</tr>
<tr>
<td>B) OFFICE EQUIPMENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office Tables</td>
<td>Nos.</td>
<td>2</td>
</tr>
<tr>
<td>Office Chairs</td>
<td>Nos.</td>
<td>6</td>
</tr>
<tr>
<td>Executive Table &amp; Chair set</td>
<td>Nos.</td>
<td>2</td>
</tr>
<tr>
<td>Air Conditioner with Cooling &amp; Heating (1.5 Ton Capacity)</td>
<td>No.</td>
<td>1</td>
</tr>
<tr>
<td>C) CONSUMABLES</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
All consumables like Stationary, Toner / ink etc. shall be provided by Tenderer till end of defect liability period. (Stationary items are inclusive of visiting cards, rubber stamps, letter pads, photocopies papers & other items of daily office use). Amount shall be restricted to Rs. 2000/- per month

| D) Office Boy on full time basis for EPI | Nos. 1 |

The above gadgets facilities should be brand new and of reputed make and all facilities shall be provided and maintained properly (including payment of water & electricity bills etc. for office accommodation only) by the Tenderer at Project site or at any other office related with execution of this project till completion of work, handing over, defect liability period in all respect at his own cost. The Tenderer shall also make stand-by arrangement for water & electricity to ensure uninterrupted supply.

The equipment/items shall be the property of Tenderer at the end of contract. The Tenderer shall be responsible for watch and ward of site office and other facilities etc. In case of theft/damage of any equipment/items, the Tenderer shall immediately replace the same within a maximum period of two days.

The Tenderer shall provide ‘Sign Board(s)’ as per design approved by EPI and/or Client.

In case the above facilities are not provided by the Tenderer within 10 (ten) days of award of work or replacement is not provided within the specified period, EPI shall arrange the same at the risk and cost of the PARTY and make the recoveries from the bills of the Tenderer for the same. The decision of EPI shall be final and binding on the Tenderer in this regard.

The Display Boards for the Project shall be supplied and erected as per given sizes, specifications and descriptions and at specified locations, as approved by EMPLOYER/EPI.

24.0 The Tenderers must understand that the items marked in schedule of work are actual items to be executed. Alteration, omission, deduction or addition from / to these items is at the discretion of the employer without effecting the terms of the contract. The rates have to be quoted on the basis of percentage (%) above, below or at par on the estimated value of the work.

25.0 ENVIRONMENTAL CONSIDERATIONS

The Contractor shall be concerned with the impact of his work upon the Environment. This applies to the effect upon the residential community, adjacent industrial facilities and upon the area outside the site boundary. Areas of concern will include but are not limited to:

ii) Use of clean fuels to minimize air polluting emissions.
iii) Control of other air pollutants.
iv) Recovery and recycling of usable materials.
v) Control of vehicle noise
vi) Control of noise from power facilities.
vii) Limitation of vibrations.
viii) Preservation of natural land to the extent possible.
ix) Preservation of archaeological features.

26.0 Custody of Drawings

All the approved Drawings shall remain in the sole custody of the Engineer-in-Charge but one copy thereof shall be furnished to the Contractor free of charge. The Contractor shall provide and make at his own expenses any further copies required by him. At the completion of Contract the Contractor shall return to the Engineer-in-Charge all drawings provided under the Contract.

One copy of the Drawings, furnished to the Contractor as aforesaid, shall be kept by him on the site and the same shall at all reasonable times be available for inspection and use by the Engineer-in-Charge and his Representatives and by any other person authorized by the Engineer-in-Charge.

27.0 Disruption of Progress

The Contractor shall give written notice to the Engineer-in-Charge on progress of the works likely to be delayed or disrupted unless any further approval of drawing or order, including a direction, instruction or approval is issued by the Engineer-in-Charge within a reasonable time. The notice shall include details of the drawing or order required and of why and by whom it is required and of any delay or disruption likely to be suffered if it is late.

28.0 Delays and Cost of Delay for Drawings

If, by reason of any failure or inability of the Engineer-in-Charge to issue within a time reasonable in all the circumstances any approval of drawing or order requested by the Contractor in accordance with clause (6) of this section, the work remains suspended or delayed then the Contractor shall be granted necessary extension of time only. But he shall have no claim to extra payment or compensation whatsoever on the grounds of above delay.

29.0 Delay in Getting Site of Work

If at any time after the issue of work order, the work, and/or any part thereof cannot be started or shall remain suspended due to public opposition, non-availability of site, delay in shifting public utilities or for any other reason whatsoever within the period of completion of work, the Contractor shall be granted necessary extension of time. But he shall have no claim to extra payment or compensation whatsoever on the grounds of
above delay.

If, however, the above hindrances are not removed within the schedule time and the Contractor is not agreeable to execute further works in the extended time, the Contract may be terminated and the Contractor shall have no claim to any payment on account of idle labour, establishment etc. or compensation whatsoever on account of any profit or advantage which he might have derived from the execution of the aforesaid work in full or in part.

30.0 Survey : Layout and Access

The Contractor shall satisfy himself regarding the correctness of the site Layouts, levels etc. as shown in the drawings or given in the specifications. Before starting the work he shall also carry out at his own cost survey of the whole work site jointly with the Department. Discrepancies noticed between Departmental drawing and the joint survey shall be informed in writing to the Engineer-in-Charge and got corrected by the Engineer-in-Charge. Such deviations as may arise out of the joint survey shall not vitiate the provisions of contracts and shall not entitle the Contractor to any extra payment of claim in any way.

After the joint survey a survey plan shall be prepared by the Contractor at his cost and got approved by the Engineer-in-Charge. Reference line and points shall be established by the Contractor at his own cost so as to serve as reference and “Dimension al Checking” of works. He shall prepare and submit a plan in quadruplicate to the E.I.C. showing such reference points with their full description at his cost.

The Contractor shall provide for all arrangements labour, equipments and materials needed for carrying out survey, setting out, layout checking, inspections measurements, testing at his own cost for which no separate payment will be made.

The Contractor shall also provide proper approach and access to all the works and stores including clearance of sites at his own cost.

31.0 Arrangement of Land

If on account of restriction of space within the project site, the Contractor experiences difficulties (on installation of plant and machinery and also) in stacking construction materials within the project site, he may have to arrange for lands(Road side flank, private land etc.) adjacent to the project site on his own and at his cost. The Contractor will not be entitled to any payment or any other incidental charges caused due to such arrangement.

32.0 Fire Fighting Arrangement

The Contractor shall provide at his own cost suitable arrangement for fire fighting. For this purpose he shall provide requisite number of Fire Extinguishers and adequate
number of buckets, some of which are to be always filled with sand and some with water. These equipments shall be provided at suitable prominent and easily accessible places and shall be properly maintained.

33.0 Terms & Stages of Payment

The Contractor is entitled to prepare and submit the running account bill before EPI, when work done value is more than Rs 25 lakh.

34.0 Reduced Rates and Part Rates

34.1 Reduced rates as decided by the E.I.C. shall be allowed for the works, which in the opinion of the E.I.C. are not done in strict conformity with specification and schedule of works but are acceptable. The relevant item rates in such cases shall be reduced and approved by the Tender Accepting Authority, on the basis of analysis, which shall be binding to the contractor.

Works which are not in conformity with the specification and not acceptable in the opinion of E.I.C. will not be paid for and the cost of rectification or dismantling of such unacceptable work will have to be fully and solely borne by the Contractor.

34.2 Part payments for items, which are not fully complete as per specification of the contract, may be made by EPI/NKDA in cases when it is ensured that the items can be completed as per specification, in following days, by the contractor, when so allowed by the E-I-C. Application of this provision shall be very restricted and can only be exercised under specific case wise approval of the E-I-C strictly.

35.0 Supplementary and Substituted works:

(a) NKDA/EPI may require the contractor to do some additional work, newly or in substitution of items in the schedule of work, in the interest of the work under the contract. In such cases ‘Supplementary’ and / or ‘Substituted’ items may result. The specification and other details shall be governed and directed by the Tender Accepting Authority. The rate of such items shall be finalized and approved by competent authority of NKDA/EPI. The claim sheets, serially in triplicate, shall have to be furnished by the contractor, duly checked and forwarded, with item wise comments of approval by E-I-C. The claim sheet forms a part of the original contract and shall have all the relevant bearings of the contract. The limitations of such claims shall be governed by prevailing financial powers and provisions of NKDA.

These claims are usually termed as ‘extra claims’ and relates to extra works. Thus, no such extra works can be taken up by the contractor until their written appeal is allowed by the Tender Accepting Authority.

Notwithstanding to what has been stated elsewhere, any item of work which can be legitimately considered as not stipulated in the ‘Scope of work’ of the contract, but
becomes necessary as a reasonably contingent during actual execution of the work, it will have to be done by the contractor as and when directed by the E-I-C.

The admissibility of any claim of supplementary / substituted item or the acceptance thereof including award of item wise rates and all other related matters will rest with the tender / quotation accepting authority and shall be binding to all concerned.

(b) Rates for Supplementary and Substituted item of works: The schedule of rates shall mean the schedule of rates of the Presidency circle, PWD, West Bengal, DSR, MES or any references made in similar other authorities, as been settled by NKDA/EPI, applicable during the tenure of this contract. Rates for any other item (or part thereof), which are not covered in the said schedule of rates, will be analyzed from various other references and market rates, in which usual profit and overhead (as per state PWD schedule) will be included.

**36.0 Time of Completion**

The entire work as per offer shall be completed within 8 (eight) months from the date of issue of work order. The time of completion is firm and final and supersedes any other time mentioned elsewhere in any clause(s) of tender document.

The period of completion given includes the time required for mobilization and testing as well, rectifications, if any, re-testing and completion in all respects to the entire satisfaction of the Engineer-in-Charge including the monsoon season.

The Contractor shall scrupulously adhere to the targets/program as envisaged in his micro-plan of work program by deploying adequate personnel and construction tools and tackles and he shall also supply all materials of his scope of supply in time to achieve the targets set out.

**37. INFORMATION TO BE SUPPLIED BY THE CONTRACTOR DURING THE EXECUTION PERIOD.**

A senior representative of the CONTRACTOR shall attend weekly meetings at the site and in addition, meetings as arranged by the EMPLOYER to discuss the progress of work and sort out problems if any and ensure that the work is completed in the stipulated time. The CONTRACTOR shall submit to the Engineer-in-Charge, every fortnightly:

a. Detailed industrial statistics regarding the labour employed by him daily. A fortnightly progress report along with requisite photographs.

b. Special incident at site.

c. Whether the work is progressing according to schedule, or not. If not, what are the problems and the remedial measures to be taken to regain schedule.

d. Record of the approvals by EMPLOYER
e. Record of the discussions by EMPLOYER
f. Fortnightly Construction Schedule
  g. Monthly Construction Schedule
  Detailed Schedule indicating when the REPRESENTATIVE’S presence is required at site.

38.0 The Contractor shall comply with all the provisions of the following statutory acts or any modifications thereto and the rules made there under from time to time.
  - Indian Factories Act 1948
  - Payment of Wages Act 1936
  - Minimum Wages Act 1948
  - Employers Liability Act 1938
  - Apprentices Act 1961
  - Workmen’s Compensation Act 1923
  - Industrial Disputes Act 1947
  - The Maternity Benefits Act 1961
  - Contract Labour (Regulation and Abolition) Act 1970
  - Employment of Children Act 1933
  - Provident Funds and Miscellaneous Provisions Act 1952
  - The Employee’s Pension Scheme 1995

39.0 Should a report be made by an Inspecting Officer, as defined in the Contract Labour (Regulation and Abolition) Act 1970, EPI shall have the right to deduct from any money due to the Contractor any sum required, or estimated to be required, for making good the loss(es) suffered by a worker or workers by the reason of non-fulfillment of the Conditions of the Contract relating to the benefits of workers, non-payment of wages or of deduction made from their wages which are not justified by the terms of the Contract or non-observance.

40.0 The Contractor shall indemnify the employer against any payments to be made as hereunder and for the observance of the provisions of the aforesaid Acts.

41.0 In the event of the Contractor committing a default or breach of any of the provisions of the aforementioned Acts, as amended from time to time, of furnishing any information or submitting or filling in any Form/Register/Slip under the provision of these Acts which is materially incorrect, then on the report of the Inspecting officers, the Contractor shall, without prejudice to any other liability, pay to the employer a sum not exceeding Rs. 1000.00 as Liquidated Damages. This shall be applied to each incident for every default, breach or furnishing of, submitting, making and/or filling-in materially incorrect statements, the exact amount shall be fixed by the Engineer in Charge.

42.0 In the event of the Contractor’s default continuing in this respect, the Liquidated Damages may be increased to Rs 100.00 per day for each day that default occurs
up to a maximum of one percent (1%) of the Contract Amount.

43.0 The Engineer in Charge shall deduct such amounts from the interim application for Payment or the Security Deposit of the Contractor and credit the same to the Welfare Fund constituted under these Acts. The decision of the Employer in this respect shall be final and binding.

44.0 Technical Manpower Requirement

<table>
<thead>
<tr>
<th>Description</th>
<th>Minimum number required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Site-in-Charge, Engineering graduate with eight years of experience / DCE with ten years of experience.</td>
<td>One</td>
</tr>
<tr>
<td>2. Billing Engineer, DCE with five years of experience.</td>
<td>One</td>
</tr>
<tr>
<td>3. Site Safety Officer with five years experience</td>
<td>One</td>
</tr>
</tbody>
</table>

45.0 Rate of Recovery in case of non compliance of above stipulated following rates:

<table>
<thead>
<tr>
<th>No</th>
<th>Qualification</th>
<th>Experience (Years)</th>
<th>Rate of Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Site-in-Charge, Engineering graduate with eight years of experience / DCE with ten years of experience</td>
<td>8</td>
<td>Rs.60,000/- per month</td>
</tr>
<tr>
<td>2.</td>
<td>Billing Engineer</td>
<td>5</td>
<td>Rs.35,000/- per month</td>
</tr>
<tr>
<td>3.</td>
<td>Site Safety Officer</td>
<td>5</td>
<td>Rs.35,000/- per month</td>
</tr>
</tbody>
</table>

46. SPECIFIC CONDITIONS (Part-A)

A. Operation phase:

The project proponent shall obtain necessary permissions from the New Town Electrical Supply Co. through NKDA/EPI in connection with drawing approval towards electrical layout / testing of HT Sub-station if required.

Noise barriers will be provided at appropriate locations so as to ensure that the noise levels do not exceed the prescribed standards.

The solid waste generated should be properly collected, segregated before disposal to the City municipal facility.

Any hazardous waste including biomedical waste from the site should be disposed of as per applicable Rules & norms with necessary approvals of the West Bengal Pollution
Control Committee.

Incremental pollution loads on the ambient air quality, noise and water quality should be periodically monitored after commissioning of the project.

The contractor should engage licensed electrician towards HT/ LT erection works. Necessary copy of license should be submitted at the time of commissioning in connection with taking approval from New Town Electricity Supply Company/ Electricity Authority/ NKDA.

B Quality Assurance Programme

The following paragraph shall be added to clause no.81.0 of General Conditions of Contract (GCC) as under:

The quality testing of materials are to be done as per the frequency of sampling & testing prescribed in relevant code of different items of works, all mandatory tests of materials shall be conducted at site laboratory and the test not possible at site shall be tested outside through reputed laboratories with NABL accelerated like Government Engineering College /National Test House/IIT.

47.0 GENERAL CONDITIONS (Part-B)

1) All the laborers to be engaged for erection works should be screened for health and adequately treated before the issue of work permits.

2) Financial provision should be made by the project proponent in the total budget of the project for implementation of the suggested safeguard measures.

3) NKDA/EPI reserves the right to add additional safeguard measures subsequently, if found necessary and to take action including revoking of the environment clearance under the provisions of the environmental (Protection) Act, 1986 , to ensure effective implementation of the suggested safeguard measures in a time-bound and satisfactory manner.

The agency is to obtain licence from the registering officer & assistant labour commissioner of the respective division /office under the contract labour (Regulation and abolition ) act 1970 and rule framed there under and to submit the same to the concerned EIC within seven days from the date of issue of work order.

Any Typographical mistake /omission if found may immediately be brought to the notice of the authority for rectification. In case of any inadvertent typographical mistake in the specific price scheduler of rate , the same will be treated to be so corrected as to confirm with the prevailing relevant schedule of rates and /or technically sanctioned estimate.

48. Insurance
Without limiting his obligations and responsibilities, the agency shall insure in the names of the Employer and the agency against all loss or damage from whatever cause arising for which he is responsible under the terms of the contract and in such manner that the employer and Agency are covered for the period of execution as well as during the period of Maintenance for loss or damage arising from a cause, and for any loss or damage occasioned by the agency in the course of any operations carried out by him for the purpose of complying with his obligations as follows:

(a) The entire contract value (including the Contract Price Plus 10% of the Contract price for the period of completion of the works which includes till the works are handed over to the owner).

(b) All equipments, plants etc. brought on to the site by the Agency and the replacement value of the same. These shall include materials belonging to the Employer but issued to or intended to be issued to the Agency for use in the work, if any.

(c) Damage insurance against loss or damage by fire or any other disaster to the works due to Civil commotion, riots, war, earth quake, terrorist attack and other disturbances during construction until its completion.

Such insurance as mentioned in para (a), (b) and (c) above shall be effected with an insurer and in terms approved by the Employer. The Agency shall bear the cost of all such insurance and whenever required, produce to the Engineer-in-charge or his representative the policy or policies of insurance and the receipts for payment of the current premiums.

49.0 Electricity & water

To be arrange by contractor on his own cost.

50.0 Liquidation damages

Equivalent to an amount equal to one percent on the full tendered amount / contract sum for the whole work for every day that the due quantity of work remains incomplete or unfinished, provided always that the entire amount of liquidity damages to be paid under the provision of the clause shall not be exceeding on the 10% on the accepted tender amount / contract sum of the work as shown in the tender.

Freight, Insurance, packing, forwarding, loading & unloading to be included in the quoted rate.

51. Watching and Lighting

The Agency shall in connection with the works provide and maintain at his own cost all light, guards, fencing and watching when and where necessary or as required by the Engineer-in-Charge, for the protection of the works, or for the safety and convenience of the existing plant contractor’s employees, employers supervisors or for any other reason deemed fit by the Engineer-in-Charge.
52. Discrepancies
Should any discrepancy appear in any of the documents and drawings included in this contract or between different parts of the same documents or any ambiguity or insufficiency of information the Agency shall point out the same to the Engineer-in-Charge in writing and receive his instructions, explanations or decision in the matter. Decision of Engineer-in-Charge is final and binding on the Contractor.

53. Materials to be Supplied by Agency
The Agency shall supply all materials required for successful completion of the work. The quality of such materials as stated above shall conform to the requirements of the BIS (Bureau of Indian Standard), P.W.D. or any other approved standard specification. In all cases, the latest modification or revision of such specifications will be applicable for use.

All sampling, testing and transportation of such materials shall take place under the direction of the Engineer-in-Charge at the testing laboratory as may be designated by the Department at the cost of the Contractor. Tests will be made in accordance with the standard methods of testing of the I.S. or other standard specifications. The Engineer-in-Charge have full power to reject or condemn any workmanship or materials that he may deem unsuitable.

All materials not conforming to the requirements of these specifications shall be considered as defective and shall be rejected for use and shall be removed by the Agency from the site of the work within 24 hrs. at his own cost.

In case of non-compliance with such orders, the Engineer-in-Charge shall have the full authority to cause such removal at the cost and expense of the Agency and the Agency shall not be entitled to any loss or damage on that account. The Engineer-in-Charge will have full right to inspect the store of materials supplied by the Agency for the use of this contract work.
All materials and workmanship shall be of the respective kinds described in the contract and in accordance with the Engineer-in-Charge’s instructions and shall be subjected from time to time to such tests as the Engineer-in-Charge may direct at the place of manufacture or fabrication, or on the site or at such other place or places as may be specified in the contract, or at all or any of such places. The Agency shall provide such assistance, instruments, machines, labour and materials as are normally required for examining, measuring and testing any work and the quality, weight or quantity of any materials used and shall supply samples of materials before incorporation in the works for testing as may be selected and required by the Engineer-in-Charge, be it at site or at the manufacturer/Vendor’s premises. Agency will have to procure materials from manufacturers / vendors as may be approved by the E.I.C. No variation will be allowed. Agency will have to furnish original documentary evidence of procurement of the materials from the specified vendors if required by the EIC. Cost of samples – all samples of materials/articles to be tested as may be required by the Engineer-in-Charge shall be furnished by the Agency at his cost.

If the rate for completed items of work are inclusive of supply of stone materials, the Agency shall arrange for procurement of such stone materials required for the work by his own resources and it shall be clearly understood that the Department shall not sponsor any traffic movement by wagon for stone materials.

54. Workmen’s Compensation

In every case in which by virtue of the provisions of the Workmen’s Compensation Act, 1923, and any other relevant Acts and Rules, compensation to a workman employed by the Agency, is payable, then this should be done by the Contractor. If the Department is obliged to make any compensation under the said Rules and Acts, then the amount shall be recovered without prejudice, from the bills and dues of the Agency. The Department shall not be bound to contest any claim made against it in respect of workmen’s compensation under Section 12 sub section 1 of the said Act, except on the written request of the Agency and upon his giving to NKDA full security
for all the costs for which NKDA might become liable in consequence of contesting
such claims.

55. Contractor's Employees
No labour below the age of eighteen years shall be employed on the work.
Any labour supplied by the Agency to be engaged on the work on day work basis
either wholly or partly under the direct order or control of his representative shall be
deemed to be a person employed by him.
The Agency shall comply with the provision of all labour legislation including the
requirement of the Payment of Wages Act and the rules framed there under and
modifications thereof in respect of men employed by him in carrying out the contract.
The Agency shall comply at his own cost with any order or requirement of any Health
Officer of the State or any local authority and the Engineer-in-Charge regarding the
maintenance of proper environmental sanitation of the area where the labourers are
housed or accommodated, for the prevention of any communicable diseases. The
Agency shall provide, maintain and keep good sanitary condition and provide facilities
for potable water at all times for the use of men engaged on the work and shall
remove and clear away the same on completion of the work. Adequate precaution
shall be taken by the Agency to prevent nuisance of any kind in the site of work.

The Agency shall provide efficient medical attendant and care for his staff and for the
workmen employed to the satisfaction of the Engineer-in-Charge or his representative.
The Agency shall arrange to provide first aid and treatment facilities to the labourers
engaged on the works and shall within 24-hours of the occurrence of any accident at
or about the site in connection with the execution of the work, report each accident to
the Engineer-in-Charge and also to the competent authority where such report is
required by law.
56. **Safety Measures and Public Convenience**

The Agency shall in the course of execution of the work take all necessary precautions for the protection of all persons and property at his cost.

The entire site of works shall be well illuminated from sunset to sunrise at his cost.

The Agency shall take adequate measures to protect the work and prevent accidents during the

Project work and prevent accidents during the construction. He shall provide and maintain temporary side-walks access to construction site and where necessary, danger signals. Road closed sign, watchman and necessary appliances for properly safeguarding life and site of work for safety. The lamp must kept lit from sunset till at least one hour after sunrise. He shall protect all excavations equipment and materials with barricades and danger signals so that no life may be endangered.

The Agency shall so conduct his operation as to cause the least possible obstruction and inconvenience to the other users and contractors in adjacent site. He shall have under construction not more than such amount of work as he can handle properly with due regard to the right of others.

57. **Loss and Damage**

Neither the department nor the Engineer-in-Charge or his representative shall be answerable or accountable in any manner for any loss or damage that may happen to the work or any part thereof or to any of the materials or other things used in the performing the work, or for injury to any person, either a workman or any member of the public, or for damage to any property for any cause which might have been provoked by the Agency. The Agency shall properly guard against all these injuries or damages to persons or property resulting from his operations under this contract at any time before issuance of the certificate of completion and maintenance. He shall indemnity and save harmless the Department from all suits or actions of every description brought for, or on account of, any injury or damage received or sustained by any person or persons by reason of the construction of the work, negligence in guarding the same, the use of improper materials or of any act of omission or deviation from the contract.
58. **Supervision of Work**

The Engineer-in-Charge shall have the power at any time and from time to time by notice to the Contractor to delay or suspend the progress of the work or any part of the work during unsuitable weather for any other adequate reasons and on receipt of such notice, the Agency shall forthwith suspend further progress of the work until further notice from the Engineer-in-Charge.

