TENDER DOCUMENT

TENDER No.: NERO/CON/735/254

FOR

DESIGN, MANUFACTURE, PRE-DISPATCH INSPECTION, SUPPLY, DISPATCH TO SITE, UNLOADING AT SITE, INSTALLATION, TESTING AND COMMISSIONING OF PANELS FOR THE PROJECT “EXTENSION OF ACADEMIC COMPLEX (PHASE-V) AT IITG CAMPUS, GUWAHATI”

VOLUME–II

NOTICE INVITING TENDER

ADDITIONAL CONDITIONS OF CONTRACT

TECHNICAL SPECIFICATIONS

DRAWINGS
ENGINEERING PROJECTS (INDIA) LIMITED  
(A Govt. of India Enterprise)  
North Eastern Regional Office, Guwahati  
NOTICE INVITING TENDER

NIT No. NERO/CON/735/254  
Date: 20.07.2017

Tender For Design, Manufacture, Pre-Dispatch Inspection, Supply, Packing and Forwarding,  
Dispatch to Site, Unloading at Site, Installation, Testing and Commissioning of Panels in  
Academic Buildings For The Project “Extension Of Academic Complex (Phase-V) at IITG  
Campus, Guwahati”

Sealed item rate open e-Tenders through e-tendering are invited by Engineering Projects  
(India) Limited (EPI) in single stage two bid system from the eligible contractors/firms who fulfill  
the eligibility criteria as per the brief particulars of scope for Design, Manufacture, Pre-Dispatch  
Inspection, Supply, Packing and Forwarding, Dispatch to Site, Unloading at Site, Installation,  
Testing and Commissioning of Panels in Academic Buildings For The Project “Extension Of  
Academic Complex (Phase-V) at IITG Campus, Guwahati” in line with scope of work and terms  
and conditions described fully at the relevant places in the tender documents forming part of this  
tender.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Work</th>
<th>Estimated Cost</th>
<th>Earnest Money Deposit</th>
<th>Completion Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Design, Manufacture, Pre-Dispatch Inspection, Supply, Packing and Forwarding, Dispatch to Site, Unloading at Site, Installation, Testing and Commissioning of Panels in Academic Buildings For The Project “Extension Of Academic Complex (Phase-V) at IITG Campus, Guwahati”</td>
<td>Rs. 23,00,00,000.00 (Rupees Twenty Three Lakhs only)</td>
<td>Rs. 23,000.00 (Rupees Twenty Three Thousand only)</td>
<td>2 (Two) months</td>
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The brief scope of work in this tender shall include providing all labour, materials, tools and  
plant, transportation to site, superintendence, unloading at site at IITG campus, Guwahati etc. all  
complete for Design, Manufacture, Pre-Dispatch Inspection, Supply, Packing and Forwarding,  
Dispatch to Site, Unloading at Site, Installation, Testing and Commissioning of Panels in  
Academic Buildings For The Project “Extension Of Academic Complex (Phase-V) at IITG Campus, Guwahati” except those which are specifically mentioned to be excluded elsewhere in tender documents. 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 detailed scope of work is given in the tender document.
Time schedule of tender activities:

i) Last Date & Time for Downloading of tender documents: up to 02.08.2017(12:00 PM)

ii) Last Date & Time of online submission of Tenders: on or before 02.08.2017 up to 02:00 PM

iii) Date & Time of online opening of tenders (Techno-Commercial Bid): 02.08.2017 at 04:00 PM

iv) Date & Time of submission of documents in physical form: 02.08.2017 (upto 03:00PM)

In case of any unscheduled holiday taking place on the last day of issue of tender/submission of tender the next working day shall be treated as the scheduled time and day of issue of tenders/submission of tenders.

Contractors who fulfill the following requirements are eligible to participate in this tender. The joint ventures/Consortium are not accepted.

a) The bidder must have experience of having satisfactorily completed following “similar works” during the last 7(seven) years ending last day of month previous to the one in which applications are invited.