The Agency shall recommence work immediately on receiving a notice to do so from the Engineer-in-Charge. The whole or any part of the time lost for such delay or suspension shall, if the Department in its absolute discretion thinks fit but not otherwise, be added to the time allowed for completion. The Agency shall have no claim to extra payment or compensation whatsoever on the grounds of above delay.

59. **Occupying Prior to Completion**

The Employer/Department expressly reserves the right to occupy at any time and for so long a time as the Engineer-in-Charge deems fit in issuing a notice to the Agency, require any portion or portions of the site of works, whether the works to be executed thereof be commenced or in progress or temporarily suspended or completed and to employ thereon agents and workmen other than the contractor or his men in the execution of matters not included in the contract.

The Agency shall not obstruct such agents and workmen, and without extra charge and without relief from any liabilities or responsibility, or such allowance provide them free access to the work and to such facilities as in the judgment of the Engineer-in-Charge may be reasonably required.

60. **Supplementary Specification**

Whenever reference is made in these documents to certain special specifications, the reference shall be construed to include all subsequent amendments, changes or additions that are published and in effect at the date of signing of this contract.

The department reserves the right to issue additional conditions, specification etc. if necessary which will be incorporated with tender documents already sold to tenderers for the purpose of this work.
61. Land for Contractor’s Establishment

For the purpose of constructing Agency’s Storeyard, godowns, site office and ancillaries, he may utilise portion of the land belonging to the Employer at such location as would not interfere with the execution of works. For all these, the Agency shall have to obtain the requisite permission of the Engineer-in-Charge. The Agency shall for this purpose submit to the Engineer-in-Charge for his approval a plan of the proposed layouts for the site facilities. The Engineer-in-Charge reserve the right to alter and modify the Agency’s proposals as he may deem fit. In case sufficient land is not available with the Employer, the Agency will have to arrange for private land of his cost to meet his requirement.

62. First-Aid Facilities

The Agency shall provide at his own cost for medical attention to be promptly available when necessary. He shall for this purpose provide a number of First-Aid stations at suitable location within easy reach of the workmen and other staff engaged in the Works. Each First-Aid station shall be properly equipped and will remain in charge of a suitably qualified person. The Agency shall also provide for transport of serious case to the nearest hospital. All these arrangements shall be to the approval of the Engineer-in-Charge.

The Contractor shall provide, to the satisfaction of Govt. or Local Authority concerned, adequate medical attendance for his employees and labours.

63. Satisfactory completion of various items

The various items of the sub-work are to constitute the whole work complete in every respect as per satisfaction of the Engineer-in-Charge. Each sub-work will be considered as complete when it is completed as per drawing & specifications, as per standards, as a successful component part of the whole work.

64. Reports and Returns

The Agency shall maintain at Site daily records of progress with regard to the works carried out, labour engaged and construction equipment deployed. These will form the basis of preparing periodic reports and returns as may be required by the Engineer-in-Charge and in the manner as directed by him.
65. **Insurance of works, etc.**

Without limiting his obligations and responsibilities, the Agency shall insure in the names of the Employer and the Agency against all loss or damage from whatever cause arising for which he is responsible under the terms of the contract and in such manner that the employer and Agency are covered for the period of execution as well as during the period of Maintenance for loss or damage arising from a cause, and for any loss or damage occasioned by the Agency in the course of any operations carried out by him for the purpose of complying with his obligations as follows:

(a) The entire contract value (including the Contract Price plus 10% of the Contract Price for the period of completion of the works which includes till the works are handed over to the owner).

(b) All equipments, plants etc. brought on to the site by the Agency and the replacement value of the same. These shall include materials belonging to the Employer but issued to or intended to be issued to the Agency for use in the work, if any.

(c) Damage insurance against loss or damage by fire or any other disaster to the works due to Civil commotion, riots, war, earthquake, terrorist attack and other disturbances during construction until its completion.

Such insurance as mentioned in para (a), (b) and (c) above shall be effected with an insurer and in terms approved by the Employer. The Agency shall bear the cost of all such insurance and whenever required, produce to the Engineer-in-Charge or his representative the policy or policies of Insurance and the receipts for payment of the current premiums.

66. **Damage to Persons and Property**

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

(a) The Permanent use or occupation of land by the works or any part thereof.
(b) The right of the employer to execute the works or any part thereof on over, under, in or through any land.

(c) Injuries or damage to persons or property, which are the unavoidable result of the execution or maintenance of the works in accordance with the contract.

(d) Injuries or damage to persons or property resulting from any act or neglect of the Agency, his agents, servants or other contractors, not being employed by the Agency or for or in respect of any claims, proceedings, damages, costs, charges and expenses in respect thereof or in relation thereto or where the injury or damage was contributed to by the Agency, his servants or agents such part of the compensation as may be just and equitable having regard to the extent of the responsibility of the Employer, his servants or agents or other contractors for the damage or injury.

67. Accidents or Injury to Workmen:
The Employer shall not be liable for or in respect of any damages or compensation payable at law in respect or in consequence of any accident or injury to any workman or other, person in the employment of the Agency or any sub-contractor, have and except any accident or injury resulting from any act or default of the employer, his agents, or servants. The Agency shall indemnify and keep indemnified the Employer against all such damages and compensation, save and except as aforesaid and against all claims, proceedings, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

68. Insurance Against Accident etc. to Workmen:
The Agency at his cost shall insure against all liabilities as indicated in clause 37, 39 and 44 with an insurer, and shall continue such insurance during the whole of the time that any person is employed by him on the works and shall, when required, produce to the Engineer-in-Charge or his representative such policy of insurance and the receipts for payment of the current premium. Provided always that, in respect of any persons employed by any sub-contractor, the Agency’s obligation to insure as aforesaid under this sub-clause shall be satisfied if the sub-contractor shall have insured against the liability in respect of such persons in such manner that the Employer is indemnified under the policy, but the Agency shall require such sub-contractor to produce to the
Engineer-in-Charge when required, such policy of insurance and the receipt for the payment of the current premium.

69. **Notification to Insurer:**
It shall be the duty of the Agency to notify the insurers under any of the insurances referred in any matter or count which by the terms of such insurances are required to be notified and the Agency shall indemnify and keep indemnified the Employer against all losses, claims, demands, proceedings, costs, charges and expenses whatsoever arising out of or resulting from any default by him in complying with the requirements of this sub-clause whether as a result of the avoidance of such insurance or otherwise.

**All Insurance at Contractor’s Cost:**
The insurances referred to in this Tender document shall be entirely at the cost and expense of the Agency.

70. **Remedy on Contractor’s Failure to Insure:**
If the Agency shall fail to effect and keep in force the insurances referred to Clauses hereto, or any other insurance which he may be required to effect under the terms of the Contract, then and in any such case the Employer may effect and keep in force any such insurance and pay such premium or premium or premiums as may be necessary for that purpose and from time to time and deduct double the amount so paid by the Employer as aforesaid from any money due or which may become due to the Contractor, or recover the same as a debt due from the Contractor.

71. **Idle Labour**
No claim for idle labour would be entertained under any circumstances.

72. **Inspection Facilities.**
The Agency shall provide necessary facilities for inspection of work for quality control by the Engineer and for the purpose of carrying his instructions as may be recorded in writing in site Order Book.
73. Testing & Testing Equipment
Testing of materials to be used in the permanent work or of the quality of finished items, shall have to be done from approved laboratory at the expense of the Agency. Should the E.I.C. consider it necessary to satisfy himself as to quality of work, the Agency shall offer sample of work done as necessary, pull down reasonable part of the work required for such inspection and testing. The Agency shall bear the cost of pulling down and shall make good the same at his own cost and to the full satisfaction of the E.I.C. without any extra cost.

74. Labour Act
The Agency should obtain the license under the provision of the Contract Labour (Regulation and Abolition) Act 1970 and the Contract Labour (Regulation and Abolition) General rules, 1971 including the provisions of amendments made there under of the same.

75. Local Employment
No labour should be imported from any district other than where work is to be executed without prior consent of the Executive Engineer. Imported labor can only be engaged with permission of the Executive Engineer when the exigency or progress of work so demands and sufficient local labours are not available. For importing special class of labor for any specialized work no extra cost will be paid to the agency.

76. Import License and Imported Equipments
Use of any imported equipment for the work is not envisaged. However, if it becomes absolutely necessary, requisite Foreign Exchange and import license shall have to be arranged for by the contracting agency independently and NKDA will not take any responsibility in this regard. A certificate stating the necessary of the particular materials for the work entrusted to the Agency may be issued at its discretion by NKDA on request. Delay in getting any materials will not be entertained for extension of time limit of contract.

77. Water Supply, Sanitation & Power
The Agency shall have to make his own arrangement for supply of electrical power and water at all stages of execution of work. Arrangement for obtaining water for the work as
well as for the labourers and sanitation facilities for labourers shall have to be made by the Agency at his cost. The quality of water shall be conducive for construction works in terms of soluble, insoluble materials and chloride content. The cost of erection/installation for obtaining either electricity or water from W.B.S.E.B. or Municipality or any other agency shall have to borne by the Contractor for which no extra claim can be placed before NKDA. However, NKDA may provide power and water if the same is available at site. If the contractor draws power and water from NKDA’s point then he is required to pay the prevailing charges for power and water connection and usage. But supply of power and water should not be considered as the responsibility of NKDA. Nevertheless electrical power from NKDA’s point may not be continuously available due to various reasons including load shedding. In that case water supply from NKDA’s point will also stop and the Agency will make his own arrangement for water and power through generator at his cost.

78. Storage and Safety of Equipments

The equipment at site shall have to be stored in waterproof shed with proper security arrangement made by the agency. The Agency shall insure at his cost all the equipment against pilferage and breakage at site during storage and erection under their custody till the work is completed and handed over to the Employer.

79. Language for Correspondences

All written materials and correspondence in connection with the contract shall be in English.

80. Agency’s Local Address

The Agency shall furnish the postal address of his site Office. Any notice or instruction to be given to the Agency under the terms of contract shall be deemed to have been served if it has been delivered to his authorised agent or representative of site or sent by registered letter to the site office or to the address.

81. Recoveries

Any recovery from the Agency advised by the Employer/Government shall be recovered from any bill or money retained from this contract.
82. **Site Clearance before final acceptance of the work.**
Before final acceptance, all items of work shall be completed, ready to operate and in a cleaned condition. All debris, unused material and temporary structures shall be removed from the site of work. Tools and erection machinery (except which is needed for repair and adjustment of the work consequent to operational tests) shall not remain on the site.

83. **Minimum Wage Act**
The Agency is required to follow the provisions of Minimum Wage Act.

84. **Precedence of Contract Documents**
If any stipulation indicated in any component of contract documents are at variance in any respect with those in the other, the decision of the Superintending Engineer (NKDA) will stand final and binding.

85. **Action for Non-Compliance**
Failure to comply with above conditions and specifications will result in the department taking action at the risk and cost of the agency. Execution of agreement binds the Contractor for complying with requirements of the above conditions and specifications without any extra payment on any account.

86. **Deduction of Tax**
Deduction of VAT, Income Tax and any other taxes payable as per prevailing tax Laws at the prescribed rate at the time of making payment to the Contractor.

87. **Typographical Error**
Typographical errors detected or pointed out are subject to corrections by E-I-C. Any party on account of such error can derive no benefit. Any Typographical error shall immediately be brought to the notice of the authority for rectification. NKDA/EPI reserves the right to rectify mistake / omissions if detected, at any point of time even during execution of work.

88. **Completion of Work and Guarantee**
The work shall be deemed to be completed when all works itemized in the Schedule of work and the entire work as per drawing or otherwise undertaken have been completed in all respect including successful testing.

The Contractor shall guarantee for successful operation of the project for 12 months from the date of successful completion of the project and shall within the operation and maintenance period remove/rectify/make good any such deficiency forthwith at his own cost. During the guarantee period after the trial run period the firms representative shall visit the site once in a month and advise in writing the engineer in charge about the condition, state of health, operation and maintenance procedure of the project.

The successful tenderer shall also give the following guarantee in respect of the equipment supplied by him.

1. All equipments shall be free from any defects due to faulty design of the components, material, and/or workmanship and shall operate satisfactorily with highest performance efficiency.

2. Formal acceptance of the work or equipment covered under the contract will not be made by the engineer until all the work done by the contractor have satisfactorily passed all tests required and run for a reasonable period to his satisfaction.

If during testing of work including equipment prior of formal acceptance of the same or the material thereof fails in respect of meeting the specification guarantee or otherwise, the contractor shall replace all the accessories etc. in such a condition which will meet the guarantee performance and shall be up to the specification, in both material and workmanship.

The contractor will provide back to back guarantee to NKDA/EPI for all kind of supplied equipments for electrical, HVAC, fire fighting, electromechanical works etc. The Final Bill for the work shall be processed by EIC on completion of work in all respect including submission of all test certificates by the Contractor in quadruplicate.

89. Operational Maintenance
Contractor shall provide operational maintenance for 12 months from the date of successful completion of the project and shall within the operation & maintenance period train the NKDA officials regarding operation and maintenance work.
90. Defect Liability Period

a) Defects Liability Period shall be Twelve calendar months after actual completion of the works. Any defects in material of workmanship observed in the entire work during execution or work or within defect liability period shall be notified in writing by the Employer to the Contractor and shall be rectified by him at his own cost within time as specified by Employer.

b) To facilitate prompt attention to the defects the contractor shall employ a team of tradesmen like Transformer, HT VCB, LT Distribution board, Air Conditioning with VRF, Generators, Fire Fighting Equipment & Lighting etc. A supervisor will also be available along with the maintenance team to take instructions from Employer. The maintenance team will be available throughout the defects liability period. The composition of the tradesmen will vary according to the nature of recurring defects noticed in the buildings. In case of default the Employer may employ any other person to rectify or make good such defects. All expense consequent thereon or incidental thereto shall be borne by the Contractor and shall be recoverable from him by the Employer and shall deduct from RA bills or Security deposit as the case may be.

c) Should any defective works have been done or material supplied by any sub contractor employed, the contractor shall be liable to make good in the same manner as if such work or material has been done or supplied by the contractor. The contractor shall remain liable under the provisions of this clause notwithstanding the signing by engineer in charge of any certificate or passing any account.

91. Safety Requirements:

Agency shall use safety belts, whenever his workmen will have to work at a high altitude to avoid risk of any accident or fall Hard Top Hats to be used by the Agency’s workmen at the places wherever required.
Necessary Fire Protection arrangements by installing portable fire extinguishers on suitable locations at work site and material storage area. The Agency shall also use Safety devices like Welder’s apron, hand gloves, goggles, helmets etc. and other accident preventive arrangement at work site as per prevailing safety code.

92. COMPLETION AND TAKING OVER

As soon as the project is finally completed, the Contractor shall inform EPI and EPI shall in turn inform to NKDA. NKDA shall nominate a Board of Officers for checking/verification of completed work as per the scope of work for final taking over the project.

93. I.E. Act.

The Contractor is required to comply with the I.E. Act and Rules framed the under. He will have to produce to the EIC evidence of possession of Electrical Contractor’s license with current validity and also copy of Electrical Supervisor’s Certificate with qualification, registration no. etc. in respect of employees involved in electrical works.

94. Foreclosing of Work

If at any time after the acceptance of the tender the Employer shall for any reason whatsoever not require the whole or any part of the works, to be carried out, the Employer shall give notice in writing of the fact to the contractor, who shall have no claim to any payment of compensation or otherwise, whatsoever on account of any profit or advantage which he might have derived from the execution of the work in full but which he did not derive in consequence of the foreclosing of whole or part of the work.

95. Measurements:

i) The contractor along with representative of E-I-C shall measure the work done according to PWD mode of practice and enter into their measurement book, sign and submit it in triplicate to the engineer in charge for verification and certification. The measurement so taken shall be checked by the concerned Assistant Engineer in charge of the work.
ii) If any alterations or additions (other than those authorized) have been covered up by the Contractor without his having given notice of his intention to do so, the engineer-in-charge shall be entitled to appraise the value thereof and in the event of any dispute the decision of the Employer thereon shall be final and binding.

iii) Payments for Works: On account payment will be made till completion of the work. Rate quoted shall be inclusive of all taxes, octroi, toll, sales tax, professional tax, works contract tax, Service taxes, royalties, VAT or any other new taxes or levies etc. and shall be payable by the contractor. The employer will not entertain any claim whatsoever in this respect. Income tax will be deducted from the RA Bills/Final Bill.

96. Progress Photographs

The Contractor shall at his own cost and expenses, arrange to take periodic still digital photographs to show the progress of work or interesting features thereof. The time and the position wherefrom a photograph is to be taken would be as per direction of the Engineer-in-Charge or his Representative. Colored prints of each of these still photographs to an enlarged size of about 25 cm x 15 cm shall be supplied to the Engineer-in-Charge in albums by the Contractor at his cost and these shall become the property of the Employer. Each photograph shall be suitably captioned with the date of the photograph, location and other relevant particulars.

The Contractor in C.D shall submit soft copy of photographs showing monthly progress, stages of work with dates to EIC. Any circulation of these photographs to any other source other than NKDA, shall be treated as breach of security and shall make them liable for prosecution and consequences.

Restrictions to photography or security restrictions that may be applicable to any particular area must be carefully and rigidly observed. The number of hard photographs (each consisting of two prints) for the complete works is not expected to exceed 25 (twenty-five).
Electrification of First Phase (B+G+IV) of Administrative Building of New Town Kolkata Development Authority At Plot no. DG / 13, Premises No. 04-3333, Action Area – ID, New Town, Kolkata.

TECHNICAL SPECIFICATION FOR ELECTRO – MECHANICAL, HVAC FIRE – FIGHTING AND ELECTRIFICATION WORKS.
## TECHNICAL SPECIFICATIONS

### CONTENTS

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>General Scope of Work</td>
</tr>
<tr>
<td>2.</td>
<td>Design Basic &amp; Site Condition</td>
</tr>
<tr>
<td>3.</td>
<td>H.T. Sub Station</td>
</tr>
<tr>
<td>4.</td>
<td>L.T. Panel</td>
</tr>
<tr>
<td>5.</td>
<td>L.T. Switchgears</td>
</tr>
<tr>
<td>6.</td>
<td>Internal Electrification of Building</td>
</tr>
<tr>
<td>7.</td>
<td>Telephone System</td>
</tr>
<tr>
<td>8.</td>
<td>Addressable Fire Detection &amp; Alarm System</td>
</tr>
<tr>
<td>9.</td>
<td>L.T. Cables</td>
</tr>
<tr>
<td>10.</td>
<td>Cable Tray</td>
</tr>
<tr>
<td>11.</td>
<td>Earthing</td>
</tr>
<tr>
<td>12.</td>
<td>Safety Equipment</td>
</tr>
<tr>
<td>13.</td>
<td>Diesel Generator</td>
</tr>
<tr>
<td>14.</td>
<td>Procurement, Inspection of Equipment &amp; Approval</td>
</tr>
<tr>
<td>15.</td>
<td>Electrical Rising Main</td>
</tr>
<tr>
<td>16.</td>
<td>Capacitor Panel</td>
</tr>
<tr>
<td>17.</td>
<td>Shop Drawing Approval of Electrical Installation</td>
</tr>
<tr>
<td>18.</td>
<td>Air Condition System</td>
</tr>
<tr>
<td>19.</td>
<td>Fire Hydrant and Wet System</td>
</tr>
</tbody>
</table>
TECHNICAL SPECIFICATIONS

1.0 GENERAL SCOPE OF WORK:

The scope of work shall cover internal and external electrical works for NEW TOWN KOLKATA DEVELOPMENT AUTHORITY, KOLKATA. The scope of work covers major electrical equipments as per BOQ. Also, supply, installation, testing and commissioning of electrical works of the project including the following main items / systems:

i. H.T. Sub-station including VCB panel, Transformers, HT cables etc

ii. Main LT , Capacitor panels (APFC), Rising mains, MV Panels.

iii.DG sets including AMF panels etc.

iv.MCB Distribution Boards.

v. Internal electrification through concealed PVC conduit and provide light Points, fan points, socket outlets etc. including supplying, installation, testing and commissioning of light fixtures, fans etc.

vi. Conduiting and wiring for telephone points including Main Telephone Distribution Boards (Tag Blocks), telephone outlets etc. complete with telephone cabling from tag blocks to telephone outlets including EPABX, telephone instruments etc.

vii.Addressable Fire Detection & Alarm System consisting of MainFire Control & Indicator Panel, Smoke & Heat Detectors, Manual Call Point Hooter etc. including conduiting/wiring & cabling complete.

viii. Conduiting and wiring for Cable TV system

ix. Conduiting for computer networking

x. Lightning protection system consisting of lightning arrester, finial, horizontal and vertical strips, test joints, earth electrodes etc.

xi. Lifts
Xii. LT Cabling.

xiii. Earthing, safety equipments and misc items required for electrical installation complete in all respect.

xiv. Outdoor lighting

xv. Testing and commissioning of all electrical installations

xvi. Any other items/ works required for the completion of electrical works.

xvii. Enhancement/Sanctioning Electrical Load from State Electricity Board.

xviii. Submission of GA drawings of electrical equipments and getting approvals from Client/ Owner before manufacturing/fabrication.

xix. Obtaining approvals from Chief Electrical Inspectors, Local Electricity Supply Authority, Telecom Department, and any other statutory Authorities for the complete scope.

xx. Proper approval for Diesel tank and pollution control for DG set. Contractor shall submit equipment drawing from manufacturer along with The layout etc. and working drawings for approval from EPI through NKDA Electrical Engineer before manufacture / commencement of work at site.

xxi. Contractor has to submit the working drawing of internal as well as external electrification based on our tender drawings for the approval of NKDA Electrical Engineer through EPIL before commencement of work.

xxii. Contractor has to take the approval of DB schedule/drawing of each DB from NKDA through EPIL.

xxiii. In case, details of any electrical item/ system are left out, then kindly refer the CPWD specifications & approval from Engineer.

1.01 REGULATIONS AND STANDARDS:

All equipments their installation, testing and commissioning shall conform latest CPWD/ IS specifications in all respects.
Indian Standard Code of Practice for Electrical Wiring Installation IS:732-1989. It shall also be in conformity with Indian electricity Rules and the Regulations, National Electric Code, National Building Code, latest CPWD specifications amended up to date and requirements of the Local Electric Supply Authority. In general, all materials equipment and workmanship shall conform to the Indian Standards specifications and code. Mode of all measurement will be as per latest CPWD norms/ specifications Some of the applicable codes / standards are as under:

a) CPWD General specifications for electrical works Part-I (Internal)- 2005

b) CPWD General specifications for electrical works Part-II(External)-1995

c) CPWD General specifications for electrical works Part-III (Lifts & Escalators)-2003

d) CPWD General specifications for electrical works Part-IV (Substation)- 2007

e) CPWD General specifications for electrical works Part VII (DG Sets)

f) CPWD Specification/norms for measurement Latest revision

g) Guide for marking of insulated conductors IS 5578

h) Guide for uniform system of marking and identification of conductor and apparatus terminals. IS 11353

i) Low voltage switchgear and control gear assemblies S 8623 Part-1 to 3

j) Specification for low voltage switchgear and control gear IS 13947

k) Enclosed distribution fuse boards and cutouts for voltages not exceeding 1000V AC and 1200 V DC IS 2675

l) Code of practice for selection, Installation and maintenance of switchgear and control gear. ISI 10118 Part – 1 - 4

j) Low-voltage fuses for voltages not exceeding 1000V AC or 1500V DC ISI13703 Part-1&2
k) PVC insulated (heavy duty) electric cables IS 1554

l) PVC insulated cables for working voltages upto and including 1100V. IS 694

m) Conduit for electrical installations IS 9537

n) Accessories for rigid steel conduits for electrical wiring IS 3837

o) Boxes for the enclosure of electrical accessories IS 14772

p) General and safety requirements for luminaries IS 1913

q) Code of practice for earthing IS 3043

r) Electrical accessories – circuit breakers for over current protection for household and similar installations. IS 8828

Specification for factory built assemblies of switch gear and control gear for voltage up to and including 1000V AC and 1200VDC IS 8623

s) Low voltage switchgear and control gear IS 13947 part 1 – 5

t) Residual current operated circuit breakers IS 12640

u) Current Transformers IS 2705 & relay IS 3231

v) Voltage Transformers IS 3156

w) Direct acting indicating analogue electrical measuring instruments and their accessories IS 1248 part – 1 to 9

A1) Control Switches (switching device for control and auxiliary circuits including contactor relays) for voltages upto and including 1000V ac and 1200V DC. IS 13947 & IS 1336

A2) Indicating instruments IS 1248 & Integrating Instruments IS 722.

A3) Control switches & push button IS 6875.
A4) AC motor starters of voltage not exceeding 1000V IS 1822

In case of contradiction in specification the priority of the documents shall be as follows:
CPWD/ IS specification, BOQ, drawings, Technical specifications.

2.00 DESIGN BASIS & SITE CONDITIONS:

All the equipment and components provided in the transformer and accessories shall be suitably designed for installation and satisfactory operation as specified below.

2.01 SITE CONDITIONS
Location : Kolkata          Site altitude : 50 M above mean sea level

<table>
<thead>
<tr>
<th>Ambient Temperature</th>
<th>Relative Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum : 40 Deg C</td>
<td>Maximum : 71.6 %</td>
</tr>
<tr>
<td>Minimum : 12 – 14 Deg C</td>
<td>Minimum : 37%</td>
</tr>
<tr>
<td>Design : 50 Deg C</td>
<td>Design : 90% at 45 Deg C</td>
</tr>
</tbody>
</table>

Ground Temperature: 35 Deg C   Rainfall : 1582 mm/year

Seismic factor: Zone III as per IS : 1893

Environmental: Tropical / humid / corrosive conditions

3.00 H.T. SUBSTATION (11 KV VACUUM CIRCUIT BREAKER PANE BOARD)

3.1.1 GENERAL:

Power supply for Equipment

Voltage: 11KV +/- 15%        Frequency: 50Hz +/- 3%

Permissible combined Voltage & Frequency variation: +/- 6%

System design fault level (Symmetrical) : 50 KA for 1 sec. Max.
Grounding: solidly earth

**DESIGN CRITERIA**
The switchgear shall be capable of continuous operation of specified rating under the following condition:

- **Voltage variation**: +/- 10%
- **Frequency variation**: +3%, -6%
- **Combined voltage & frequency variation**: 10%

Vacuum Circuit Breaker shall be incorporated in H.T. Panel wherever specified.

VCB’s shall conform to IEC 298 and 694 IS 3427, BS 5227 and VDE 0670, part 6 as well as the regulations mentioned therein. VCB’s shall be suitable for operation on 11kV, 3 phase, 50Hz, AC supply.

### 3.1.2 TYPE AND CONSTRUCTION:

The metal clad panel shall be fully extensible and compartmentalized to give.

- **a. Circuit Breaker Compartment**
- **b. Busbar Compartment**
- **c. CT and Cable Compartment**

3.1.2.1 The compartments shall be safe to touch and compartments thus formed shall be dust proof & vermin proof. A separate metering chamber for fixing the necessary instrumentation metering and protective equipment shall be provided.

3.1.2.2 The VCB shall consist of three air insulated poles incorporating mechanism of interrupters. The body of interrupters shall be made of nickel chromium steel supported on insulators made out of metalised aluminum oxide. The contacts shall be of chromium copper and butt shaped.

3.1.2.3 Vacuum circuit breaker shall be mounted on truck or a carriage mechanism. In case of truck mechanism, the breaker shall be on a trolley while in a carriage mechanism, it shall be separate door and it shall be possible to perform all operations with front door closed. The draw out carriage shall have two positions for the circuit breaker viz isolated/test & service position. Bus bars shall be insulated type made of high conductivity copper supported on cast epoxy monobloc designed to withstand full short circuit currents and shall be provided all along the length of the H.T. board.
3.1.2.4 It shall be horizontal isolation, horizontal draw out type, fully interlocked, with dust and vermin proof construction, suitable for indoor instillation. The panel shall be supplied with the manufacturer’s test certificates.

3.1.2.5 Certificates with date of manufacture and shall be complete in all respects as per details in the schedule of quantities. The steel work should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric acid and recognized phosphate process and shall then be given power coating (Electrostatic) paint of manufacturer’s standard shade.

3.1.2.6 The switchgear constructions shall be such that breaker operation and Internal explosions do not endanger the operating personnel, and the front of the panel shall be specially designed to withstand these. Pressure relie flaps shall be provided for safely venting out gases produced inside the high voltage compartment, bus bar compartment and termination compartment. These flaps shall be vented upwards and cannot be opened from outside. These relief flaps shall be of such construction as to permit ingress of dust/water in harmful quantities under normal working conditions. Enclosure shall be constructed with sheet steel of at least 2.0mm thickness. It shall have a rigid, smooth, leveled, flawless finish.

3.1.2.7 Voltage transformer of burden not less than 100 VA and a proper ratio as Specified shall be provided in the incoming panel. The accuracy class for the VT shall be 0.5 as per IS 3156 parts I to III for incomers and class 1 for outgoing panels. The transformer shall be of cast epoxy resin construction. It shall be fixed/ withdrawable type. HRC fuses/ MCBs shall be provided on both HV and LV side.

3.1.2.8 The making contact arms (upper & lower) of the circuit breaker shall be encased in polypropylene tubes. Penetration type bushings shall be provided in the busbars & cable compartment for the fixed contacts.

3.1.2.9 Safety shutters shall be provided to cover up the fixed high voltage contacts on busbar and cable sides when the carriage is moved to Isolated disconnected position. The shutters shall move automatically with the movement of the draw out carriage. It shall, however, be possible to open the shutters of busbars side and cable side individually.

3.1.2.10 Mechanically operated circuit breaker auxiliary switches of minimum 5 NO + 5 NC ways, shall be provided for control and indication purposes. Control wiring shall be done by 1.5 sq. mm; 1.1kV grade
stranded copper PVC insulated cable. All control fuses shall be HRC link type.

3.1.2.11 Terminal blocks shall be clamp type suitable for connection of only 2 wires per terminal and shall be 650 V grade. The L.T. control circuit shall be routine tested to withstand 1.5kV for one minute.

3.1.2.12 Busbar compartment shall be provided at the rear. Electrolytic copper busbars shall be of rectangular cross section and insulated. Busbars shall be supported properly by cast epoxy resin insulators so as to withstand thermal and dynamic stresses during system short circuits. Busbars shall be provided with necessary color coding for phases indication. The busbars shall be designed to withstand a temperature rise of 60 deg. C above and ambient temperature of 45 deg. C

3.1.3 BUSBAR AND REGULATORS
3.1.3.1 All busbars and jumper connections shall be of electrolytic copper conforming to relevant IS standards. They shall be adequately supported on epoxy insulators to withstand electrical and mechanical stresses due to specified short circuit currents. Busbar cross section shall be uniform throughout the length of switch board.

3.1.3.2 Contact surface at all joints shall be properly cleaned and No-oxide grease applied to ensure an efficient and trouble free connections. All bolted joints shall have necessary washers for maintaining adequate contact pressure. All connection hardware shall have high corrosion resistance.

3.1.3.3 Busbar insulators shall be of track-resistance, high strength, and non-hygroscopic, non-combustible type & shall be suitable to withstand stresses due to over voltages and short circuit current. Busbar shall be supported on the insulator such that the conductor expansion and contraction are allowed without straining the insulators. The temperatures of the busbars and all other equipments, when carrying the rated of relevant Indian Standards, duly considering the specified ambient temperature.

3.1.4 EARTHING AND PROTECTIVE EARTHING
3.1.4.1 Copper earthing bus shall be provided. It shall be bolted/ welded to the framework of each panel. The earth bus shall have sufficient cross time fault currents to earth without exceeding the allowable
temperature rise. Suitable arrangement shall be provided at each end of the earth for bolting. Earthing conductors and earth bus shall run inside at the back of the panel for entire length. Facilities shall be provided for integral earthing of busbars & feeder circuit.

3.1.5 METERING AND PROTECTION

3.1.5.1 The VCB Panel Board shall be provided with epoxy resin current transformers for metering and protection. The protection CTs shall be of accuracy class 5 P 10 of IS 2705- Part-III-1992. The metering CTs shall confirm to the metering ratio and accuracy class 0.5 of IS 2705-1992 for incomer and class 1 for outgoing feeders. Ammeter and voltmeter to be installed on panel shall be of moving iron type or as specified in the BOQ. All meters shall be 96mm square pattern, flush mounting type with necessary selector switches. Necessary indicating lamps of low voltage type with built in resistors shall be provided (maximum wattage 2.5W).

3.1.6 OPERATING MECHANISM:

3.1.6.1 Vacuum Circuit Breaker shall be equipped with motorized spring charge 9230V AC). These operating mechanisms shall be of the stored energy type. In the closed state of the breaker, the energy stored in the springs shall be suitable for O-C-O duty.

3.1.6.2 Interlocking and Safety Arrangement.

3.1.6.3 Vacuum Circuit Breaker shall be provided with the following safety and Interlocking arrangements:
   i. The draw out carriage cannot be moved from either test/disconnected to service position or vice versa, when the circuit breaker is ‘On’.

   ii. The circuit breaker cannot be switched ‘ON’ when the carriage is in any position between test & service position.

   iii. The front door of the panel cannot be opened when the breaker is in service position or in an intermediated position.

   iv. The low voltage plug & socket cannot be disconnected in any position except test/isolated position.
v. The door cannot be closed unless the LV plug has been fitted.

vi. It shall be possible to mechanically close and trip the circuit breaker through push buttons with the circuit breaker in service position and the door closed.

vii. Individual explosion vents shall be provided for breaker, busbar, cable chambers on the top of the panel to let out the gases under pressure generated during an unlikely event of a fault inside the panel.

viii. Circuit Breaker & sheet metal enclosure shall be fully earthed.

ix. Self locking shutters shall be provided which close automatically and shall be interlocked with the movement of the draw out carriage mechanism.

3.1.7 Rating:

The rating of the vacuum circuit breaker shall be as per the drawings and schedule of quantities. The rated/breaking capacity of the breaker shall be 350 MVA (18.37 KA RMS) at 11 kV. The rated making capacity shall be as per the relevant standards.

3.1.8 Accessories:

Circuit Breakers shall be provided with the following accessories.
i. Auxiliary Switch with minimum 5 NO+ 5 NC auxiliary contacts.
ii. Tripping Coil
iii. Mechanical Operation Counter
iv. Spring Charging Handle

3.1.9 Additional Accessories

3.1.9.1 The loose items to be supplied with the 11kV VCB Panel Board shall comprise of the following:
a. Instruction Book.
c. Reaching in/out handle.
d. Handle for spring charging mechanism.
e. Foundation bolts.
f. Busbar Earthing & Circuit Earthing Trolley.

3.1.10 Mounting:

3.1.10 Vacuum Circuit Breakers shall be mounted as per manufacturer’s standard practice.

3.1.11 Auxiliary Supply:

a. The tripping shall be at 24 Volt D.C. through a power pack unit.

b. Space heater indication & other auxiliary supply requirement shall be at 230 V AC. Necessary termination arrangements complete with isolating switch, control fuse & link shall be provided at one place in the panel for receiving the purchaser’s cable.

3.1.12 CURRENT TRANSFORMER:

Current transformers shall be bar primary, cast resign type. All secondary connections shall be brought out terminal blocks where Y or D connection will be made.
2. Class 5P20 for other relaying.
3. Class 1.0 and ISF < 5 for metering.

The current transformer shall be capable of safety withstanding the short circuit, stresses corresponding to the fault level as indicated & shall be able to meet the short-time requirement specified.

All CT secondary shall be earthed through separate switch link on terminal block. The secondary terminals of the CTs shall have the provision of shorting and disconnecting facilities by links.

CT terminals & their polarities shall be clearly marked.

3.1.14 VOLTAGE TRANSFORMER:

Voltage Transformer shall be cast-resin, draw out type and shall have an accuracy class of 2.0, 3P. Voltage Transformer mounted on breaker carriage is not acceptable.
High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully draw-out position.

Low voltage fuses, sized to prevent overload, shall be installed in all undergrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the switchgear is energized.

The connections from main circuit to PT shall be capable of withstanding short circuit stresses.

3.1.14 RELAY
Protective relay shall be numerical type. Relays shall be of draw out design with built-in site testing facilities. Small auxiliary relays may be in non-draw out execution and mounted within the cubicle. Relays shall be rated for operation on 24VDC secondary voltages and 5A secondary current. Number and rating of relay contacts shall suit the job requirements.

3.1.15 TESTS:

3.1.15.1 Factory Tests
The circuit breakers panel shall be subjected to routine tests at manufacturer’s Works in accordance with the details specified in the relevant IS specifications. These shall however necessarily comprise of the following.

a. Power frequency voltage test on the main power circuit.
b. Verification of the correct wiring/Functional Test.
c. Dielectric test at 1.5kV on the control circuit. Apart from above, the vendor shall submit the routine test certificates for the following equipment.
   i. Circuit Breakers
   ii. Current Transformers
   iii. Voltage Transformers

The vendor shall submit the type test certificate for following along with the offer.

a. Temperature rise test.
b. Impulse & power frequency voltage test
c. Short time current test on circuit breaker.

3.1.16 Site Test:

3.1.16.1 General:

1. Verification for completion of equipment, physical damage/deformities.
2. Alignment of panel, interconnection of busbars & tightness of bolts & connection etc.
3. Interconnection of panel earth busbar with plant earthing grid.
4. Inter panel wiring between transport sections.
5. Cleanliness of insulators and general Cleanliness of panel to remove traces of dust, water etc.

3.1.17 Circuit Breaker & Panel:

1. Check for free movement of circuit breaker, lubrication of moving part & other parts as per manufacturers manual.
3. Meggar before the Hi Pot test.
4. H.T. Test - Hi Pot test (Power frequency withstand test for one minute at 28kV RMS). At site Hi Pot test is carried out at 80% of 28kV RMS value.
5. Meggar after the Hi Pot test.
6. CT/PT ratio/polarity primary injection test.
7. Secondary injection test on relays to practical characteristics.

3.2 HT CABLES:

3.2.1 Construction:

All H.T cables shall be of 11kv grade XLPE earthed insulated & PVC sheathed Flat steel wires (strips) armored electrical purity aluminum conductor cables shall be manufactured & tested in accordance with IS Specification.

3.2.2 TERMINATION JOINTS:

Terminal joints shall be carried out as per IS specifications. Heat shrink cable termination kit shall be used for terminations.
3.2.3 INSTALLATION OF CABLES:

Cable laying shall be carried out as per CPWD specifications

3.3 CABLE TRAY:

Cable tray is manufactured at Indian Standard Specification. Laying is done as per IS & CPWD specification.

3.4 EARTHING:

Earthing specified in BOQ is done as per IS & CPWD specification.

3.5 TRANSFORMERS:

GENERAL FEATURE
Installation : outdoor
Service : continous
Type of Cooling :ONAN
Position : Plength mounted

3.5.1 ELECTRICAL DATA
Earthing on LV side : solid
Nos. of winding : Two
Voltage Ratio : 11/0.433 V
Vector Group : Dyn11
Termination on H.V side : Disconnecting type cable box
    Size 1 No. 3C x 240 Sqmm AL HT XLPE(E) CABLE
L.V side : as per drawing.
TAP CHANGER
Tappings : HV circuit
Tap changer : LINK type Off load tap changer
Tapping range : -7.5% to +7.5% (750KVA)
No. of steps : in steps of 2.5%

a) HV test, if directed by owner in accordance with IS:2026-1962.
b) Insulation resistance to earth of each winding to earth in accordance with IS:2026-1962.
c) Ratio Polarity and phasing check(IS-1886).
d) OIL Test (IS-335:1953) should withstand 40 KV/cm
e) Buchholz relay operation and test (by compressed air or other suitable means approved by owner)
f) Operation of all other accessories including OTI, WTI, oil level gauge. No. load test for 8 hours prior to throwing load progressively on the transformer.

4.0 L.T. PANELS AND:

4.1 M.V. PANELS:

4.2 GENERAL:

Main/Sub Distribution Panels shall be indoor type, metal clad, floor mounted, free standing, totally enclosed, extensible type, air insulated, cubicle type for use on 415 Volts, 3 phase, 50 cycles system.

4.3 CONSTRUCTION
Main/Sub Panels shall be:
i. Of metal enclosed, indoor, floor mounted, free standing construction (unless otherwise specified) type.
ii. Made up of the requisite vertical sections, which when coupled together shall form continuous dead front switchboards.
iii. Provide dust and damp protection.
iv. Be readily extensible on both sides by the addition of vertical sections after removal of the end covers in case of Main Panels.
v. All panels shall be front access type.
Main/Sub Panels shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses, as the effects of humidity, which are likely to be encountered in normal service.
Each vertical section shall comprise of the following:
i. A front-framed structure of rolled/folded sheet steel channel section, of minimum 2 mm thickness, rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, moulded case circuit breaker, main horizontal busbars, vertical risers and other front mounted accessories. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 2mm thickness and 100 mm height. The design shall ensure that
the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.

ii. A cable chamber housing the cable end connections, and power/control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling, and adequate safety for working in one vertical section without coming into accidental contact with live parts in an adjacent section.

iii. A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.

iv. Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

The height of the panels should not be more than 2100 mm for MV Panels. Operating handle of breaker in top most compartments shall not be higher than 1800 mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be less than 350mm. Doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 1.6 mm thickness. All sheet panels shall be smoothly finished, leveled and free from flaws. The corners should be rounded. The apparatus and circuits in the power control centers (panels) shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety. Apparatus forming part of the Main/Sub Panels shall have the following minimum clearances.

i. Between phases - 32 mm
ii. Between phases and neutral - 26 mm
iii. Between phases and earth - 26 mm
iv. Between neutral and earth - 26 mm

When, for any reason, the above clearances are not available, suitable insulation shall be provided. Clearances shall be maintained during normal service conditions. Creepage distances shall comply with those specified in relevant standards. All insulating material used in the construction of the equipment shall be of nonhygroscopic material, duly treated to withstand the effects of the high humidity, high temperature tropical ambient service conditions. Functional units such as circuit breakers and moulded case circuit breakers shall be arranged in multi-tier formation, except that
not more than two air circuit breakers shall be housed in a single vertical section. Cable entry for various feeders shall be from the rear. Panel shall be suitable for termination of bus duct for incoming breakers. Metallic/insulated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:

i. Main busbars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.
ii. Cable termination of one functional unit, when working on those of adjacent unit/units.

All doors/covers providing access to live power equipment/ circuits shall be provided with tool operated fasteners to prevent unauthorized access.

Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections.

4.4 METAL TREATMENT & FINISH:

All steel work used in the construction of the Main/Sub Panels should have undergone a rigorous metal treatment process as follows:-

i. Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.
ii. Pickling in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.
iii. A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.
iv. Passivating in de-oxalite solution to retain and augment the effects of phosphating.
v. Drying with compressed air in a dust free atmosphere.
vi. Panel shall be powder coated with epoxy based powder paint after the above process so as to render the material suitable for corrosive environment.
vii. Paint shade shall be Pebble (light) grey, shade no RAL 7032 unless otherwise specified.
4.5 BUSBARS:

The busbars shall be air insulated and made of high conductivity, high strength aluminum alloy complying with the requirement of IS-5082. The busbars shall be suitable braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of 50 kA RMS symmetrical for one second. The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent busbars. Large clearances and Creepage distances shall be provided on the busbar system to minimize possibilities of fault. The Main/Sub Panels shall be designed that the cables are not directly terminated on the terminals of breaker etc. but on cable termination links. Capacity of aluminum busbars shall be considered as 0.8 Amp per sqmm. of cross sectional area of the busbar. The main busbars shall have continuous current rating throughout the length of Panels. The cross section of neutral busbars shall be same as that of phase busbar for busbars of capacity up to 200Amp; for higher capacity the neutral busbar shall not be less than half (50%) the cross section of that the phase busbars. The busbar system shall consist of main horizontal busbar and auxiliary vertical busbars run in busbar alley/chamber on either side in which the circuit could be arranged/connected with front access. Connections from the main busbars to functional circuit shall be arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Busbars to be colour coded with PVC sleeves.

4.6 CABLE TERMINATIONS:

Cable entries and terminals shall be provided in the Main/Sub Distribution Panels to suit the number, type and size of aluminium conductor power cables and Copper conductor control cable specified. Provision shall be made for top or bottom entry of cables as required. A cable chamber 150 mm. high shall be provided at the bottom throughout the length and depth of the MDB/SDB. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated. Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit. Cable risers shall be adequately supported to withstand
the effects of rated short circuit currents without damage and without causing secondary faults.

4.7 LABELS:
Labels shall be anodised aluminium with white engraving on black background shall be provided for each incoming and outgoing feeder of Main/Sub Distribution and all Panels.

4.8 TEST AT MANUFACTURES WORK:
All routine tests specified in IS: 8623-1977 shall be carried out and test Certificates submitted.

4.9 TESTING AND COMMISSIONING:
Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment / setting shall be done before commissioning in addition to routine meegar test.
Checks and tests shall include the following.
   a) Operation checks and lubrication of all moving parts.
   b) Interlocking function check.
   c) Insulation test: As per CPWD Specifications.
   d) Trip tests & protection gear test.

5.00 L.T. SWITCHGEARS:

5.01 AIR CIRCUIT BREAKERS;

5.01.1 GENERAL
Air circuit breakers shall be incorporated in Main Distribution Panels wherever specified. ACBs shall conform to IS 13947 (Part 2) & IEC 947 (2) in all respects. ACBs shall be suitable for operation on 415 volts, 3 phase, 50Hz, AC supply.

5.01.2 Technical Specifications:
The Air circuit breakers shall conform to the requirements of IS13947-2 and IEC 60947-2 & their latest amendments and should be type tested & certified for compliance to Indian standards from CPRI/ERDA. Manufacturer shall submit test report for combined sequence tests from CPRI/ERDA. The breakers shall be suitable for isolation and should be clearly indicated on the front facia. The Air circuit breakers shall be suitable for following system conditions:
1) The ACBs shall have lcs = lcu = lcw for 1 sec for short circuit breaking capacity of not less than 50 KA rms at 415 Volts 50Hz AC.
2) Rated Operational Voltage (V) & Frequency: 415 Volts, 3 phase, 4wire 50Hz.
3) Rated insulation voltage (Uij): 1000 volts AC
4) Ambient temperature: designed at 40 degree C ambient temperature. ACB shall be fully rated at inside panel temperature of 50 deg C.
5) Rated impulse voltage 8 KV for Main circuit.
6) Utilization Category: B

All ACBs shall be of electrically operated and draw out type (EDO) unless otherwise stated. The circuit breakers shall be 3/4 pole (as specified in BOQ) with Quick make/break, trip free operating mechanism. All current carrying parts shall be silver plated and suitable arcing contacts with proper arc chutes shall be provided to protect the main contacts. The ACBs shall be fitted with detachable arc chutes on each pole designed to permit rapid dispersion, cooling and extinction of the arc. It should be possible to remove arc chutes without using any tool & without removing the breaker from the panel. The ACBs shall have minimum mechanical life of 20000 operations for ratings up to 2500A & 5000 operations for higher ratings. It should be possible to extend electrical life of the ACB to mechanical life by replacing the arcing contacts at site. It shall be possible to directly terminate Aluminum links / bus bars as specified in IS13947-2. All 4 Pole ACBs should have fully neutral Pole. Auxiliary switches directly operated by the breaker operating mechanism and having 6NO and 6NC contacts, shall be provided on each breaker. The auxiliary switch contacts shall have a minimum rated thermal current of 10 Amps at 230V ac. All the ACB ratings shall have a uniform panel door cut-out, on left or right side of the panel for allowing maximum utilization of panel space. The ACB with Panel should meet IP53 protection on breaker front.

**Cradle:**

The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. Draw out ACBs shall have 4 distinct and separate positions wrt cradle i.e. Service Position, Test Position, Isolated Position and Maintenance. ACB should have facilities for carrying out maintenance without physically removing the breaker from panels. For ease of maintenance, it should be possible to replace jaw contacts without disturbing the busbar links for draw-out type ACBs.
Protection Release:
The protection release of Incomer level ACBs (except APFC Panels) should be microprocessor based release having inbuilt adjustable protections against overload, short circuit, instantaneous and earth fault protection with adjustable time delay settings for all protections except instantaneous zone. The release should have separate indication by LEDs for Power ON, Overload, Short Circuit, Instantaneous and Earth Fault, Trip & Alarm. The release should provide following additional protection with necessary modules apart from basic protections:

- Undercurrent
- Current Unbalance
- Reverse power
- Under and over voltage
- Under and over frequency.
- Phase sequence
- Maximum demand exceed

The parameterization should be possible through communication and menu. The release must provide a password protection to access the protection configurations. The release shall meet the EMI / EMC requirements. The release should have high-resolution LCD for comprehensive metering with the following parameters:

- Phase and Neutral currents (running, avg & max), percentage loading etc
- Phase voltages (P-P & P-N) (running, avg & max)
- Energy & power parameters (active, reactive and apparent)
- Maximum demand in KW
- Power Factor
- System Frequency
- Harmonic- Voltage & current

5.01.2 TYPE AND CONSTRUCTION:
Air Circuit Breakers shall be of enclosed pattern, dead front type with 'trip free' Operating mechanism. It shall have microprocessor based electronic release. Air Circuit Breakers shall be EDO type (Electrically draw out type unless otherwise specified) with horizontal draw out carriage. The ACBs shall be strong and robust in construction with suitable arrangements for anchoring when in fully engaged or fully drawn-out positions. The carriage or cradle on which the breakers are mounted shall be robust design made of fabricated steel, supported on rollers. Cradle shall also comprise of main and secondary
separable contacts and all draw out mechanism in a completely fig welded assembly. There shall be no dependence upon the switchboard frame for any critical alignment. The withdrawal arrangement shall be such as to allow smooth and easy movement. All the current carrying parts of the circuit breakers shall be silver plated, suitable arcing contacts shall be provided to protect the main contacts. The contacts shall be of spring loaded design. The sequence of operation of the contacts shall be such that arcing contacts 'make before' and break after' the main contacts. Arcing contacts shall be provided with efficient arc chutes on each pole and these shall be such suitable for being lifted out for inspection of main as well as arcing contacts. The contact tips and arc chutes shall be suitable for ready replacement. Self aligning isolating contacts shall be provided. The design of the breaker shall be such that all the components are easily accessible to inspection, maintenance and replacement. Inter phase barriers shall be provided to prevent flashover between phases.

5.01.3 OPERATING MECHANISM:
Air Circuit breaker shall be provided with a quick-make, trip free operating mechanism, the operating mechanism shall be 'strain-free' spring operated. The operating handle shall be in front of the panel type. The design shall be such that the circuit breaker compartment door need not be opened while moving the breaker from completely connected, through test, into the disconnected position. Electrical operated breakers shall have a motor wound spring charged closing mechanism. Breaker operation shall be independent of the motor, which shall be used solely for charging the closing spring. The operating mechanism shall be such that the breaker is at all times free to open immediately and the trip coil is energized. Mechanical operation indicator shall be provided to show open and closed position of breaker. Electrically operated breakers shall be additionally provided with mechanical indication to show charged and discharged condition of charging spring. 24 volt DC supply through battery backup for closing and opening for tripping circuit. Means shall be provided for slow closing and opening of the breaker for maintenance purposes and for manual charging and closing of electrically operating breakers during emergencies.

5.01.4 INTERLOCKING AND SAFETY ARRANGEMENT:
Air Circuit Breakers shall be provided the following safety and interlocking arrangements:

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

iii. The breaker shall be capable of being racked into 'testing', 'isolated' and ‘maintenance’ positions and kept locked in any of these positions.

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

v. The operating mechanism shall provide for racking the breaker into connected, test and disconnected positions without operating compartment door. When cubicle door shall be open position, the breaker can be pulled out to a fourth position, maintenance, where free access shall be possible to all parts of the breaker.

5.01.05 RATING:
The rating of the circuit breaker shall be as per the drawings and schedule of quantities. Rated service breaking capacity (Ics) of the breakers shall be 50kA unless otherwise specified at 415 volts. The rated making capacity shall be as per specified at 415 volts. The rated making capacity shall be as per the relevant standard.

5.01.06 ACCESSORIES:
The breaker shall be equipped with electronic microprocessor based release to provide over current & earth fault protection. The breaker shall be fitted with following accessories for control, signal and interlocking.

i. Auxillary contacts 6 NO + 6 NC, of rating 16Amp at 415 volts 50Hz.

ii. Shunt release for tripping the breaker remotely and shall be suitable for 240 volt/415 volt 50Hz with range of operation from 10% to 130% of rated voltage.

iii. Micro switches shall be mounted on the cradle of draw out breaker to indicate the position of the breaker on the cradle.

a. Kit for test/isolated indication.
b. Kit for service position indication.
c. Kit for shutter assembly.

iv. Accessories for following interlocking schemes shall be provided.

a. Accessory kit for locking the breaker in isolated position. This kit is useful for interlocking scheme as well as keeping personnel and equipment safe.
b. Door interlock kit: Panel or cubicle door cannot be opened with the ACB in Test or Service position.
c. Lockable trip push button.

5.01.07 MOUNTING:
Circuit Breakers shall be mounted as per manufacturers’ standard practice.

5.01.08 TESTING:
Testing of each circuit breaker shall be carried out at the works as per IS 2516 and the original test certificate shall be furnished in triplicate. The tests shall incorporate at least the following.

i. Impulse withstand test.
ii. Power frequency withstand test.
iii. Short circuit test.
iv. Temperature - rise test under rated conditions.

5.02 MOULDED CASE CIRCUIT BREAKERS:

5.02.01 GENERAL:
Moulded Case Circuit Breakers shall be incorporated in the Main/Sub Distribution Boards wherever specified. MCCBs shall conform to IS 13947 (Part 2) & IEC 947 (2) in all respects. MCCBs shall be suitable either for single-phase AC 230 volts or three phase 415 volts. All MCCBs shall have microprocessor based over current and short circuit releases with adjustable current setting from 0.4In/0.8 In to 1.0 In. as per BOQ.

5.02.02 Technical Specifications:
The MCCB should be current limiting type with trip time of less than 10 milli sec under short circuit conditions. The MCCB should be either 3 or 4 poles as specified in BOQ. MCCB shall comply with the requirements of the relevant standards IS13947 – Part 2 /IEC 60947-2 and should have test certificates for breaking capacities from independent test authorities CPRI / ERDA MCCB shall comprise of Quick Make -break switching mechanism, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. The breaking capacity of MCCB shall be minimum 25KA / 50 KA or as specified in BOQ. The rated service breaking capacity should be equal to
rated ultimate breaking capacities (Ics=Icu). All MCCBs upto 200A ratings should be provided with Thermal Magnetic type release with adjustable Overload and fixed short circuit protections. MCCBs of ratings 250A & above shall be provided with Microprocessor based having inbuilt adjustable protections against Over Load (L), Short Circuit (S) and Ground Faults (G)] with time delay. All MCCBs should be provided with the Rotary Operating Mechanism. The ROM should be with door interlock (with defeat feature) & padlock facility MCCB should have Spreader links & Phase barriers as standard feature. Superior quality of engineering grade plastics confirming to glow wire Tests as Per IEC 60695-2-1 should be used for insulation purpose. 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.

5.02.02 FRAME SIZES:

The MCCBs shall have the following frame sizes subject to meeting the fault level.

a. Upto 100A rating ............... 100A frame.
b. Above 100A upto 200A ...... 200A frame.
c. Above 200A up to 250A ...... 250A frame.
d. Above 250A up to 400A ...... 400A frame.
e. Above 400A up to 630Aq .... 630A frame.
f. Above 630A to 800A .......... 800A frame.

5.02.03 CONSTRUCTIONS:

The MCCB's cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be quick make/quick break, trip-free type. The operating handle shall have suitable "ON", "OFF" "and" "tripped" indicators. Three phase MCCBs shall have common operating handle for simultaneous operation and tripping of all the three phases. MCCBS shall be provided with rotary handle.

Suitable extinguishing device shall be provided for each contact. Tripping unit shall be of thermal magnetic or static release type provided in each pole & connected by a common trip bar such that tripping of any pole operates all three poles to open simultaneously. MCCB shall be current limiting type.
Contact trips shall be made of suitable air resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

5.02.04 BREAKING CAPACITY:

Unless otherwise specified, rated service breaking capacity of the Moulded Case Circuit Breakers shall be minimum 25kA or as mentioned in the BOQ.

5.03 TESTING:

a. Original test certificate of the MCCB as per Indian Standards (IS) 315-C- 8370 shall be furnished.

b. Pre-commissioning tests on the Main Distribution/Sub Distribution Board incorporating the MCCB shall be done as per standard.

5.03.1 MINIATURE CIRCUIT BREAKERS:

Miniature Circuit breakers shall be current limiting type conformed with British Standard BS: 3871 (Part I) 1965 and IS: 8825. The housing of MCBs shall not be less than 9000 A at 230 V. The MCBs shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical ‘ON’ and ‘OFF’ indications.

The Circuit breaker dollies shall be of the trip free pattern to prevent closing the breaker on a faulty circuit.

The MCB contacts shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCBs shall be provided with magnetic fluid plunger release for over current and short circuit protection. The overload or short circuit device shall have a common trip bar in case of DP and TPN miniature circuit breakers. All the MCBs shall be tested and certified as per Indian Standards, prior to installation.

5.03.2 FUSE:

Fuses shall be of high rupturing capacity (HRC) fuse links and shall be in accordance with IS: 2000-1962 and having high rupturing capacity of not
less than 35 MVA at 415 V. The backup fuse rating for each motor/equipment shall be so chosen that the fuse does not operate on starting of motors / equipment. HRC fuses shall be of the make as specified in Make of material.

5.04 MEASURING INSTRUMENTS, METERING & PROTECTION:

5.04.01 GENERAL:

Direct reading electrical instruments shall be in conformity with IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between -10 degree Centigrade to +50 degree Centigrade. All meters shall be of flush mounting type of 96mm square or circular pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instrument glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings. The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right. Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three-phase supply. The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The ratings type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

5.04.02 AMMETERS:

Ammeters shall be moving iron or moving coil type. The moving part assembly shall be with jewel bearing. The jewel bearing shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks, the ammeters shall be manufactured and calibrated as per the latest edition of IS: 1248. Ammeters shall be instrument transformer operated, and shall be suitable for 5A secondary of instrument
The scales shall be calibrated to indicate primary current, unless otherwise specified. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

5.04.03 VOLTMETERS:

Voltmeter shall be of moving iron or moving coil type. The range for 415 volts, 3 phase voltmeters shall be 0 to 500 volts. Suitable selector switch shall be provided for each voltmeter to read voltage between any two lines of the system. The voltmeter shall be provided with protection fuse of suitable capacity.

5.04.04 CURRENT TRANSFORMERS:

Current transformers shall be in conformity with IS: 2705 - 1964(Part I, II & III) in all respects as amended upto date. All current transformers used for medium voltage applications shall be rated for 1kV. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated acceptable minimum class of various applications shall be as given below:

Measuring : Class 0.5 to 1
Protection : Class 5P10.

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50KA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate. Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner. All Current Transformer shall be Cast resin type.

5.05 MISCELLANEOUS:

Control switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-
flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the filament type of low watt consumption, provided with series resistor where necessary, and with translucent lamp covers, bulbs & lenses shall be easily replaced from the front.

Colour shade for the indicating lamps shall be as below – the LED shall be 22.5 mm and self coloured:

- **ON indicating lamp**: Red
- **OFF indicating lamp**: Green
- **TRIP indicating lamp**: Amber
- **PHASE indicating lamp**: Red, Yellow, and Blue

Push buttons shall be of the momentary contact, push to actuate type fitted with self reset contacts & provided with integral escutcheon plates marked with its functions. The contacts shall be of silver alloy and rated at 10 Amps. Continuous current rating.

**5.06 DRAWING & INFORMATION:**

Prior to fabrication of the panels the supplier/contractor shall submit for consultant’s approval the shop / vendor drawing consisting of G.A. drawing, sectional elevation, single line diagram, bill of material etc. and design calculations indicating type, size, short circuiting rating of all the electrical components used, busbar size, internal wiring size, panels dimension, colour, mounting details etc. The contractor shall submit manufacturer’s catalogues of the electrical components installed in the panels.

**INSPECTION & TESTING:**

At all reasonable times during production and prior to transport of the panels to site, the supplier/contractor shall arrange and provide all the facilities at their plant for inspection.

Testing of panels shall be carried out at factory and at site as specified in Indian standards in the presence of consultant / client. The results shall be recorded on a prescribed form. The test certificate for the test carried out at factory and at site shall be submitted in duplicate to the consultant for approvals.
METHOD OF MEASUREMENT:
All the items will be measured as mentioned in Bill of Quantity.

6.00 INTERNAL ELECTRIFICATION OF BUILDING:

6.1 GENERAL:
The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice for Electrical Wiring Installation IS: 732-1989 and IS:2274-1963. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations, so far as these become applicable to the installation. Electrical work in general shall be carried out as per following CPWD Specifications with up to date amendment.

- Specifications for Electrical Works Part-1 (Internal) by CPWD – 2005 or latest revision - Specifications for Electrical Works Part-II (External) by CPWD – 1994 or latest revision Wherever these specifications calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take precedence over the said regulations and standards.

6.2 DISTRIBUTION BOARDS:
As a general practice only pre-wired MCB type double door DB shall be used. Prewired DB shall have following features:

i) Recess/ surface type with integral loose wire box.
ii) Phase/neutral/ earth terminal blocks for termination of incoming & outgoing wires.
iii) DIN channel for mounting MCBs.
iv) Arrangement for mounting incomer MCB/RCCB/MCCB as required.
v) Copper bus bar.
vi) Earthing terminals.
vii) Wiring from MCBs to terminal block.
viii) Interconnection between terminal block/ incoming switch/ bus bar/ neutral/terminal block/ earth terminal connector with specified size of FRLS pre insulated copper conductor cable duly fitted with copper lugs/thimbles.
ix) Termination block should be suitable for termination of conductor/cable of required size but minimum rated cross section of the terminal blocks should be 6 sq. mm.
x) Terminal block shall be made of flame retardant polyamide material.
xii) Coloured terminal blocks and FRLS wires for easy identification of RYB phases, Neutral and Earth.
xiii) Pre-wired DB shall be provided with a detachable cassette for safe removal of MCBs, RCCBs. Terminal connectors from the DB without loosening the internal cable connections of phase and neutral circuits.
xiv) The pre-wired DB shall have peel able poly layer on the cover for protection from cement, plaster, paints etc during the construction period.
xv) Detachable plate with knock out holes shall be provided at the top/bottom of board. Complete board shall be factory fabricated and pre-wired in factory, ready for installation at site. The box and cover shall be fabricated from 1.6mm sheet steel, properly pretreated, phosphotized with powder coated finish.
xvi) DB shall be of double door construction provided with hinged cover in the front. Distribution Board shall be standard type. Distribution boards shall contain miniature circuit breakers of rating specified in BOQ/DB Schedule.

Miniature circuit breakers shall be quick make and quick break type with trip free mechanism. MCB shall have thermal and magnetic short circuit protection. All miniature circuit breakers shall be of 10 KA rated rupturing capacity unless otherwise specified. Neutral busbars shall be provided with the same number of terminals, as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. All live parts shall be screened from the front. Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. A circuit identification card in clear plastic cover shall be provided for each distribution board. MCB's shall be provided on the phase of each circuit. The individual banks of MCB's shall be detachable. There shall be ample space behind the banks of MCB's to accommodate all the wiring. All the distribution boards shall be completely factory wired, ready for connections. All the terminals shall have adequate current rating and size 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. Residual Current Circuit
Breaker shall be current operated type and of 100mA sensitivity unless otherwise specified.

Distribution Boards shall be ready for connections and shall be inspected in the factory by NKDA Electrical Engineer before dispatch. Before procurement of Distribution Boards, MCB’s, RCCB’s (incomer and Outgoings) etc., the contractor has to take approval of the DB Schedule /Drawings of each DB from the NKDA Electrical Engineer. The whole unit i.e. Distribution Board, MCB’s, RCCB’s etc. shall come from the manufactures premises/workshop. After inspection and clearance from the NTKDA Electrical Engineer the same may be dispatched to site for installation. However if a single component (such as RCCB or MCB or DB) is required for any reason such as replacement, increase in no. of Circuits in the DB, change in the load of existing circuit, change in the total load on a particular DB etc., the same may be ordered separately but after the approval of NTKDA Electrical Engineer.

6.3 PVC CONDUIT WIRING SYSTEM.

6.3.1 TYPE AND SIZE OF CONDUIT:

All conduit pipes shall be of approved gauge (not less than 16 SWG for conduits of sizes up to 32 mm diameter and not less than 14 SWG for conduit of size above 32mm diameter) solid drawn or reamed by welding finished with black stove enameled surface. All conduit accessories shall be of threaded type and under no circumstances pin grip type accessories shall be used. The maximum number of PVC insulated 650/1100 volts grade copper conductor cable that can be drawn in conduit of various sizes shall be as per IS Code. No steel conduit less than 20mm in diameter shall be used.

6.3.2 CONDUIT JOINTS:

Conduit pipes shall be joined by means of threaded couplers, and threaded accessories only. In long distance straight run of conduits, inspection type couplers at reasonable intervals shall be provided or running threads with couplers and jam nuts shall be provided. In the later case the bare threaded portion shall be treated with anti-corrosive preservative. Threads on conduit pipes in all cases shall be between 13mm to 19 mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories.
Cut ends of conduit pipe shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductor while pulling them through such pipes.

6.3.3 PROTECTION AGAINST CONDENSATION:
The layout of conduit should be such that any condensation or sweating inside the conduit is drained out. Suitable precaution should also be taken to prevent entry of insects inside the conduit.

6.3.4 PROTECTION OF CONDUIT AGAINST RUST:
The outer surface of conduit including all bends, unions, tees, junction boxes etc. forming part of conduit system shall be adequately protected against rust when such system is exposed to weather by being painted with two coats of oxide paint applied before they are fixed. In all cases, no bare threaded portion of conduit pipe shall be allowed. Unless such bare thread portion of conduit is treated with anticorrosive preservative or covered with approved plastic compound.

6.3.5 PAINTING OF CONDUIT AND ACCESSORIES:
After installation, all accessible surface (if any) of conduit pipes, fittings etc. shall be painted with two coats of approved enameled paint or aluminium paint as required to match the finish of surrounding wall, trusses etc.

6.3.6 RECESS CONDUIT:
The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. Incase of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work. Entire work of chasing the wall, fixing the conduit in chases, and burring the conduit in mortar before plastering shall form part of point wiring work. The conduit pipe shall be fixed by means of staples or by means of saddles not more than 60cm apart or by any other approved means of fixing. Fixing of standard bends and elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with the long radius, which shall permit easy drawing in of conductors. All threaded joints of conduit pipe shall be treated with some approved preservative compound to secure protection against rust. Suitable inspection boxes to
the barest minimum requirements shall be provided to permit periodical inspection and of facilitate replacement of wires, if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Wherever the length of conduit run is more than 10 meters, then circular junction box shall be provided.

**6.3.7 METAL OUTLET BOXES & COVERS:**

The switch box shall be made of modular metal boxes with suitable size modular cover plates. Modular metal box shall be made of mild steel on all sides except on the front. The metal box (other than modular type) shall be made of metal on all sides except on the front. Boxes shall be hot dip galvanized mild steel. Metal boxes upto 20 x 30 cm size M.S. box shall have wall thickness of 18 SWG and MS boxes above 20 x 30 cm size shall be of 16 SWG. The metallic boxes shall be painted with anticorrosive paint before erection. Clear depth of the box shall not be less than 60mm. All boxes shall be covered from top with Phenolic laminated sheet of approved shade. These shall be of 3 mm thick synthetic phenolic resin bonded laminated sheet as base material and conform to grade P-I of IS: 2036-1994.

**6.3.8 ERECTION AND EARTHING OF CONDUITS:**

The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested in presence of NKDA Electrical Engineer for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirement by means of special approved type of earthing clamp effectively fastened to conduit pipe in a workmen like manner for a perfect continuity between the earth and conduit.

**6.3.9 SWITCHES:**

All 5 and 15 Amp switches shall be modular type of 240 volts A.C. grade. All switches shall be fixed on modular metal boxes. All 5 Amp socket shall be 5 pin type and 15 Amp socket shall be 6 pin type (unless otherwise specified) suitable for 15/5 Amp. All modular switches, sockets, telephone outlets, TV outlet etc. shall be in off white finish unless otherwise specified. The switches controlling the lights or fans shall be connected to the phase wire of the circuit. Switch boards shall be located at 1200 mm
above finished floor level unless otherwise indicated on drawings or directed by Engineer-In-Charge.

6.3.10 COVER PLATE:

All modular switches, sockets, telephone outlets etc. shall be fixed modular metal boxes with modular base plates and modular cover plates on top.

6.3.11 WALL SOCKET PLATE:

Each outlet shall have a switch located beside the socket preferably on the same cover plate/modular base. The earth terminal of the socket shall be connected to the earth wire.

6.4 WIRING:

All PVC insulated copper conductor wires shall conform to relevant IS Codes. All wires/cables shall be stranded type irrespective of its size. Cable conductor size and material shall be specified in BOQ. All internal wiring shall be carried out with PVC insulated wires of 650/1100 volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be allowed in the length of the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light/fan. A light/fan switchboard may have more than one circuit but shall have to be of same phase. Looping circuit wiring shall be drawn in same conduit as for point wiring. Each circuit shall have a separate neutral wire. Neutral looping shall be carried out from point to point or in light/fan switchboards. A separate earth wire shall be provided along with circuit wiring for each circuit. For point wiring red/yellow/blue colour wire shall be used for phase and black colour wire for neutral. Circuit wiring shall be carried out with red, yellow or blue colour PVC insulated wire for RYB phase wire respectively and black colour PVC insulated wire for the neutral wires. Bare copper wire shall be used as earth continuity conductor and shall be drawn along with other wires. No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of
moisture, dust and dirt. Drawing and jointing of copper conductor wires and cables shall be as per CPWD specifications.

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

6.5 Bunching of Cables:
Conductors of different circuits / different phases / different voltages shall be bunched in separate conduits. The number of insulated cables that may be drawn into single conduit is given in the following table with maximum space factor of 40%.

<table>
<thead>
<tr>
<th>Nominal section mm²</th>
<th>Cross area mm²</th>
<th>Number and diameter in mm of wires</th>
<th>Size of Conduit (mm) outside diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>19/20</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S/B</td>
<td>S/B</td>
</tr>
<tr>
<td>1.5</td>
<td>1/ 1.4</td>
<td>7/5</td>
<td>12/10</td>
</tr>
<tr>
<td>2.5</td>
<td>1/ 1.8</td>
<td>6/5</td>
<td>10/8</td>
</tr>
<tr>
<td>4.0</td>
<td>1/ 2.24</td>
<td>4/3</td>
<td>7/6</td>
</tr>
<tr>
<td>6</td>
<td>1/ 2.8</td>
<td>3/2</td>
<td>6/5</td>
</tr>
<tr>
<td>10</td>
<td>1/ 3.55</td>
<td>2/0</td>
<td>5/4</td>
</tr>
<tr>
<td>16</td>
<td>7/ 1.7</td>
<td>---</td>
<td>2/0</td>
</tr>
<tr>
<td>25</td>
<td>7/ 2.24</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>35</td>
<td>7/ 2.5</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>50</td>
<td>7/ 3</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

The above table shows maximum capacity of conduits for the simultaneous drawing of cables. Supply to runs of conduit which has distance not exceeding 4.25M between drawn in boxes and which do not deflect from the straight run by an angle more than 15°. The B applies to runs of conduit, which deflect from the straight run by an angle more than 15°.

6.5.1 JOINTS:

All joints shall be made at main switches, distribution board socket and switch boxes only. No joint shall be made in conduits and junction boxes. Conductors shall be continuous from outlet to outlet.
6.5.2 LOAD BALANCING:
Balancing of circuits in three-phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

6.5.3 COLOUR CODE FOR CIRCUIT WIRING:

Colour code for circuit and sub main wiring installation shall be Red, Yellow, and Blue for three phases. Black for neutral and yellow/green or green only for earth incase of insulated earth wire.

6.5.4 CLASSIFICATION OF POINTS:

6.5.4.1 General:

Classification and measurement of Point wiring shall be as per CPWD specification for Electrical Works (Part-I-Internal) 1994.

6.5.4.2 Point Wiring

(Modular) : Definition of point wiring:

A point (other than socket outlet point) shall include all work necessary in complete wiring to the light points/fan/exhaust fan/call bell point from the controlling switch/MCB. The scope of wiring for a point shall, however, include the wiring work necessary in tapping from another point in the same distribution circuit i.e. from first switch board (wiring from distribution board to first switch box is covered in the circuit wiring and is not in the scope of point wiring) to subsequent switch board(s) in the same distribution circuit. The point wiring includes all materials specified below including chasing the wall (in case of recessed wiring in wall), fixing the conduit and making the wall good as it originally was. It also includes supply, drawing, testing and commissioning of wires.

Scope of point wiring:
Following shall be deemed to be included in point wiring.
(a) Supply & fixing conduit & conduit accessories for the same and wiring cables(including supplying and drawing wires) between the switch box and the point outlet.
(b) All fixing accessories such as clips, nails, screws, phil plug, rawl plug etc. as required.
(c) Modular Metal boxes for control switches, regulators, sockets etc. recessed or surface type, modular base plates and modular cover plates over the same.
(d) Outlet boxes, junction boxes, pull-through boxes etc. but excluding modular metal boxes if any, provided the switchboards for loose wires/conduit terminations.
(e) In case of recessed wiring in wall the scope includes chasing of wall, fixing the conduit and making the wall good as it originally was.
(f) Control modular switch (5/6A) as specified.
(g) Ceiling rose or connector (in case of points for ceiling/exhaust fan point, prewired light fittings and call bells).
(h) Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.
(i) Interconnecting wiring between points on the same circuit, in the same switch box or from another. Interconnecting wiring from first switchboard to subsequent switch board(s).
(j) Protective (loop earthing) conductor (as specified in the BOQ) from one metallic switch box to another in the distribution circuits, and from switchboard to each point (light/fan/exhaust fan/call bell etc).
(k) Bushed conduit where wiring cables pass through wall etc.
(l) Ceiling rose (in the case of pendants except stiff pendants).
b) Lamp holder (in the case of goose neck type wall bracket, batten holder and fittings which are not pre-wired).
c) Back Plate (in the case of stiff pendants).
d) MS Fan Boxes with MS hook (as per CPWD specifications) for the erection of Ceiling Fans

**Measurement of Point Wiring** (other than socket outlet points)

i) There shall be no linear measurement for point wiring for light points, fan points, exhaust fan points and call bell points. These shall be measured on unit basis by counting,

ii) No separate measurement shall be made for interconnections between points in the same distribution circuit and for the circuit protective (loop earthing) conductors between metallic switch boxes.
6.5.5. Circuit and Sub main Wiring:

Circuit Wiring:
Circuit wiring shall mean the wiring from the distribution board upto the tapping point for the nearest first point of that distribution circuit i.e. up to the nearest first switch box.

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

Measurement of circuit wiring and sub main wiring:

(i) Circuit and sub main wiring shall be measured on linear basis along the run of the wiring. The measurement shall include all lengths from end to end of conduit, exclusive of interconnections inside the switchboard etc. The increase on account of diversion or slackness shall not be included in the measurement.
(ii) The length of circuit wiring with two wires shall be measured from the distribution board to the first nearest switch box in the circuit irrespective of whether neutral conductor is taken to switch box or not.
(iii) When wires of different circuits are grouped in a single conduit, the same shall be measured on linear basis depending on the actual number and size of wires run.
(iv) When circuit wires and wires of point wiring are run in the same conduit, circuit wiring shall be measured on linear basis depending on the actual number and sizes of wires run in the existing conduit.
(v) Protective (loop earthing) conductors, which are run along the circuit wiring and sub main wiring, shall be measured on linear basis and paid separately. This is not applicable if protective conductor is clubbed with the BOQ item of circuit and sub main wiring.

6.5.6 Power Plug Wiring:

5A Plug Wiring
Wiring for all 5 A Socket Outlets shall be done with 2X1.5 sqmm PVC insulated copper wire in suitable size PVC Conduit (including supplying and fixing PVC Conduit) along with the earth wire as specified in the BOQ/Drawings, from the switchboard or 15A power point as the case may be. Measurement of 5A point wiring shall be done on number basis
from Switch board/15A power point to 5A point. Conduit of point wiring/power point wiring can also be used for 5A point wiring, but both phase and neutral wires shall come directly from switchboard/power point. Looping of neutral shall not be done.

15A Power Plug Wiring:

Wiring for all 15 A Socket Outlets point shall be done with 2X4 sq.mm. PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing PVC Conduit) along with the earth wire as specified in the BOQ/Drawings, directly from the MCB-Distribution Board or from one power point to another in case of computer power points. Looping shall not be done in general 15A power points (other than computer power points). Measurement of power point wiring shall be done on number basis under following two subheads:

i) Directly from MCB-Distribution Board to the Socket Outlets
ii) From One power point/computer power point to another (looping)

6.5.7 CONDUCTOR SIZE:
Wiring shall be carried out with following sizes of PVC insulated stranded single core copper conductor wire/cable.

i. Light point. - 1.5Sq.mm
ii. Ceiling /Cabin/Exhaust Fan Point - 1.5Sq.mm
iii. Call Bell Point - 1.5Sq.mm
iv. Plug Point (5 A Outlet) - 1.5Sq.mm
v. Circuit Wiring - 1.5Sq.mm & 2.5sqmm.
vi. General Power Point - 4Sq.mm

6.5.8 LIGHTING FIXTURE AND FANS:

6.5.8.1 GENERAL:

a. The Contractor shall supply and install lighting fixtures including but not limited to lamps, ballasts, accessories fixing hardware necessary for installations, as shown on the Drawings, as required, and as herein specified.
b. All fixtures shall be delivered to the building complete with suspension accessories, canopies, hanging devices, sockets, holders, reflectors, ballasts, diffusing material, louvers, plaster frames, recessing boxes, etc. all wired and assembled as indicated.
c. Full size shop detail drawings of special fixture or lighting equipment, where called for in the fixtures schedule, shall be submitted to the HSCC Electrical Engineer for approval.

d. Fixtures, housing, frame or canopy, shall provide a suitable cover for fixture outlet box or fixture opening.

e. Fixtures shall comply with all applicable requirements as herein outlined unless otherwise specified or shown on the Drawings.

f. Manufacturer's name and catalogue number of light fixtures, fans, switchgears etc. shall be strictly adhered.

g. Fixtures shall bear manufacturer's name and the factory inspection label.

h. Fixtures shall be completely wired and constructed to comply with the IEE wiring regulations requirements for lighting fixtures, unless otherwise specified.

i. Revamping the fixture shall be possible without having to remove the fixture from its place.

j. Lamps of the proper type, wattage and voltage rating shall be furnished and installed in each fixture.

6.5.9 INSTALLATION:

Fixtures shall be installed at mounting heights as detailed on the Drawings or as instructed on site by the Engineer-In-charge. Pendent fixtures within the same room or area shall be installed plumb and at a uniform height from the finished floor. Adjustment of height shall be made during installation.

Flush mounted recessed fixtures, shall be installed so as to completely eliminate leakage of light within the fixture and between the fixture and adjacent finish. Fixtures mounted outlet boxes shall be rigidly secured to a fixture stud in the outlet box. Hickeys or extension pieces shall be installed where required to facilitate proper installation. Fixtures located on the exterior of the building shall be installed with non-ferrous metal screws finished to match the fixtures.

6.5.10 LAMPS-GENERAL:

Lamp shall be supplied and installed in all lighting fixtures listed in the BOQ. Lamp shall be the part of Fitting no extra Payment will be made. Lamps used for temporary lighting service shall not be used in the final fixture units. Lamps shall be of wattage and type as shown in the BOQ.
Lamps for permanent installation shall not be placed in the fixtures, until so directed by the Engineer In-charge.

6.5.11 BALLASTS-FLUORESCENT:

Ballasts shall be electronic type and having high power factor type. Ballasts shall have manufacturer's lowest sound level and case temperature rise rating. Ballasts shall be special cool operated type. Ballasts for indoor fixtures shall be protected by an integral thermal automatic resetting protective unit, which shall disconnect the ballast in the event of overheating. Ballasts shall be of the same manufacture as the lamps/fixture.

6.5.12 FIXTURE SAMPLES:

Detailed catalogue for all fixtures or if so required by the NKDA Electrical Engineer sample fixtures shall be submitted for prior approval of the NKDA Electrical Engineer before orders for the fixtures are placed.

6.5.13 TESTING:

After all lighting fixtures are installed and are connected their respective switches, test all fixtures to ensure operation on their correct switch in the presence of the engineer. All non-operating fixtures or ones connected to the wrong or inconveniently located switch shall be correctly connected as directed by the Engineer In-charge.

6.5.14 CEILING FANS:

All ceiling fans shall be provided with suspension arrangement in the concrete /slab/roof members. Contractor to ensure that provision are kept at appropriate stage at locations shown on the drawing. Fan box with MS hook shall be as per CPWD specification. Ceiling fan shall be double ball bearing type, copper wound motor complete with canopy, down rod, blades etc. and shall conform to relevant IS standards ceiling fan shall be white in colour. Ceiling fan shall be provided with electronic regulator. Electronic Regulator shall be suitable for 240 volts A.C supply 50 Hz and shall be of continuous duty type.
6.5.15 EXHAUST FANS:

Exhaust fans shall be heavy-duty type with double ball bearing and conforming to IS 2312 (latest revision). Exhaust fan shall be complete with copper wound motor, capacitor, Louver/shutter, frame and mounting bracket. Exhaust fan shall be suitable fan operation on 240 volts single phase A.C supply.

7.00 TELEPHONE SYSTEM:

7.01 Telephone point wiring:

(a) The point wiring shall be carried out with Five pair telephone wire/cable, unarmored, PVC insulated, 0.5 mm dia annealed tinned copper conductor (IS:2532-1965)in suitable size conduit (one pair always remaining spare for one point) Minimum Dia of Conduit for Internal/External Telephone Wiring - 20mm. If more than one telephone point has to be provided at one point, multicore, unarmored telephone cable shall be used (pairs required are equal to 2 nos. of points) in suitable size of conduit.
(b) The point shall commence from the main telephone tag box/sub tag box and would terminate at outlet box of point. Connection at both ends included in point wiring.
(c) Fixing of conduit, conduit accessories draw out boxes and outlet box etc. in concealed/surface conduit works as that of wiring for light fixtures shall be applicable for telephone wiring conduit system also.
(d) Joint in telephone wiring (between main tag box/sub tag box and outlet box of point) shall not be allowed and the contractor should bear the wastages of wire if resulted due to this special requirement of telephone system.
(e) External/Internal telephone and intercom wiring can be drawn in the same conduit, provided after drawing wires, 50% of conduit cross sectional area is free. However, independent PVC insulated telephone wire of suitable pairs shall be used for external, internal and intercom.
(f) To identify each pair of multipair telephone wire/cable, PVC indication numbers shall be put on both ends of pair just before termination.
7.02 Telephone Tag Boxes:

These shall be of MS sheet 2 mm thick with connector suitable for telephone connection (as approved by ITI). It shall have hinged MS sheet cover.

8.00 ADDRESSABLE FIRE DETECTION AND ALARM SYSTEM:

8.01 GENERAL:

The Contractor shall supply and install the Addressable Fire Detection & Alarm System as per schedule of quantities are as herein specified. The system shall include Addressable Main Fire Alarm Control Panel with microprocessor based, software complying with BS5839 Part 4(1995) & CE mark, battery charger, batteries, addressable heat detectors, addressable smoke detectors, manual fire alarm station, fire alarm bells/hooters, response indicators, conduiting, wiring and all necessary accessories required to complete fire alarm system installation as per IS: 2189-1988. Equipment like control panel, smoke detector, heat detectors etc shall be EN-54/ UL approved.

8.02 FEATURES:

The system shall be general alarm electrically supervised type activation of manual fire alarm station or any of the automatic alarm initiating devices shall sound the general alarm bells on all floors and shall give indication on the control panel. The signal shall be continuous unit the station from which it is originated is restored to normal and a reset button on the control unit is operated.

The system shall be electrically supervised against open and ground on both the stations and signal device wiring. Open and ground in the system shall cause a trouble bell to ring at the fire alarm control panel and a trouble lamp to light. It shall be possible to silence the bell but the lamp shall remain lit until the fault is rectified. Incase of power failure the system shall automatically changeover to the battery standby.
8.03 CONDUITING & WIRING:

Conducting & Wiring for FDA system shall be carried out in PVC Conduit with copper conductor PVC insulated wires.

8.04 CONTROL PANEL:

The fire control panel has to be addressable type. The Main Fire Control Panel shall be constructed to sheet steel of red colour, and provided with windows for the alarm and trouble lights. All components shall be of the plug in type, for simple replacement and extension in the future. Control panel shall be wall mounting type conforming to IS 513-1986. The number of loops is mentioned in B.O.Q. Each loop shall be able to support at least 128 any device addressable analog/digital (as the case may be) sensors and control module etc. The control panel shall have alphanumeric display. The Main Fire control panel shall be provided with all necessary relays, resistors, fuses, transformers, rectifiers and all other components to assure full and proper functioning of the system. All relays shall conform to the relevant IS Standards. Control panel shall include power include power on lamps, system trouble lamps, audible trouble signal, trouble silence switch with ring back, alarm silence push button with repeat alarm capability, low battery indicator with reset, ground detection indicator, alarm reset, milli ammeter, supervised alarm lamps, zone "Open" test pushbutton, zone alarm test push button, end of line resistors etc. Each zone shall be equipped with an auxiliary contact for control of a remote annunciation. Main control panel shall include a power supply model to provide a filtered and regulated source of power to provide additional power wherever supplementary power is required within the system. It shall include an output fuse, key reset switch, provision for automatic transfer to standby power upon primary power failure. Main control panel shall in addition have audible signal and lamp to indicate as failure of the charge of battery. Two stages general Alarm shall be provided in which a continuous evacuation alarm is immediately given in zone of fire and its adjoining zones. In other zone intermittent alarm signal shall be provided as per IS 2189-1988. Repeater Panel shall be of same specification as main control panel and shall have fire/fault indication with audio device.
8.05 CHARGER AND BATTERY:

Unit shall comprise a ventilated cabinet supplied complete with charger, meters, high rate charge switch and lock and key in a sheet metal enclosure.

8.06 ELECTRONIC HOOTERS:

Hooter shall be electronic solid-state speaker type having tone for fire, which shall be wailing. Hooter should be loop powered having an output of approximately 6 watt. The audible range shall be around 100m under normal condition. Cable for this in our system shall be 2 cores. The switching shall be provided on the control panel. The outer enclosure of the speaker shall be of MS sheet and shall be suitably oven baked and painted. The speaker shall be 4" heavy magnet type. All hooters shall be on one or more circuits.

8.07 MANUAL ALARM CALL POINT FOR SURROUNDINGS (ADDRESSABLE)

The manual call point shall be electrically compatible with the standard range of automatic detectors so that it can be connected directly into a supervised two-wire zone of the manufacturer's standard range of control units. The manual call point shall be of pleasant, streamlined and flat appearance permitting its use as flush and surface mounted unit. The manual call point shall consist of base plate, insert and cover. The push button shall have minimum one normally closed plus one normally open contacts. The push button shall not be shrouded and the same shall be projected out from the surface of the MS Box. The whole assembly of push button shall be enclosed in the 16 SWG MS Box except from the front side. The front side shall be sealed with breakable glass covering neoprene or equivalent gasket. The glass cover shall be fixed in such a way that the actuating push button is kept depressed (with NC contact open) so long as the glass cover is in contact. In case of fire, when the glass cover is broken to give the fire warning the push button shall be released due the spring action hence giving remote fire alarm through the NC contact. The breaking of the glass must release an alarm. All inscriptions, texts and marks must be on the manual call point front plate, not on the glass, so that the glass can easily be replaced anywhere. The alarm contacts shall be of self-cleaning design to prevent
failure after a prolonged period of inactivity in unclean environments. It shall be possible to test the call point without destroying the seal or removing the cover. The manual call point shall be equipped with a self-holding device to maintain the alarm condition until reset by an authorized person. The complete unit and the push button shall be painted signal Red. The internal surface of the MS enclosure of the box shall painted white colour. The external painting shall be of synthetic enameled paint. Aluminium hammer shall be suspended on a hook fixed to the external MS enclosure by means of a non-corrodible easy breaking of the glass cover. Manual alarm call point located on the outer walls of the building and/or exposed to weather conditions shall be weather proof type and satisfying the requirement of APB. The manual call point shall be capable of being remotely tested from control panel.

8.08 Optical (Photoelectric) Type Smoke Detectors (Addressable Type):

The optical type smoke detectors shall be based on light attenuation by smoke/ or light scattering by smoke particles. Smoke detectors shall have an inherently stable sensor with built-in automatic compensation for changes in ambient conditions. All electronic circuits must be solid-state devices and virtually hermetically sealed to prevent their operation from being impaired by dust, dirt or humidity. All circuitry must be protected against usual electrical transients and electromagnetic interference. Reversed polarity or faulty zone wiring shall not damage the detector. The detector shall have no moving parts or components subject to wear. The response sensitivity of each detector shall be factory set. A built-in barrier shall prevent entry of insects into the sensor. The detector shall be designed for fast and simple laboratory cleaning. The detector shall be inserted into or removed from the base by a simple push-twist mechanism to facilitate exchange for cleaning and maintenance. The manufacturer shall produce and provide test equipment allowing to test and exchange smoke detectors up to 7m (23ft) above floor level. The detector shall connect to the control unit via a fully supervised two-wire circuit. The detector shall be capable of being remotely tested from control panel.
8. 09 HEAT DETECTOR (ADDRESSABLE TYPE):

Heat detector shall be combined rate of rise and fixed temperature type. Heat detectors shall consist of two independent thermistors, designed to automatically compensate virtually hermetically sealed to prevent their operation from being impaired by dust, dirt of humidity. All circuitry must be protected against usual electrical transients and protected against usual electrical transients and electromagnetic interference. Reversed polarity or faulty electromagnetic interference. Reversed polarity or faulty zone wiring shall not damage the detector.

The detector shall have no moving parts or components subject to wear. It shall be possible to test the detector in the field. The response (activation) of a detector shall be clearly visible from the outside by a flashing light of sufficient brightness. The detector shall be installed into the base by a simple push-twist mechanism to facilitate exchange for cleaning and maintenance. The detector shall connect to the control unit via a fully supervised two-wire circuit.

The manufacturer shall produce and provide test equipment allowing to test and exchange rate-of rise/ fixed temperature heat detectors up to 7m (23ft) above floor level. The detector shall be capable of being remotely tested from control panel.

8. 10 PLUG-IN BASES:

The smoke & heat detectors shall fit into a common type of standard base. Once a bases has been installed, it shall be possible to insert, remove and exchange different types of detectors by a simple push-twist movement. The standard base shall be equipped with crewels wiring terminals capable of securing wire sizes upto formation and weakening of contact pressure. The standard base shall be supplied with a sealing plate, preventing dirt, dust, condensation or water from the conduit reaching the wire terminals or the detector contact points. All standard bases shall be supplied with a removable dust cover to protect the contact area during installation and construction phase of the building. It must allow the check out and certification of the zone wiring before insertion of any detectors. The standard base shall feature a built-in mechanism, which allows mechanical locking of as installed detector head, thus preventing unauthorized removal or tempering while maintaining. The detector contact points shall be designed to retain the detector safely and to ensure uninterrupted
contact also when exposed to continuous severe vibration. All electronic components of base and modules must be solid state and virtually hermetically sealed to prevent their operation from being impaired by but, dirt or humidity. All circuitry must be protected against usual electrical transients and electromagnetic interference. Reversed polarity or faulty zone wiring shall not damage the detector. The standard base shall allow snap-on insertion of an (optional) electronic module, it shall be possible to turn a standard base part into an individually addressable detector base with its own unique identification address at the control unit. The standard base shall have a built in alarm indicator which is repeatable by connecting a simple 2 core wire to the base. No changes in the zone wiring shall be required to operate the additional alarm indicator. Removal and insertion of dust covers or detectors shall be feasible by a simple push twist movement, even if the locking device has been activates. Special base assemblies shall be available for use in air ducts and aspiration air-sampling system wherever required. Contractor is required to submit samples and get approved from NKDA Electrical Engineer of all above mentioned items including Response Indicators, Hooters, manual call points.

9. LT CABLES:

9.1 GENERAL:

L.T. Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

9.2 MATERIAL:

The L.T. power cable shall be PVC insulated PVC sheathed type aluminium conductor armoured cable and L.T. control cable shall be PVC insulated PVC sheathed type copper conductor unarmoured cable conforming to IS: 1554: 1988 (Part-I) with up to date amendments.

9.3 INSTALLATION OF CABLES:

Cables shall be laid directly in ground, pipes, masonry ducts, on cable
tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of NKDA Electrical Engineer. Cable laying shall be carried out as per CPWD specifications.

9.4 INSPECTION:

All cables shall be inspected at site and checked for any damage during transit.

9.5 JOINTS IN CABLES:
The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilisation and avoiding of cable joints. This apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.

9.6 LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/CEILING:

Cable shall be laid on perforated GI. Cable tray /ladders. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable GI clamps/saddles. Care shall be taken to avoid crossing of cable.

9.6.1 CABLES TAGS:

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Tray tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

9.7 TESTING OF CABLES:

Prior to installation burying of cables, following tests shall be carried out. Insulation test between phases, phase & neutral, phase & earth for each length of cable.

a. Before laying.
b. After laying.
c. After jointing.

Along with the test as prescribed in IS Code, cross sectional area shall also be checked. On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer in Charge.

a. Insulation Resistance Test (Sectional and overall).

b. Continuity Resistance Test.

c. Earth Test All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules. The Contractor shall provide necessary instruments, equipments and labour for conducting the above tests & shall bear all expenses of conducting such tests.

10.00 CABLE TRAY:

10.1 Perforated Type Cable Tray:

The cable tray shall be fabricated out of slotted/perforated GI. Sheet as channel section single or double bended. The channel section shall be supplied in convenient length and assembled at site to the desired lengths. These shall be galvanized or painted as specified. Alternatively, where specified, the cable tray may be fabricated by two angle irons of 50mm x 50mm x 6mm as two longitudinal members, with cross-bracings between them by 50mm x 5mm flats welded/bolted to the angles at 1 m spacing. 2mm thick GI perforated sheet shall be suitably welded/bolted to the base as well as on the two sides.

10.2 Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works - Part II -External,1994.

10.3 The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler plates and cable tray shall be scraped and removed before the installation.

10.4 The maximum permissible uniformly distributed load for various sizes of cables trays and for different supported span are as per CPWD
General Specification of Electrical Work Part II -1994. The sizes shall be specified considering the same.

10.5 The width of the cable tray shall be chosen so as to accommodate all the cable in one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 300mm.

10.6 Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. (Details are typically shown in figure 3 of CPWD General Specification of Electrical Work Part II -1994). The radius of bend, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

10.7 The cable tray shall be suspended from the ceiling slab with the help of 10mm dia GI rounds or 25mm x 5mm flats at specified spacing as per CPWD General Specification of Electrical Work Part II -1994. Flat type suspenders may be used for channels upto 300mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angles 50mm x 50mm x 5mm at the bottom end as specified. These shall be grouted to the ceiling slab at the other end through an effective means, as approved by the NKDA /Consultant to take the weight of the cable tray with the cables.

10.8 The entire tray (except in the case of galvanized type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

10.9 The cable tray shall be bonded to the earth Terminal of the switch bonds at both ends.

10.10 The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross-joints, etc, and paid for accordingly.

11.0 EARTHING:

11.01 GENERAL:
All the non-current metal parts of electrical installation shall be earthed properly. All metal conduits trunking, switchgear, distribution boards, switch boxes, outlet boxes, and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. Earthing work shall conform to CPWD General Specifications for Earthing work shall conform to Internal) -1994 and Indian Electricity Rules 1956 amended up to date and in the regulations of the local Electricity Supply Authority.

11.02 EARTHING CONDUCTOR:

Earth continuity conductor along with submain wiring from Main/Sub Distribution boards to various distribution boards shall be of copper. Earth continuity conductor from distribution board onward up to outlet point shall also be of bare copper. Earth continuity conductor connecting Main & Sub Distribution boards to earth electrode shall be with galvanised GI strip.

Minimum distance of 2 mtr. Shall be maintained between other electric conductor, earthing conductor and the conductor laid for the lightning protection system.

The earthing met conductors, risers, earthing cables, etc. passing through walls shall be covered with galvanized iron sleeves for the passage through wall.
Water stop sleeves shall also be provided wherever the earthing conductor enters the building from outside.

11.03 SIZING OF EARTHING CONDUCTOR:

Single phase distribution board shall have one earth continuity conductor while three phase distribution board shall be provided with two earth continuity conductors. Earthing of main switch board and sub switch boards shall be earthed with two independent earth electrodes or as indicated elsewhere. Earth conductor laid in ground shall be protected for mechanical injury & corrosion by providing GI pipe.

11.04 GI pipe shall be of medium class 50mm dia and 3.04 metre in length. Galvanising of the pipe shall conform to relevant Indian
Standards. GI pipe electrode shall be cut tapered at the bottom and provided with holes of 12mm dia drilled not less than 7.5cm from each other upto 2 metre of length from bottom. The electrode shall be buried in the ground vertical with its top not less than 20cm below ground level as per detail enclosed. Earth electrode shall not be situated less than 2metres from the building. The location of the earth electrode will be such that the soil has reasonable chance of remaining moist as far as possible. Masonry chamber of size 300 x 300 x 300mm shall be provided with water funnel arrangement a cast iron or MS frame &cover having locking arrangement at the top.

11.05 : PLATE EARTH ELECTRODE:

Earthing shall be provided with either GI plate electrode or copper plate electrode of following minimum dimensions.

i. Copper Plate Electrode : 600mm x 600mm x 3.12 mm thick
The electrode shall be buried in ground with its faces vertical and not less than 3 metres below ground level. 20mm dia medium class GI pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on the top of this pipe for watering and earth electrode. Earth electrode the watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300mm deep. A cast iron or MS frame with cover having locking arrangement shall be provided at top of metres from the building. Care shall be taken that the excavation for earth electrode may not affect the column footing or foundation of the building. In such cases electrode may be further away from the building.

11.06 : RESISTANCE TO EARTH:

The resistance of earthing system shall not exceed 5 ohm.

12.00 SAFETY EQUIPMENTS:

12.01 DANGER NOTICES:

Danger notices shall be affixed permanently in a conspicuous position in Hindi or English and the local language of the district with sign of skull and bones at every overhead lines, transformer, electrical equipments motors, etc.
12.02 FIRST AID BOX:

Standard first aid box with all standard contents shall be supplied.

12.03 FIRE BUCKETS:

The fire bucket unit shall consist of our galvanised iron baskets, which shall be with round bottom, and of 13 liters capacity. They shall be filled with dry sand. Arrangement shall be made to hang them on GI pipe stand comprising of at least 2 vertical and one horizontal members of 50 mm GI pipe. The stands shall have hooks and locking chain arrangement. The buckets and stand shall be painted with epoxy red paint.

12.04 FIRE EXTINGUISHER:

Foam type Fire extinguishers of 9 Kg. capacity and Dry Chemical type Fire Extinguishers of 10 Kg capacity shall be of approved make. It shall be filled with carbon tetrachloride. It shall have horns. Extinguishers shall be fixed on walls/columns with necessary clamps made out of 50 mm x 6mm MS flat and coated bolts and nuts grouted in wall/column.

12.05 RUBBER MAT:

Corrugated rubber insulating matting shall be provided in front of all power & motor control centers, push button station and distribution board in the electrical rooms. The width of matting shall be one meter. It shall be as ISI mark.

12.06 INSTRUCTION CHART:

Printed instruction chart both in English and Hindi and duly framed with front glass, prescribing treatment to be given to persons having Electric shock, shall be supplied.

13.00 DIESEL GENERATOR SETS:

13.1 INTENT OF SPECIFICATION:

13.1.1 This specification covers the design, manufacture, assembly,
packing, dispatch, transportation supply, erection, testing, commissioning, performance and guarantee testing of **Diesel Gen-Sets with Acoustic Enclosure**, complete in all respects with all equipment, fitting and accessories for efficient and trouble free operation as specified here under.

### 13.2 SCOPE OF WORK:

#### 13.2.1 Scope of Supply & Services:

General Scope of work shall include, supply, erection, testing and commissioning of the following:

a) Diesel engine complete with all accessories, an Alternator directly coupled to the engine through flexible/rigid coupling complete with all accessories for starting, regulation and control, including base frame etc. interconnecting piping and accessories, power and control cable glands and lugs.

b) Diesel Local/Remote control panel including cables between bidders local equipment and special cables if any.

c) Equipment necessary for engine cooling system, radiators, pumps, valves, inter connecting pipes etc.

d) Equipment necessary for fuel storing and distribution, day oil tank (990 Lt.), piping, pumps, valves, level indicators etc.

e) Flexible connections and residential type silencer of exhaust system, including thermal lagging.

f) Batteries with iron battery stand and battery charging equipment, including their connections as necessary along with tools & accessories for battery maintenance.

g) Anti Vibration Mountings etc.

h) Preparing all related shop drawings for approval from client/consultant and statutory bodies.

i) Obtaining approval of the installation of Diesel Generators by the Electrical Inspectorate and Pollution Control bodies and any other statutory bodies.

j) Minor civil works like chasing, grouting etc. for execution of jobs.

k) Carrying out performance and guarantee test at site available load but not more than the capacity of D.G. Set.

l) Acoustic enclosure as per CPCB norms and type approved.
13.2.2 Specific Exclusions:
Following items of works are excluded from the scope of works under this specification:

a) All civil works relating to DG foundation etc.
b) All cables between contractors and owners equipment other than special cables external to the equipment.

13.3.2 The installation work shall conform to Indian Electricity act and Indian Electricity Rules as amended up to the date of installation.
The fuel oil installation shall meet all statutory requirements of Govt. of India as amended up to the date of installation. Any approval required from statutory authorities shall be obtained by the Contractor. Nothing in this specification shall be construed to relieve the contractor of these responsibilities.

13.3.3 Equipment conforming to any other National/International Standard which ensures equal or better quality may be accepted. In such case the bidder shall furnish copies of the standards in English along with his bid and shall clearly bring out the salient features of comparison with corresponding listed standards.

13.3.4 The equipment furnished under this specification has to operate in a tropical climate and shall be given tropical and fungicidal treatment as per relevant specification

13.3.5 Period of Operation/Duty Cycle:

The sets are intended to supply power only during an emergency for essential services and may be idle for long periods except for periodic routine tests once in a week. When there is a total failure of main power supply, the sets shall be required to operate continuously at full load for a period which at times may exceed even 24 hours.

13.4 Engine Type:

The diesel engine shall be of stationary type four stroke/two stroke with vertical in line or (V) type cylinder arrangement, Turbo-charged, cooled with radiators.
13.4.2 Rating:

a) Prime power BHP rating of the engine shall be such that the DG set deliver the specified net electrical output while supplying power/driving all electrical and mechanical auxiliaries connected to alternator terminals and engine shaft at specified site conditions and ambient temperature of 500C. The bidder shall submit the deration calculations if the engine is not designed for 50deg C. ambient temperature.
b) It shall also be capable of satisfactorily driving the alternator at 10% over load at the rated speed for one hour in any period of 12 hours of continuous running.

The bidder shall have to furnish copy of duration chart from the original manual of the engine manufacturer and supporting calculations to arrive at diesel engine rating.

13.4.3 Speed and Vibration Levels:

a) Speed shall be 1500 revolutions per minute. Speed governor/over speed protection shall be provided. At due running conditions, speed shall be stabilized at plus or minus 2% nominal speed, regardless of load. At transient condition, engine speed shall vary not more than 10% plus or minus. Governor class shall be A1 (4% drop) for normal application unless otherwise specified.
b) The engine vibration level shall not exceed 100 microns.

13.4.4 Lubrications:

a) The engine shall have a closed cycle forced & splash lubricating system with positive oil pressure and a crank chamber for collection/storage of the lubricating oil during circulation.
b) A lubricating oil filter shall be provided for operation under normal conditions for a period of 300 hours without the necessity of its replacement or cleaning.
c) In case lubricating oil coolers are required it shall be supplied as an integral part of the Diesel Generator Set.
d) Necessary temperature and pressure gauges and other instruments shall be supplied and fitted on the lubrication system.
e) A lubricating oil level dipstick suitably graduated shall be provided and located in the accessible position.
13.4.5 Fuel System: The engine shall be capable of running on all types of diesel fuel oil normally available in India.

a) The fuel consumption of the engine at full, three quarters and half of its rated power output shall be indicated by the Contractor in the bid.
b) A fuel service tank of 990 litres capacity with each D.G. Set shall be provided on a suitably fabricated steel platform. The tank shall be complete with level indicator marked in litres, filling inlet with removable screen, an outlet, a drain plug, an air vent and necessary piping. The fuel tank shall be painted with oil resistant paint. All pipe joints should be brazed/welded.

13.4.6 Air Intake System:

The diesel engine shall be provided with special dry type air filters having low resistance to air passage, high dust retaining efficiency and provision for easy cleaning. Filters shall be suitable for achieving satisfactory engine operation and ensuring the engine life under tropical humid conditions, with sulphur dioxide fumes, abrasive dust and coal particles of 5 to 100 microns present in the atmosphere. The minimum efficiency of filters shall be 90% down to 5 micron size.

13.4.7 Cooling:

The diesel engine should be water cooled with radiator heat exchanger system. The cooling system should include temperature gauge with high temp., alarm/trip corrosion resistor etc.

13.4.8 Engine Governor:

The governor shall be Electronic ISO-Chronous type to maintain zero speed rate or regulation and shall be Al type as per BS:5514 in order to take care of heavy motor starting. It shall have necessary characteristics to maintain the speed substantially constant even with sudden variation in load. However, a tripping shall be provided if speed exceeds maximum permissible limit. The governor shall be suitable for operation without external power supply.

13.4.9 Turbo Charger:
It shall be of a robust construction, suitable of being driven by engine exhaust having a common shaft for the turbine and blower. It shall draw air from filter of adequate capacity to suit the requirements of the engine.

13.4.10 Quietness of Operation:

a) The engine shall be designed to achieve maximum quietness of operation.

b) Efficient residential silencer shall be provided as per engine manufacturer’s approved make only for the exhaust.

c) Noise level of the set shall not exceed 115-120dbA at one meter distance of the engine.

13.4.11 Engine Starting:

a) Engine starting shall be by electric starting motor complete with manual/automatic starting arrangement. The starter motor shall conform to IS:4722 and shall be of adequate power for its duty and be of inertia or preengaged type. The pinion shall positively disengage when the engine starts up or when the motor is de-energized. The engine cranking shall be only from the panel both for AMF & DG sets (Manual) and any engine starting devices etc. that are given as original fitment on the engine by engine manufacturers shall be either removed or padlocking arrangement given for this so that all normal start/stop operations could be done only from panel whether the set is AMF or manual. The engine wiring shall be appropriately modified, ferruled to totally match with schematic drawings of the panel.

b) Time for Run-up to Speed: From the initial operation of the starting device, the engine shall start, run up to normal speed and be capable of accepting 60% of full load within a maximum time of 20 seconds, and full load within a further 20 second.

13.4.12 Starter Battery:

a) The battery shall conform to the requirement of IS:1651. Starting battery each of 12 V, heavy duty high performance approved
make/quality shall be provided to enable crank & start the engine even in cold/winter morning conditions. Type/voltage/AH capacity of same on 20 hour rated discharge period shall be indicated in the offer. The battery set shall be capable of performing at least (5) five normal starts without recharging.
b) The battery shall be provided with good quality teakwood stand painted with acid proof black paint with min 3mm thick rubber mat below the batter.
c) Batteries shall be of load container type only and not with PVC moulded sealed container so that each individual cells are available for individual monitoring during its life span. Each cell shall be provided with electrolyte filling cap with level floats for easy monitoring of electrolytic level.
d) The battery shall be provided with 2 Nos. cables, minimum 1.5m long heavy duty rubber/PVC insulated cabling with brazed tinned lug at one end and with brazed tinned brass terminal lug at battery end - for connecting batteries to cranking system - with 0.25 m long inter battery connecting cable.
e) The lugs shall be clearly stamped (+) or (-) and positive cable also red sleeved for easy identification.
f) The batteries Set shall be supplied fully filled and first charged ready to use.

13.4.13 Battery Charging System:

a) Float rate charging and quick rate charging system shall be provided at the generator panel with appropriate bridge charger system, LC network, rate selector switch and generously rated charging transformer and silicon one rectifier bridge, so that the cranking battery system can be kept fully charged at all times from E.B. supply network with quick charging rate limited to 0.8 times rated discharge current with provision in control transformer and Si rectifier present to enable boost charging the battery at 2 times rated discharge current in case of emergencies. To this and in the mode selector switch boost charge position shall be present which however shall be kept disconnected at mode selector switch normally.

b) DC ammeters to clearly indicate float charging current and quick/boost charging current shall be provided.
c) Dropper resistor network on the load side of battery charger system shall be provided so that higher charger voltages in quick or boost conditions does not get impressed on the I/L and Contactor coils, which voltage shall remain well within +10% of rated voltage.

d) Battery charging subsystem shall be designed for continuous operation at cubicle ambient of 50OC corresponding to 45OC ambient outside and should be designed to operate at 1.5 times rated maximum current corresponding to boost charge current which can reach in practice as high as 2.5 times or 3 times rated discharge current.

e) Any charger dynamo and dynamo charging current network present on the set shall be made in operative so that both for AMF and manual application the cranking battery system is kept charged from the charger at the panels at all times during or shut down periods of the set.

f) To the above and in case of manual DG sets, the input to charger subsystem viz.,240 V AC is foreseen to be provided from customer network from the portion that is normally supplied by manual DG Set during DG operation or being fed by E.B. System.

13.4.14 Engine Fitments:

The engine shall be provided with but not limited to following essential basic fitments:
Crank case breather - Dry type element.
Air Cleaner - Dry type mounted.
Corrosion resistor - to control acidity and impurities from coolant.
Lubricating Oil Cooler -
Filters - Lub oil & fuel oil, paper element type.
Coolant Pump - Gear Driven.
Fuel Pumps - Priming & Transfer
Governor - Electronic Class A1.
Turbo Charger - Exhaust gas driven in case of turbo
charged engines.
Flywheel with flywheel housing - SAE Type
Vibration dampers - One Set
Exhaust/Intake manifolds -
Oil Sump (crank case) with dip stick
Engine Supports
Residential type silencer in exhaust system
Electrical starter 12 V or 24 V
Safety controls & instruments

13.4.15 Engine Instrumentation:

The following instruments mounted on instrument panel shall be essentially present as minimum:
- Engine speed tachometer with service hour counter
- Lub oil pressure gauge
- Coolant water temperature gauge
The instrument panel shall be mounted on engine using rubber dampers for vibration isolation.
The gauges shall have clear red marking to identify the limiting dangerous levels, ‘Zone Markings’ on the scale to indicate the normal healthy & abnormal operating zones for the parameters concerned. The metering could be either normal electro-mechanical analogue type or electronic digital type, latter being preferred as manufacturers fitment only. The engine control panel must be supplied by the engine manufacturer only.

13.5 ALTERNATOR:

13.5.1 The alternator shall have brushless type with rotating field and static excitation circuit controlled by field control unit suitably compounded for voltage and load current for a self excited self regulated system.
13.5.2 The alternator shall be in SP-DP enclosure, foot mounted with ball and roller bearings on end shields.
13.5.3 The alternator shall conform to IS:4722/BS:2613 and shall be suitable for tropical conditions.
13.5.4 The alternator shall comply with the following specifications: Rating - As per BOQ.
(Shall be capable of 10% over loading at the rated speed for one hour of 12 hours continuous running).
Voltage - 415 V
Speed - 1500 RPM
Frequency - 50 Hz.
P.F. - 0.8 lag
Enclosure - IP:23
Insulation - H
Execution - Self excited, self regulated with brushless system and static voltage control unit suitably compounded for voltage and current to maintain terminal voltage constant at ± 5% at all load for p.f. not less than 0.8 lag.
Terminal Box - As per BOQ.
Earthing Studs - 2 Nos. in each DG

14.5.5 Neutral Point:

The winding of the alternator shall be star-connected.

13.5.6 Terminal Box and Connection:

The alternator output terminals shall be enclosed in a terminal box mounted in an accessible position on the alternator frame. As far as possible, connections between the exciter and alternator shall be contained within the machine frame and connections carrying A.C. and D.C. shall be segregated from each other. The terminal box shall be of sufficient size to conveniently terminate the size and number of the Owner’s cables, which shall be intimated during detailed engineering. Suitable tinned copper pads shall be provided for power cable termination along with all necessary hardware and cable lugs. Glands and lugs shall be provided for control cables also. For single phase cables, gland plate shall be of non-magnetic material. Gland plate shall be removable type.

13.5.7 The generating set shall be so designed that it is capable of reaching its full voltage and frequency and shall be ready to take full load within 30 seconds of a remote starting impulse being received.

13.5.8 Acoustic Enclosure:
**Thickness of Sheet – 14-G:**

High Class sheet metal fabricated enclosure for reducing the noise level of DG Set and also acts as weather proof housing. Genset will be an integral part of acoustic enclosure and whole construction will be on multi-fold sheet channels and ISMC sections. Enclosure construction is fully bolted keeping in view the major service requirements all doors are provided with specially designed hinges and lockable handles, battery, fuel tank is housed inside the enclosure.

**Acoustic Materials:**

Rock wool in the form of slabs of 75 – 100 mm thickness and 48 KG/Metric cube density (Specification of Rock wool conforms to IS: 8183. Further to increase the life of Acoustic material resin coated fiber glass cloth is provided on exposed surface of Rock wool slabs and the panels are supported by perforated sheets.

**Ventilation:**

Acoustic enclosure is designed in such a way that there are no hot pockets around engine and it is provided with suitable designed engine radiator/or additional axial flow fan and does not allow the temperature to rise more than 70C. To achieve optimal output and minimum sound level from the DG Set, suitable openings with acoustic hoods are provide for increasing the inflow of air required for combustion and forced ventilation. Air intake system as per the recommendations and engine requirement are provided.

- Acoustic hoods with noise splitters provided to block and reduce the sound
- Leakage.
- The sound control system designed to suppress the sound level to 75 db Maximum at 1 meters distance in open environment.

**Silencer:**

Specially designed low noise silencer is provided. Silencer & engine exhaust outlet, connected with flexible SS below.
Vibration Isolation:

- To avoid transfer of vibration from Genet to enclosure & surrounding specially
- Designed vibration isolators are used.

13.6 AMF PANEL:

13.6.1 General:

a) The control panel shall be sheet steel enclosed and shall be dust and vermin proof providing a degree of protection of IP-42. Sheet steel used shall be cold rolled and at least 2.0mm thick and properly braced and stiffened.
b) Control panel shall be provided with hidden hinged door(s) with pad locking arrangement and suitable brackets/channels shall be provided for floor mounting.
c) All doors, removable covers and plates shall be casketed all around with neoprene gaskets. All accessible live connections shall be shrouded and it shall be possible to change individual switches, fuses, MCCBS without danger of contact with live metal.
d) All live parts shall be provided with at least phase to phase and phase to earth clearances in air of 25mm and 20mm respectively.
e) Adequate interior cabling space and suitable removable cable gland plate shall be provided. Necessary number of cable glands shall be supplied and fitted on to this gland plate. Cable glands shall be screwed on type and made of brass.
f) Two number of earthling terminals shall be provided.
g) All sheet steel work shall be degreased, pickled, phosphate and then applied with two coats of zinc chromate primer and powder coat finishing both inside and outside of shade 631 (gray).

13.6.2 AMF Control of Diesel Generating Sets:

a) All DG Sets shall be controlled independently.
b) Diesel Generator shall be capable of being stopped manually from remote as well as local. However, interlock shall be provided in the DG local control panel to prevent shutting down operations as long as circuit breaker is closed.
c) Auto Operation:

When mains power is available, the healthiness of this power will be monitored through a mains voltage monitor. If voltages on the 3 phases are within limits, the monitor will send a closing signal to the mains breaker and mains power will be connected to the load. If the voltage drops on any phase or on all phases, the monitor will sense this drop through a timer, and if this drop persists for more than a pre-adjusted period of time (say 1 to 20 seconds) a signal is sent to the engine starting circuit while at the same time opening the mains supply breaker and disconnecting load from mains as voltage is below acceptable limits. The engine starting control monitor will send a signal to the D.C. battery supply for starting the engine through the starting solenoid. When the engine is healthy, it starts up in a few seconds and the generator develops voltage. The generator voltage monitor, monitors the voltage and when the voltage is developed, this give a signal to the generator breaker which closes and connects the diesel generator to the load. Simultaneously, it sends a signal to de-energize the engine starting circuit and the starter motor is disengaged. The engine protection circuits for high water temperature and low lubricating oil pressure are also energized.

d) Resumption of Supply:

If voltage from mains is resumed, the main voltage monitor will sense this voltage for healthiness, i.e. for maintained correct voltage for a period of time (adjustable up to three minutes) and then send a signal to stop the engine and to change over the breakers from generator to mains and normal supply is resumed to the load. The solenoid operation and closing and tripping of breakers should be done through control voltage 24 V.D.C.

e) Failure to Start:

A three attempt starting facility using two impulse timers and a summation timer for engine shall be provided and if voltage fails to develop within 30 seconds from receiving the first start impulse, the
shall lockout automatically and a visual and audible alarm shall be given in the control panel. The remote panel shall receive “DG Trouble Alarm”.

**13.6.3** The control panel shall have the following provisions for the control of each DG Set:
1. MCCB’s & ACB’s as per BOQ.
2. Master engine control which for OFF/AUTO/MANUAL/TEST with a facility for starting and stopping of the set.
3. Voltmeter 144 Sqmm with selector switches for alternator/Mains/Phases complete with protection.
4. Local/Remote selector switch to facilitate remote starting/stopping of the DG Set.
5. Frequency meter 144 Sqmm reed type.
7. Ammeter 144 Sqmm with C.T. & selector switch, KWH Meter, KW 144 Sqmm.
8. Mains Supply, voltage monitor.
10. Alternator voltage monitor.
12. Engine protection system for low oil lubricating pressure and high water temperature.
13. Window type annunciator with static relays, alarm/hooter and accept, test, rest, push buttons for all functions.
14. Engine hours run counter.
15. Control fuses.
16. Lifting Hooks.
17. Gland Plates.
18. Power/Control Contactors.
20. Antivibration pads.
21. IDMT relays [CDG – 31]
22. Under Voltage Relays
23. Over Voltage Relays

**13.6.4 Indication/Annunciation:**

Pilot indicating lamps/shall be provided for the following:
1. Charger - ON/OFF
2. Earth Fault
3. Set shutdown due to `Engine high water temp.’
4. Set shutdown due to `Low oil pressure’
5. Set shut down due to `Lock of fuel’
6. Over speed trip Indicating lamp shall be of the panel mounting filament type with series resistors.

13.6.5 The DG Sets would normally be controlled from remote for which following provisions are being made on the remote control panel. The necessary control devices/contacts for these external connections shall be wired out to the DG control panel terminal blocks.
1. Starting and stopping of the DG Set
2. DG running indication

13.7 ENGINE SAFEGUARDS:
Safeguards shall be provided and arranged when necessary to stop the engine automatically by the following:

a) Energising a solenoid coupled to the stop lever on the fuel injection pump rack.
b) De-energising the “fuel on” solenoid
c) Energising the “fuel - cut off” solenoid.
The operation of the safeguard shall at the same time give individual warning of the failure by illuminating an appropriate local visual indicator and remote alarm at generator panel.
The contactors, relays and other devices necessary for signal and control, for above purposes shall be provided at Generator panel. At the set at a easily accessible place an “EMERGENCY STOP” mushroom head stay put type P.B shall provided to stop the set in emergency mode. The safe guard to “STOP THE SET” shall stop the set irrespective of mode selection of the set viz Auto, Manual or test for following cases, with simultaneous isolation of alternator ckt.

a) Emergency stop P.B’s operation
b) Over speed.
c) Low lube oil pressure.
d) Earth fault

14.00 PROCUREMENT, INSPECTION OF EQUIPMENT & APPROVALS;

Approved list of makes and vendors are given in the end of technical specifications. The makes of equipment/materials supplied shall be
strictly as mentioned therein. For items not specially mentioned, prior approval shall be taken before procurement of the same. All equipments/material supplied shall be brand new and shall be procured directly from the manufacturers, dealers or authorised agents. HSCC Electrical Engineer shall have access to the manufacturer’s premises for stage inspection/final inspection of any item during its design, manufacturing, and assembly and testing. After carrying out the necessary factory tests and routine tests as per IS Standards, a copy of the routine test certificate shall be forwarded along with the call for carrying out the inspection at the manufacturer’s works. Based on the inspection certificate, HSCC Electrical Engineer reserves the right to carry out the inspection at a mutually agreed date and/or give inspection waiver. A minimum of two weeks will be needed after receipt of complete shop inspection report and other details to depute our inspector for inspection. It is the responsibility of the contractor to ensure that all electrical works are carried out as per the IE Rules & regulations, National Building Code and IS Codes & Standards. All necessary drawings and details as required by Electricity Board, Electrical Inspector, Fire Department and other Local Statutory agencies, shall be prepared by the contractor. The contractor is responsible to submit the drawings and other details as required to the Local Authorities (refer above) and obtain necessary approvals including sanction of load/enhancement of electrical load from WBSEDCL before energizing and commissioning. All official fee required for getting the approval will be reimbursed on account of Client on submission of original documents.

15.00 ELECTRICAL RISING MAIN

15.01 SCOPE

This section covers manufacture, supply, installation, resting and commissioning of rising mains, indoor type.

15.02 Supply voltage

415/440 Volt, 3 phase, 4 wire, 50 Hz AC supply.

15.03 Standards for compliance:
15.04 Construction:
The enclosure will be made from 16 SWG GI/ CRCA sheet steel powder coated of approved shade. Bus bars would be of high conductivity aluminium in “Sandwich” construction and the conductors will be individually insulated with halogen free, fire retardant class– H – epoxy insulation. No drilling of Bus bar is permitted. Length of the section will be limited to maximum three metre. Bus bar of one section will be connected to bus bar of adjacent section by uni-block joint system removable as separate sub-assembly, so that it can be inserted or removed without disturbing the adjacent sections.

15.04.1 Technical Parameters:
Rising main shall be designed to withstand short circuit current of 35 KA for one second. Rising main system should be designed for high temperatures withstand capability of 55 degree Celsius over 50 degree Celsius as normal operating temperature.
Insulation voltage 1.1 KV
Rising Main will be suitably chosen to give permissible voltage drop.
Rated impulse withstand voltage 12 KV at 1000 volt.
Single bolt bridge system to be incorporated.

Plug in boxes
Plug in boxes will be of draw out type. Contacts will be of silver plated copper and spring loaded. Earth connection will be the first to make and last to break during insertion and withdrawal. Plug in boxes will be made from 1.6 mm CRCA sheet steel powder coated. Inside the plug in Boxes MCCB will be located as per requirements. The operating handle will be interlocked with plug in box cover so that MCCB can be operated only with the suitable cover in closed position. The plug in box will be interlocked with Rising Main so that it can not be inserted or removed with the plug in box lid open. MCCB will be of 4 pole type unless otherwise specified in BOQ. Short circuit breaking capacity of MCCB in PIB should be 35 KA.

15.05 List of test to be carried out:
15.05.1 Routine tests:
i. Verification of insulation resistance.
ii. Inspection of assembly, interlocks, locks etc.
iii. Dielectric test.

Copies of the following certificate should be submitted:
i. Verification of temperature rise limits
ii. Verification of di-electric properties.
iii. Verification of short circuit strength.
iv. Verification of degree of protection.

Insulation resistance test with 500 volt megger. The insulation resistance shall be not less than 100 mega ohm.

16.00 CAPACITOR PANEL (APFC)

16.01 SCOPE

Supply, installation, testing and commissioning of medium voltage capacitors and Automatic Power Factor Correction Panel (APFC) for improvement in power factor of electrical system. It will be connected to main LT panel. It shall improve power factor up to 0.98 legging from initial power factor. Capacitor panel shall be provided with day/night mode selector switch and double ratio C.Ts, for day/night mode. Day/night mode shall be selected based on estimated day / night load requirement.

16.02 RATING

Capacitor units as specified in the BOQ shall be used to form a bank of capacitors.

16.03 ENCLOSURE

The panel shall be indoor, floor mounted and free standing type with IP-42 degree of protection. It shall be completely made of CRCA sheet steel. The enclosure shall have sturdy support structure and shall be finished with powder coating in the approved colour shade. Suitable provisions shall be made in the panel for proper heat dissipation. Air aspiration louvers for heat dissipation shall be provided. The front portion shall house the switchgear and the rear portion shall house
capacitors and series reactors (7%). The enclosure is to be suitably sized to accommodate all the components, providing necessary air clearance between live and non-live parts, providing necessary working clearance.

16.04 APFC Relay

Microprocessor based APFC relay, (intelligent VAR controller) of suitable steps as mentioned in the BOQ, shall sense the PF in the system and automatically switch ON/OFF the capacitor unit or bank to achieve the preset target PF. The controller shall have digital settings of parameters like PF, switching time delay, step limit etc, indication of PF, preset parameter, minimum threshold setting of 1% of CT current.

16.05 CAPACITORS

The capacitor shall generally confirm to IS:13341-1992 and 13340-1993 and IEC60831-1 &2.

General specification: three phase, delta connected, 50 Hz.

i. Voltage: Must be designed to with stand system over voltage, increased voltage due to series reactor and harmonics.

ii. Capacitor type: The capacitor unit shall be super heavy duty mix dielectric type. The dielectric should be made of metalised tissue paper. These elements shall be combination of capacitor tissue paper and BOPP film impregnated with non PCB bio-degradable impregnant or film foil capacitor manufactured using Poly Propylene film placed between 2 layers of metal foil and winding. Capacitor should be fitted with safety device like pressure sensitive disconnector. The capacitor should be low loss type (total losses should not exceed 0.45 W/KVAR).

iii. Temperature category: -25 degree C to 70 degree C.

iv. Over voltage +10% (12h in 24 hours), +15%( 30 minutes in 24 hours), +20% (5 minutes) and 30% for 1 minute as per clause 6.1 of IS 13340-1993.

v. Over current: 2.5x In

vi. Peak inrush current withstand: 350 x In

vii. Capacitor shall be provided with permanently connected discharge resistors so that residual voltage of capacitors is reduced to 50 volts or less within one minute after the capacitors are disconnected from the source of supply.
viii. Each capacitor bank shall be provided with a terminal chamber and cable glands suitable for AYFY cable as specified.

ix. Two separate earthing terminals shall be provided for earth connection of each bank.

16.06 SWITCHGEAR & PROTECTION:

Incomer switchgear will be as specified in BOQ. Suitable contactor for each step shall be used and must be capable of capacitor switching duty. Busbars shall be suitably colour coded and must be mounted on appropriate insulator supports. Power cable used shall have superior mechanical, electrical and thermal properties. Internal wiring between main bus bars, contactor, capacitor etc shall be made with 1100 volt grade PVC insulated FRLS copper conductor of appropriate size by using suitable copper crimping terminal ends etc suitable bus links for input supply cable termination shall be provided. Control circuit shall be duly protected by using suitable rating MCB. An emergency stop push button shall be provided to trip the entire system (22.5 mm dia, mushroom type, press to stop and turn to reset). 440 Volt caution board shall be provided on the panel.

16.07 TESTS AT MANUFACTURER’S WORKS:

All routine and type tests as per IS:2834 relevant to capacitor bank s as amended upto date shall be carried out at manufacturer’s works and test certificates to be submitted to HSCC.

16.08 TESTS AT SITE:

Insulation resistance with 500 V DC Megger shall be carried out and test results should be recorded. Residual voltage shall be measured after switching of the capacitors and the same shall not be more than 50 volts after one minute. Each discharge resister shall be tested for its working. Drawings and Instruction manual:

16.09 INSTALLATION:

Capacitor bank shall be installed at least 30 CM away from the walls on suitable frame work of welded construction. The earth terminals
provided on the body of capacitor bank shall be bonded to main capacitor panel earth bus with 2 nos 8 SWG copper or 6 SWG GI earth wire. Contractor shall submit four copies of the following certified drawings:
i. General arrangement of capacitor bank and control panel indicating main dimensions, type of mounting, location of various devices etc., including foundation details.
ii. Schematic diagram for automatic sequential switching with terminals and ferrules numbers.
iii. Wiring diagram of control panel indicating terminal blocks and various apparatus.
iv. Final list of components of control panel.
Contractor shall also submit four sets of installation and maintenance manual.

17.01 SHOP DRAWINGS AND APPROVAL OF ELECTRICAL INSTALLATIONS:

The selected tenderer shall prepare a furnish shop drawings for approval by The Client, such shop drawings shall be based on the Architectural drawings and requirements laid down in specifications, local laws and regulations etc. The detailed drawings shall be submitted within one month of placement of order. The successful tenderer shall obtain the approval of electrical Inspector and other local authorities as per requirements before submitting the drawings to Client/Engineer. The contractor shall not proceed with in installation work till the drawings are approved by the Engineer-in-Charge. Expenses incurred such as license fee etc. towards obtaining the approval of Electrical Inspector, local authority shall be reimbursed to the contractor as per actual on production of documentary proof. Approval of contractor's drawings shall not absolve the contractor of any of his obligations to meet the requirements of specification under this contract Five sets of completion drawings operation manual, maintenance manual, spare parts details shall be submitted to the Client/Engineer after completion of work.

17.02 SPARES:
The bidder shall quote for minimum spares required for two years safe operation alongwith the offer separately.

17.03 TRANSPORT, DELIVERY & STORAGE;

The prices shall be F.O.R site basis including packing & forwarding charges as per site condition. The quoted price must include all the costs for necessary mode of transportation up to the final location of site or site store. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipments at site should form part of offer.

17.04 GUARANTEE:

The tenderer shall guarantee the equipment against all defects of materials and workmanship for a period of one year from the date of commissioning of the equipment as certified by the owner or eighteen months from the date of dispatch, whichever is earlier. Any defects arising during the guarantee period shall be rectified and replaced by the tenderer, at his own expense, to the satisfaction of the owner.

17.05 PERMITS, INSPECTION & LICENSE FEE:

The contractor shall arrange all necessary local, provincial or national government permit and shall make arrangements for inspection and tests required thereby. Expenses to be borne by purchaser.

17.06 POWER SUPPLY:

The apparatus shall be designed to operate on 415 + 5% Volts, 3 Phase, 4 wires, 50Hz A.C. Supply for illumination signal equipment shall be 240 Volts + 5% single phase 50Hz A.C.
18.0 AIRCONDITIONING SYSTEM SPECIFICATION AT ADMINISTRATIVE BUILDING, NEW TOWN RAJARHAT

BASIS OF DESIGN & EQUIPMENT SELECTION

Ambient Conditions : 105°F DB & 83°F WB (Summer),
Inside Design Conditions : 75 °F (23°C+) with RH around 60%
General Illumination : 1.0 Watt/Sq-ft
Floor above : Non- AC and insulated
Floor below : Non AC

Equipment Selection: - PLEASE REFER TO THE ANNEXURE I ATTACHED.

System description

VARIABLE REFRIGERANT FLOW (VRF)

18.1 General:

The scope of this section comprises the design, supply, erection, testing and commissioning of Digital scroll Variable Refrigerant Flow type system of air conditioning conforming to these specifications and in accordance with the requirements of Drawing and bill of Quantities. The prices quoted shall include all the equipment ancillary material as specified and all such items whatsoever and which may be required to fulfill the intent and purpose as laid down in the specification and the approved drawings. The contractor shall calculate equipment capacity based upon design parameters specified for the system design & verify all the quantities and sizes of refrigerant pipe, fitting/cables, control cable, pipes, insulation, indoor units, outdoor units etc. before placing the order to avoid any shortfall or surplus. The tenderer shall also include all necessary civil work/MS frame work for installation of outdoor and indoor units in VRF based air-condition system. The cost
quoted by tenderer shall also include the refrigerant gas R-410 & its charging for proper & specified functioning of air-conditioning system.

The scope in the tender schedule also covers detailed designing of complete air-conditioning system based on Digital Scroll VRF air-conditioner with air-cooled outdoor units system capable of cooling as per individual or season requirement suitable for operation on 415V, 3 phase, 50 Hz AC electric supply.

The outdoor units shall have cooling mode, consisting of one/multiple outdoor unit with single circuit of refrigerant piping and multiple indoor units of various types. Each indoor unit should have capability to cool as per seasonal weather changes. The scope of work shall include SITC of

1. Outdoor units.
2. Indoor units.(Ductable , cassette , wall mounted type)
3. Refrigerant piping.
5. Supply air ducting of Ductable units.
6. Control Cables between Outdoor units & Indoor units.

While designing the system care should be taken to select outdoor units of suitable capacity based on design data provided & to economize on available floor area for installation of outdoor units as well as optimum utilization of outdoor units. The indoor units should be designed based upon the heat load calculations for individual rooms/areas to be air-conditioned and over capacities should be avoided. The design should also specifically take care of disposal of condensate drain water so that there is no leakage of condensate water inside the room as well in the route of condensate water pipe line. The layout of refrigerant piping is to be designed in such a way so that it should not disturb the aesthetic of the building / room, inadvertent damage in the route of pipe should not occur in failure & optimum length of pipe line for efficient air-conditioning. After completion of the work four set of ‘as erected/commissioned drawing’ of activities listed above shall be submitted.
Design Data

The work of air-conditioning and indoor units as specified in BOQ. The specified design parameters are only tentative in nature, however, all efforts shall be made to achieve the following specified design parameters and if at any design stage need for higher capacity outdoor capacity is required, necessary approval shall be accorded based on design analysis and discussions on the subject.

18.2 OUTDOOR UNIT:

i. For testing and evaluation consideration, JIS B8616 or equivalent standard shall be applicable.

ii. The outdoor unit shall be factory assembled, weatherproof casing (Material of construction of casing shall be vendor’s standard design), constructed from heavy gauge GI sheets steel panels and coated with baked enamel finish. The outdoor unit shall be completely factory wire, tested with all necessary controls & filled with first charge of refrigerant before delivering at site.

iii. Digital Scroll VRF equipment should be capable so that refrigerant piping between indoor units and outdoor unit shall be Extendable upto 150m with maximum height difference between outdoor & indoor unit of 50m & level difference between two indoor unit maximum upto 15m. However such long pipeline and head difference may not be applicable for this project.

The minimum acceptable value of Coefficient of Performance (COP) of the offered system, in conformance with JIS B8616 or equivalent, shall be not less than 4.1 at 50% rated load with 40.5 deg C outdoor and 28.3 deg C wet bulb conditions for 30TR or equivalent nearest size outdoor unit as per OEM standard catalogue. In case, tests have been done to work out COP from other than JIS B 8616, the standards along with
necessary test procedure shall be furnished along with the tender.

*The tenderers will, however, be at liberty to supply outdoor units in ratings as specified above or higher.

(a) The above COP values, as indicated in (iii) above are required to be furnished, in original, by the tenderer directly from the original equipment manufacturer (OEM) with OEM’s seal and signatures on all the documents pertaining to the back up information for example cooling capacity at capacity indexes varying from 130% to 10% (stepless) for outdoor temperature (deg C DB) varying from 32 to 45 deg. and indoor temperature (deg C WB) varying between 24 deg. duly indicating the total cooling capacity and power input in kW.

(b) The tenderers may please note that above guaranteed figures may be checked by the client, at any stage of the work, through its nominated inspection agency either at OEM’s works or duly certified laboratory in accordance with J15B8616 or equivalent standard.

iv. The outdoor unit shall be factory tested and filled with first charge of refrigerant R-410 before delivering at site. It should be of cooling module type

v. It should also be provided with duty cycling for Digital scroll compressors capable of changing the capacity of load by Digital controller to follow variation in cooling and heating loads & switching staring sequence for better stability and prolonging equipment life Outdoor units should have minimum 2 compressors and shall be able to function with one of the compressors in failed condition.

vi. The compressors installed in the outdoor units shall be preferably equipped with at least one digital scroll compressor upto Digital scroll so that operation is not disturbed on failure of any of the compressor.
vii. The outdoor unit shall be suitable for mix match connection of all types of indoor units.

viii. It should be provided with duty cycling for switching the starting sequence of multiple outdoor units.

ix. The outdoor unit shall be modular in design and should be allowed for side-by-side installation.

x. The unit shall be provided with its own microprocessor control panel with provision for integration with the Building Management System for air-conditioning System.

xi. The outdoor units should have anti corrosion paint free plate for easy mounting of unit.

xii. The machine must have a sub cool feature to use coil surface more effectively thru proper circuit/bridge so that it prevents the flushing of refrigerant from long piping due to this effect thereby achieving energy savings.

xiii. The outdoor unit should be fitted with low noise level and should not be more than 65 db (A) at normal operation when measured at 1.5m distance from ground level.

xiv. The outdoor unit should be fitted with low noise aero spiral design fan with aero fitting grill for spiral discharge airflow to reduce pressure loss.

xv. The outdoor units are connected to multiple indoor units of various types as such the combined operating loads of indoor units may touch 100 to 120% of the nominal capacity. The outdoor unit shall be able to perform at the combined loads demands as indicated above.
xvi. In case of trouble occurs in an indoor unit(s), the continuous operation of system should be possible.

xvii. The unit shall be designed in such a way that cleaning of drain Pan should be easy & inspection/replacement of compressor should be easy.

xviii. The condensing unit shall be designed to operate safely when connected to multiple fan coil units.

18.3 Compressor:

i. The compressor in Digital Scroll system shall be highly efficient. The system should response efficiently in accordance to the variation in cooling load requirement.

ii. All outdoor units shall have multiple steps of capacity control to meet load fluctuation and indoor unit individual control. All parts of compressor shall be sufficiently lubricated stock. Forced lubrication may also be employed.

18.4 Refrigerant Circuit:

The refrigerant circuit shall include liquid and gas shut-off valves and a solenoid valves at condenser end.

The equipment must have inbuilt refrigerant stabilization control for proper refrigerant distribution.

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

18.4 Heat Exchanger:

The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminium fins to form a cross fin coil.
The aluminium fins shall be covered by anti-corrosion resin film.

The unit should be with bye-pass/e-pass heat exchanger to optimize the path of heat exchanger and for better arranged for vertical discharge. Each fan shall have a safety guard.

18.6 Safely Devices:

All necessary safety devices shall be provided to ensure safe operation of the system. Following safety devices shall be part of outdoor unit, high pressure switch, fuse, fan drive overload protector, fusible plug, crankcase heater overload relay, overload protection for digital scroll.

The outdoor roof mounted units shall be provided in such a fashion that these do not affect the overall aesthetics and ambience of the building. If required these units shall be suitably camouflaged to give good aesthetic look. These provisions, however, shall be discussed, if required, at a later date and the prices for the same shall be worked out separately as extra item.

Noise levels for outdoor units shall not be more than 67 db (measured at a point 1 meter in front of the unit at a height of meters).

18.7 INDOOR UNITS:

Ductable Type Indoor Unit:

The Unit shall be Ductable type (ceiling suspended). The unit shall include pre-filter, fan section and DX-coil section. The housing of the unit shall be powder coated/heat treated galvanized steel. The unit shall have high static fan for ductable arrangement and it should also have suitable arrangement for drain water.

CASSETTE type indoor - The indoor can be cassette type with drain pump facility, with pre-filter, fan section and DX coil.

HI - WALL SPLIT type – The indoor can be Hi wall split type unit, with Pre-filter, fan section and DX coil.
**Y-joint/Ref net separation**

Supply & installation of the Y-joint/ref.-net separation refrigeration pipe joints and headers in the appropriate orientation to enable correct distribution of refrigerant. The distribution joints should be factory insulated with pre-formed section of Expended polystyrene/Equivalent.

**Refrigerant piping**

i. The Refrigerant pipe material shall be of hard seamless copper tubes with pipes material being hard drawn copper pipe. Forged copper fittings shall be used for the refrigerant piping. The refrigerant piping arrangements shall be in accordance with good engineering practice as applicable to the air-conditioning industry, and shall include charging connections, suction line insulation and all other items normally forming part of proper refrigerant circuits except y joint/separation tubes.

ii. Before joining any copper pipe or fittings, its internals shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently it shall be thoroughly blown out using nitrogen gas.

iii. After completion of installation of the refrigerant piping, the refrigerant piping system shall be pressure tested using nitrogen gas at a suitable pressure as specify by OEM (Original Equipment Manufacturer). Pressure shall be maintained in the system for 48 hours. The system shall then be evacuated to a vacuum of not less than 700 mm Hg and held for 24 hours.

iv. The supplier of air-conditioning system shall choose sizes as designed and erect proper interconnections of the complete refrigerant circuit the thickness of copper piping shall not be less than 18 SWG for pipes upto 19.1 mm and 16 SWG for larger dia.

v. The suction line pipe size and the liquid line pipe sizes shall be selected according to the manufacturer’s specified diameter. All refrigerant pipes shall be properly supported and anchored to the building/structure using steel hangers, fastener, brackets and supports which shall be fixed to the building/structure by means of
inserts or expansion shields or anchor fasteners of adequate size and number to support the load imposed thereon.

vi. The refrigerant piping should be laid in such a way that it should not distort the interior of the room, wherever the refrigerant pipe has to be laid across the room, it should be laid in a concealed manner by making appropriate boxing arrangement matching with the interior of the room. All associated minor Civil Engineering works (like chasing on wall, ceiling & replastering and repainting etc.) related with the above items are included in the scope of work. The above scope dose not include false ceiling where ever required.

vii. Entire liquid and suction refrigerant pipe lines including all fittings, valves and strainer bodies etc. Shall be insulated with 19-mm/ 13 mm thick elastomeric Nitrile rubber as specified in BOQ.

18.8 AIR SIDE WORK:

- Velocity of air in any section of duct shall not exceed 9 M/Sec.

- The general layout of the ducting and location of air handling units, grilles, diffusers etc., shall conform to the arrangement shown in the drawings enclosed with the specification.

- Ducting shall be fabricated at site from galvanized steel or aluminum as specified.

- The construction of ducts shall conform to IS : 655 in so far as applicable. All duct seams shall be filled with bitumastic cold emulsion or equivalent vapour seal.

- All duct supports shall be provided at centres preferably not exceeding 2.5 Meter. The duct supports shall consist of structural steel angles and if required flats and jointed by bolting. Whenever duct support angles are to be fixed with reinforced concrete roof/floor slab, the anchoring screw shall be connected with duct support angles by means of intermediate angle plates with bolted connection, so as to facilitate early erection and dismantling.
For protecting the insulation from damage, duct support saddles of proper length shall be used at each support point for the entire width of the interface between insulated duct bottom surface and the top of the angle iron support member. The saddle plate shall be made from galvanized steel or aluminum.

Canvas or equal flexible connection shall be provided at each connection between duct work and AHU so as to isolate vibration.

Damper blades shall be manufactured of minimum 20 BWG Sheet Steel.

All diffusers and grilles shall be made up of extruded aluminum section finished in powder coating of approved colour.

Design of diffusers, grilles etc. shall be made by he contractor matching the lighting fitting and the décor of the office.

18.9 RECOMMENDED LIST OF MAKES:

- Copper pipe : Nippon/ Nissan / Rajco/Totaline
- Cables : Nicco/Gloster/Finolex.
- Fans / Blowers : Nicotra / Kruger / Comefri
- Vibration Isolartors : Dunlop / Resistoflex
- Insulation : Beardsell, Lloyd,Twiga
- Grilles/ Diffusers : Premier/ Dynacraft/ Ravistar
- G I Sheets : Jindal / Sail / VSP / Nipon.
- Nitrile Rubber Insulation : Aflex, K Flex , Armacell.
- VRF Units : Mitsubishi , Carrier mi dea , Blue Star
The following works and services to be provided by client and is beyond the Scope of HVAC vendor:

⇒ Provision & termination of 3 phase 415 V, 50 Hz power along with double earthing at the Electrical Panel of individual outdoor units.

⇒ Provision & termination of 1 phase 220 V, 50 Hz power along with double earthing near to the individual indoor units.

⇒ Free Power for installation, testing and commissioning of the Air conditioners

⇒ All carpentry work such as enclosure for system components, provision / modification of false ceiling/ false flooring, partition above false ceiling, partition below false flooring, duct concealment (if applicable), providing return air path, opening in the false flooring / false ceiling, cut-outs for grilles / diffusers, window modification if any etc.

⇒ Suitable provision for the drain line termination & its outlet.

⇒ Under-deck insulation for the exposed ceiling

⇒ Lockable storage place at site.

⇒ Outdoor Structural network.

⇒ Any electrical works, MCC PANEL, other than control cabling.

⇒ Thermal Insulation above false ceiling

⇒ Free provision of workmen to stay at site during execution.

⇒ All kind of civil/ concealment and foundation work.

⇒ Any other item not specifically mentioned in bill of quantities.
19.0 FIRE HYDRANT AND WET SYSTEM

19.1.0 GENERAL
This document shall be read in conjunction with all relevant commercial
documents. In case of
Contradiction between the technical specifications and other
documents, data in technical specification shall prevail.

19.2.0 All work under this job shall be carried out in accordance with the
technical specifications and the
Latest revisions of Indian Standards, Codes, Indian Electricity Rules and
also regulations and Norms of West Bengal Fire Services.

19.3 TECHNICAL PARAMETERS
Four (4) nos. Fire Pump consisting of one (1) Main Electrical driven
Pump for Hydrant, one (1) Electrical driven Pump for Sprinkler
arrangement, One (1) no. Diesel Engine driven Fire Pump and one (1)
Jockey Pump electric driven shall be installed in the Fire Pump Room,
pumping water from the underground Fire water Reservoir. The
common outlets of Fire Pump delivery system shall cater the following:
   a) Internal Fire Hydrants in each floor.
   b) External Fire Hydrants.
   c) Fire First Aid Hose Reel in each floor.
   d) Sprinkler Arrangements.

19.4.0 OPERATION

Fire Hydrant System and Sprinkler System
Water Header up-to hydrant/landing valves shall be kept pressurized by
the jockey pump which shall be started automatically on receiving the
impulses from the pressure switch in case of any leakage in the header
and subsequent fall in the pressure. It shall stop at a present pressure as
soon as pressure builds up in the header.
For smaller fires, first aid hose reel would be used while hydrant valve
would be used for bigger fires.
In the event of the fire outbreak, opening of hydrant valve/hose reel will
result in fall of pressure in the header and electric motor driven fire
pump shall come into operation automatically through the impulse from
the pressure switch. The fire pump shall be stopped manually only.
In case the electric driven main fire pump fails to start, the diesel engine driven pump shall come into action automatically on further fall of pressure and receiving impulse from pressure switch.

The setting of the pressure switches shall be done keeping the above sequence in consideration.

19.5.0 SPECIFICATIONS (TECHNICAL)

19.5.1 PUMPS

a) Electric Motor driven Main Fire Pumps
End suction type, horizontally mounted centrifugal pump (as per IS 1520), TAC/Local authority approved each capable to deliver 2850 LPM of water at minimum 80.0 M delivery head, coupled to a suitably powered electric motor mounted on a common base frame, cushy foot and rubber fiction pad coupling, coupling guard and fixing bolts etc. Motor HP to be suitably selected to suit minimum discharge and residual head at the top most or farthest hydrant and sprinkler.

b) Electric Motor driven Jockey Fire Pump
End suction type, horizontally mounted centrifugal pump (as per IS 1520), TAC/Local authority approved each capable to deliver 185 LPM of water at minimum 80.0 M delivery head, coupled to a suitably powered electric motor mounted on a common base frame, cushy foot and rubber fiction pad coupling, coupling guard and fixing bolts etc. Motor HP to be suitably selected to suit minimum discharge and residual head at the top most or farthest hydrant and sprinkler.

19.5.2 Diesel Engine driven Fire Pump
End suction type, horizontally mounted centrifugal pump (as per IS 1520), TAC/Local authority approved each capable to deliver 2850 LPM of water at minimum 80.0 M delivery head, coupled to a suitably Diesel engine, continuously rated for suitable horse power, direct injection, four stroke, water cooled type complete with coupling, coupling guard common base frame, cushy foot & rubber friction pad, Instrument panel with RPM indicator, pressure gauge, radiator with engine cooling system, fuel tank, tool kit, air filtration unit, exhaust piping with silencer, engine shut down mechanism, staring mechanism, for both automatic and manual mode, batteries with charging system
etc. The engine shall be provided with an adjustable governor to control the engine speed within 10% of its rated under any condition of load up-to the full load rating.

19.5.3 Specification Of Diesel Engine Auto Control Panel

The diode based diesel engine auto control panel consists of single battery chargercapable of charging two sets of battery (1 set working and 1 set of standby) trickleand boost charge mode. The panel should give three cracking trials of 5 secondsduration at 15 seconds interval. The panel should consists of mechanical LOPgauge, electrical LOT gauge, electrical water temperature gauge, digital hour cum rpm meter, charge indicating lamp, ammeter, 3 way start key, stop push button, termination for following safeties : pressure switch NO / NC, high water temperature switch, over speed switch, remote stop, remote start.

LED Indication

AC Supply ON
- Start failure
- Low lube oil pressure
- High water temperature
- Over speed trip
- Low fuel level
- Water heater on
- Engine running
- Hooter off
- Hydrant Pressure Normal

Switches
- Start
- Stop
- Reset
- Hooter ON / OFF

Selector Switches
- Supply on/off
- Charge selection
• Auto / Off / Manual
• Water Heater on

Meters
• DC Ammeter
• DC Voltmeter

INTERLOCKING

Jockey pump shall not start / stop / trip when fire pumps comes in operation.

19.5.4 CI SLUICE VALVE ( IS : 14846 )
All Gate/Sluice shall be of ISI marked and should be PN-1.6 Pressure rating

1.0 TYPE : NON-RISING SPINDLE TYPE.
2.0 MATERIAL OF CONSTRUCTION

A) BODY : CAST IRON TO IS:210-1993 (4th. REV.) GR.FG 200
B) VALVE TRIM : GUN METAL.
C) BONNET : CAST IRON TO IS:210-1993 (4th. REV.) GR.FG 200
D) STUFFING BOX : CAST IRON TO IS:210-1993 (4th. REV.) GR.FG 200
E) GLAND : CAST IRON TO IS:210-1993 (4th. REV.) GR.FG 200
F) HAND WHEEL : CAST IRON TO IS:210-1993 (4th. REV.) GR.FG 200
H) WEDGE NUT : LEADED TIN BRONZE LTB-2 OF IS:318-1981(2nd. REV.)
I) BODY SEAT RING : LEADED TIN BRONZE LTB-2 OF IS:318-1981(2nd. REV.)
J) WEDGE FACE RING : LEADED TIN BRONZE LTB-2 OF IS:318-1981(2nd. REV.)
K) GLAND PACKING : JUTE & HEMP TO IS:5414-1969(Amendments I)
Reaffirmed 1992
L) GASKET: FIBRE BOARD TO IS:2712-1979 (2nd. REV.)(Amendments 3)

19.5.5 FLANGE PARTICULARS: AS PER IS: 780-1984/IS: 1538

19.5.6 TEST PRESSURE

A) SEAT: 16 KG./CM2.
B) BODY: 24 KG./CM2
19.5.7 AIR/ PRESSURE RELEASE VALVE

1.0 MANUFACTURER : ISI MARKED
2.0 TYPE : Spring Type, Screwed 25 MM NB.
4.0 MATERIAL OF CONSTRUCTION

A) BODY : LTB - GR 2, IS:318-1981 (2ND. REVISION)
B) SPRING : Stainless Steel, IS: 6528
C) INLET NIPPLE : GUN METAL
D) AIR RELEASE NIPPLE : GUN METAL

19.5.8 SWING TYPE NON RETURN / CHECK VALVE

1.0 STANDARD : IS: 5312/PART – I/84
2.0 MARKING : ISI MARKED

3.0 MATERIAL OF CONSTRUCTION

BODY : CI TO IS: 210 GR.FG 200
COVER : DO
FLAP : DO
HINGE BRACKET : DO
BODY SEAT RING : LEADED TIN BRONZE, IS:318 LTB2
FLAP SEAT RING : DO
HINGE PIN : H.T. BRASS IS:320 HT2
GASKET : RUBBER IS:638 TYPE B
BOLTS,NUTS & STUDS : C.S., IS:1367

19.5.9 SPECIFICATION FOR MS PIPES & FITTINGS

FIRE WATER PIPES & FITTINGS
MATERIAL : MILD STEEL
SPECIFICATION : IS:1239 ,Part-1,1992 (6th. REVISION)
(Amendments 3)
(PART I) UPTO 150 NB AND ABOVE
150 NB IS: 3589-1991 (6.35 mim. THICKNESS)
TYPE : E.R.W.
CLASS : Medium Grade up to 150NB & above 6.35 min.thickness.
TYPE OF JOINT : WELDED / FLANGED AS PER SITE REQUIREMENT.
(Amendment 1) FOR UP 65 NB TO 150NB.PIPES
FOR 200NB & ABOVE BUT WELDED FITTINGS SHALL
BE USED.
FOR 50NB & BELOW DIA. OF PIPES NO BUTT WELDED
FITTINGS SHOULD BE USED, ONLY SOCKET WELDED
FITTINGS TO BE USED.
   BOLTS AND NUTS : IS:1367-1980 (2nd. REVISION)
Reaffirmed 1991.9 GASKET : NATURAL RUBBER

19.5.10 SPECIFICATION FOR HYDRANT/LANDING VALVES

1.0 HYDRANT / LANDING VALVE
2.0 STANDARD : IS:5290-1993, TYPE-A
3.0 TYPE & SIZE : OUTLET 63 mm. FEMALE, OBLIQUE TYPE.
4.0 BONNET : SCREWED
5.0 STEM TYPE : RISING
6.0 ENDS
   INLET : FLANGED (FLAT FACED) OF SIZE 80NB.
   OUTLET : S.S. FEMALE INSTANTANEOUS COUPLING WITH
   SPRING S.S. LOCK WITH BLANK CAP & CHAIN.
7.0 MATERIAL SPECIFICATION
   BODY BONNET : Stainless Steel, IS: 3444
   SPINDLE : Stainless Steel, IS: 6603
   STOP VALVE, VALVE
   SEAT & TRIM : Stainless Steel, IS: 3444
   INSTANTANEOUS
   COUPLING(F) : Stainless Steel, IS: 3444
   BLANK CAP : PVC
   HAND WHEEL : CI TO IS: 210

   WASHER/GASKETS : RUBBER IS:638
   SPRING : Stainless Steel, IS: 6528
8.0 COLOUR/SHADE : FIRE COLOUR AS PER SHADE NO.536 IS:5-1978
9.0 TEST PRESSURE : 21 KG./CM2

19.5.11 SPECIFICATION FOR BRANCH PIPE WITH NOZZLE

1.0 BRANCH PIPE WITH NOZZLE
2.0 STANDARD : IS:903
3.0 TYPE & SIZE : 63mm MALE INST. INLET THREADED OUTLET.
20 MM BORE NOZZLE.
4.0 MATERIAL SPECIFICATION
BODY : STAINLESS STEEL
WASHER : TYPE B, IS: 937
5.0 TEST PRESSURE : 21 KG./CM2

19.5.12 (1) (A) SPECIFICATION FOR DELIVERY HOSE COUPLING

1.0 COUPLING
2.0 STANDARD : IS:903
3.0 TYPE & SIZE : PAIR OF MALE & FEMALE PARTS 63 MM x 63 MM SIZE.
4.0 MATERIAL SPECIFICATION
BODY : STAINLESS STEEL, HEAVY DUTY AND INSTANTANEOUS PATTERN, IS:318
5.0 TEST PRESSURE : 21 KG./CM2

(B) SPECIFICATION FOR RRL HOSE

1.0 STANDARD : IS:636 TYPE – A
2.0 TYPE : Synthetic Rubber Lined, Non percolating
3.0 SIZE : 63 MM
4.0 LENGTH : 15 MTR. EACH
5.0 TESTING PRESSURE : 14 KG./CM2
6.0 BURSTING PRESSURE : 38 KG./CM2
7.0 MARKING : IS:636 TYPE – A & ISI

(2) SPECIFICATION FOR CP HOSE

1.0 STANDARD : IS : 8423
2.0 TYPE : Controlled Percolating fire Hose With special inner rubber coating
3.0 SIZE : 63 MM
4.0 LENGTH : 15 MTR EACH
5.0 TESTING PRESSURE : 14 KG/CM2
6.0 BURSTING PRESSURE : 38 KG/CM2
19.5.13 SPECIFICATION FOR Q.B. SPRINKLER

1.0 SPRINKLER
2.0 STANDARD : UL LISTED
3.0 TYPE : PENDENT AND SIDE WALL TYPE
4.0 RATED WORKING PRESSURE : 12.3 KG/CM. (175 PSI)
5.0 MATERIAL : BRASS
6.0 WEIGHT : 0.120 KG. (APPROX.)
7.0 FINISH : NICKEL CHROME PLATE

19.5.14 SPECIFICATION FOR 3 WAY FIRE BRIGADE CONNECTOR

Fire Brigade connections to Wet Riser and for underground reservoir shall be with three number 63 mm instantaneous inlets.

1.0 4 WAY FIRE BRIGADE CONNECTOR
2.0 STANDARD : IS:904
MATERIAL OF CONSTRUCTION
BODY : SS 304
COLLECTING HEAD : 3WAY INSTANTANEOUS. MALE
INLET : FLANGED

19.5.15 SPECIFICATION FOR INSTALLATION CONTROL VALVE

TECHNICAL PARAMETERS
CODES/STANDARD/APPROVAL : UL / FM
RATED WORKING PRESSURE : 12.3 KG./CM2
END CONNECTION : FLANGED, DRILLING AS PER IS:1538
MOUNTING : VERTICALLY
HYDRAULIC TEST PRESSURE : 25 KG./CM2
FINISH : FIRE RED EPOXY PAINTED
ACCESSORIES : CONSTANT PRESSURE TRIM, DRAIN VALVE, WATER MOTOR GONG, PRESSURE GAUGE, STOPVALVE ETC.
APPROX. WT. WITHOUT TRIM: 59 KGS.
MATERIAL OF CONSTRUCTION
HOUSING & COVER PLATE: CI, CONFOMING TO IS: 210 GR. 260
SEAT, CLAPPER, BUSH: BRONZE; IS: 318, LTB-II
GASKET, VALVE SEAT: NEOPRENE RUBBER
HINGE PIN, CLAMP: SS 304
BOLT: MS, IS: 1363
19.5.16 SPECIFICATION FOR BUTTERFLY VALVE

1.0 Body – Aluminium Die Cast/equivalent ASTM B85 -84-383
2.0 Neck – A351 GR. CF8
3.0 Stem – Equivalent ASTM A 276 TYPE - 410
4.0 Disc - A351 Gr. CF8M
5.0 O-ring - EPDM
6.0 Rubber seat - EPDM
7.0 Bottom stem - Equivalent ASTM A276 Type 410

19.5.17 SPECIFICATION FOR PRESSURE GAUGE

Pressure gauges with controlling cocks etc. shall be of approved make having pressure range, bourdon material and dial.

19.5.18 SPECIFICATION FOR PRESSURE SWITCHES

Pressure switches with accessories shall be approved make and design and shall actuate at preset pressure.

19.5.19 ADDRESSABLE FIRE ALARM PANEL (FAP)

It shall be possible to Command Test, Reset and Alarm Silence individual devices from the FAP

Initiate smoke control procedures as described in the plans. FAP switches shall allow authorised personnel to accomplish the following, independent of the main operating console:

- Initiate a general alarm condition.
- Silence the local audible alarm.
- Silence the alarm signals.
- Reset all devices, after all initiating devices have been returned to normal.
- Test all panel LEDs for proper operation without causing a change in the condition for any zone.

The FAP electronics shall be contained in an enclosure made of minimum 16 gauge steel. Access to FAP switches and all electronics shall
be via key-lock; no other tools shall be required. Visual indicators of FAP status for each zone shall be visible without opening the key-locked cover. The FAP should be compatible for Public Address System

19.5.20 FIRE ALARM DEVICES

Addressable Photo Electric type Smoke Detector (PED)

The Photoelectric type Smoke Detector shall be addressable type and shall connect with two wires to the FAP. The detector shall use a photoelectric light scattering principle to measure the visible products of combustion. All electronic circuits shall be solid state and hermetically sealed to prevent the effects of dust, dirt or humidity. All circuitry shall be protected against electrical transient and electro-magnetic interference, and reversed polarity or faulty loop wiring shall not damage the detector. The detector shall be capable of self-test and provide pre-maintenance signal. Hence it shall not be necessary to either poll or adjust the sensitivity of each and every detector manually from time to time. The detector shall connect to the local control unit via a fully supervised circuit. The detectors shall be ceiling mounted. The detectors shall provide a test means hereby they shall simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself, by using a test set, or may be activated remotely on command from the fire alarm panel.

Addressable Heat /Thermal Detectors ( Fixed-Rate-of-Rise)

The Heat Detector shall utilise a principle of operation based on a combined rate-of rise and a fixed temperature heat detector. Combined rate-of-rise/fixed temperature detectors shall consist of two independent thermostats, designed to automatically compensate for changes in ambient conditions. All electronic circuits shall be solid state and hermetically sealed to prevent the effects of dust, dirt or humidity. All circuitry shall be protected against usual electrical transients and electromagnetic interference and reversed polarity or faulty loop wiring shall not damage the detector. The detector shall be capable of self test and provide pre-maintenance signal. Hence it shall not be necessary to either poll or adjust the
sensitivity of each and every detector manually from time to time. The
detector shall connect to the local control unit via a fully supervised
circuit. The detectors shall be ceiling mounted. The detectors shall
provide a test means whereby they shall simulate an alarm condition
and report that condition to the control panel. Such a test may be
initiated at the detector itself, by using a test set, or may be activated
remotely on command from the fire alarm panel.

**Addressable Pull type Manual Pull Station**

The manual break glass unit shall be of the conventional type and
suitable for connection with two wires to FAP. The manual break glass
unit shall be electrically compatible with the standard range of
automatic detectors so that it can be connected directly into a
supervised two-wire zone of the manufacturer's standard range of
control units for wiring.

The unit shall consist of the base plate, insert and cover. The units shall
be designed for fast, simple and failure proof dismantling and
assembling. The unit shall have sealable openings for wire introduction
through compression cable glands on top and at the bottom of its
housing. The lid of unit shall be permanently fixed to the body of the call
point by a hinge. Every opening/removal of the cover shall release
an alarm. The alarm contacts shall be of self cleaning design to prevent
failure after a prolonged period of inactivity in unclean environments.
The manual break glass units shall be designed for fail safe operation.
The units shall be designed to permanently withstand corrosion, as
defined by international standards and consists of aluminium cast
housing. Closing the box after opening it shall automatically perform the
reset function.

**Addressable Alarm Hooters cum Strobe**

Fire Alarm Hooters cum Strobe shall be of addressable type and connect
with two wires to one of the FAP and also compatible for Public Address
System. The alarm hooter cum speaker would be used for fire alarm and
announcement for evacuation in the event of fire. The hooters being
located at vital places shall have minimum 80 Db output and shall have
adequate range to cover a radius up to 1 KM diametric range.
**Addressable Control Relay Module**

For monitored control of an extinguishing system activation of outdoor control units tripping (NO/NC Contact) with the option to reset the activated control output from the control panel, with monitoring short – circuit and interruption, Housing is designed for surface mounting of flush mounting.

**Fault Isolation Module**

Fault Isolator module shall be loop be loop on panel intelligent loop communication circuit along with other modules and sensors. It detects a wire to wire short and electrically isolates that condition from the circuit so that communication is maintained with unaffected devices on the same circuit. The isolator shall be placed preferable every 15/20 devices in the loop.

**19.5.21 Specification For Co2 Type Fire Extinguisher**

1.0 CAPACITY, KG. : 4.5 KG  
2.0 STANDARD : IS:2878/86  
3.0 CYLINDER BODY : SEAMLESS CONFORMING TO IS:7285  
4.0 CONTROLLED VALVE : CONFORMING TO IS: 3224  
5.0 DISCHARGE HOSE : 1 MTR. LONG  
6.0 DISCHARGE HORN : FITTED WITH DISCHARGE HOSE  
7.0 CARRYING HANDLE & WALL  
8.0 MOUNTING BRACKET : TO BE PROVIDE WITH EXTINGUISHER  
9.0 INITIAL GAS REFILL : YES

**19.5.22 SPECIFICATION FOR WATER CO2 FIRE EXTINGUISHER**

1.0 CAPACITY, LTR. : 9 LTRS  
2.0 STANDARD : IS:940  
3.0 CAP : GUN METAL  
4.0 INITIAL REFILL : YES
19.5.23 SPECIFICATION FOR MECHANICAL FOAM FIRE EXTINGUISHER

1.0 CAPACITY, LTR. : 9 LTRS.
2.0 STANDARD : IS:10204
3.0 CYLINDER BODY : MS
4.0 CO2 GAS CARTRIDGE : CONFORMING TO IS:4947
5.0 AFFF : CONFIRMING TO IS:4989
6.0 CARRYING HANDLE & WALL
7.0 MOUNTING BRACKET : TO BE PROVIDE WITH EXTINGUISHER
8.0 INITIAL REFILL : YES

19.5.24 SPECIFICATION FOR DCP TYPE EXTINGUISHER

1.0 CAPACITY, KG. : 5 KG.
2.0 STANDARD : IS:2171/85
3.0 CAP : GUN METAL
4.0 INITIAL REFILL : YES
5.0 MARKING : ISI MARKED

19.5.25 MODULAR CLEAN AGENT TYPE FIRE EXTINGUISHER

Exclusive assortment of NAF P1V Clean Agent (LPC Approved), which is used for computer, data center, server, Epabx, Critical Software rooms. Having ratings of 70B and 5A, our series of products are developed in compliance with the CEN standard EN3. These are used when it requires an inert and electrically non-conducting media.