   Three similar works each costing minimum 40% of the estimated cost put to tender
   OR
   Two similar works each costing minimum 50% of the estimated cost put to tender
   OR
   One similar work costing minimum 80% of the estimated cost put to tender

i) The “similar works” shall mean supply, installation, testing and commissioning of LT Panels

ii) The cost of free issue materials shall not be included in the completion cost of works.

iii) For evaluation purpose, the completion cost of works mentioned in the completion certificate shall be enhanced by 7% per annum till the end of month prior to date of NIT.

iv) The experience certificates issued by Government Organizations/Semi Government Organizations/State Government/Public Works Department / Central Government/Public Sector Undertakings/ Autonomous Bodies/Municipal Bodies/Public Limited Companies listed on BSE/NSE shall only be accepted for assessing the eligibility of the tenderer. However, the certificates issued by Public Limited Company can be considered only if they are supported by TDS certificates in support of value of work done by the tenderer. TDS certificate for full contract value as mentioned in the work order must match failing which the same shall not be considered.

b) Should have had average annual financial turnover of at least 30% of the estimated cost put to tender during the immediate last three consecutive financial years ending on 31.03.2016 duly supported by annual financial report (i.e. audited copies of balance sheet and profit and loss statement) or certified by Chartered Accountant along with Income Tax return for last financial year (2015-16/2016-17).

c) Should submit Sale Tax return for last quarter of financial year (2016-17).

d) Should not have incurred any loss in more than two years during the immediate last five consecutive financial years, ending 31.03.2016, Copies of balance sheet/ Certificate from Chartered Accountant duly self attested by the tenderer shall be submitted.
e) Should have a Solvency of 40% of the estimated cost issued by a Bank. The Solvency Certificate should have been issued not earlier than one year of last date of submission of the tender.

f) Should have valid Permanent Account Number of Income Tax and GST registration certificate. In case the tenderer is unable to get migrated to GST Registration he shall give an undertaking to obtain it within one month of issuance of LOI or order in case he becomes the successful bidder.

g) Should have valid PF Registration number. In case the bidder does not have this registration number, he shall remain bound to obtain them within one month from the date of LOI or before release of 1st R/A bill whichever is earlier.

h) Bidders who intend to get exemption from submission of Tender fee and EMD shall submit confirmation letter whether they are registered under MSME Act or not and if yes, then relevant copies of the registration letter (Registered under single point registration scheme of NSIC, Govt. of India, Ministry of MSME, New Delhi) vide Gazette Notification dated 26.03.2012 along with the form of Memorandum-2 (with the concerned DIC) certificate in the appropriate category and limit as applicable under the present tender to be enclosed in Technical Bid and a request letter for exemption from submission of Tender fee and EMD.

i) Site visit for the subject tender is mandatory. The bidders shall visit the site to Study/assess the tendered work and also acquaint themselves of the prevailing local conditions before submitting their bid. Bidder has to enclose a certificate counter signed by EPI official or furnish undertaking for having visited the site.

The credentials of the Bidders shall be verified and inspection of the works, if required, to be carried out by EPI. If not found satisfactory, their bid will be considered non-responsive.

2.0 Tender documents comprising of the following are available on the website of EPI: www.epi.gov.in, CPP-Portal: www.eprocure.gov.in and as well as on TCIL portal http://www.tcil-india-electronic-tender.com.

Volume I: Instructions to Tenderers, Addendum to Instructions to Tenderers, Special Instructions to Bidders for e-Tendering & General Conditions of Contract (ITT&GCC) of EPI

Volume II: a) Notice inviting Tender
b) Additional Conditions of Contract
c) Technical Specification (Electrical)

Volume III: Price bid/bill of quantity

3.0 In order to participate, the bidder should have Digital Signature Certificate (DSC) from any one of the authorized Certifying Authorities.

4.0 Interested bidders have to necessarily register themselves on the portal https://www.tcil-india-electronic-tender.com through M/s Telecommunications Consultants India Limited, New Delhi to participate in the bidding under this invitation for bids. It shall be the sole
responsibility of the interested bidders to get them registered at the aforesaid portal for which they are required to contact M/s Telecommunications Consultants India Limited, New Delhi at following address to complete the registration formalities:

M/s Telecommunications Consultants India Limited,
6th Floor, TCIL Bhawan, Greater Kailash – 1
New Delhi 110 048
Contact No.: 011-26241790, 98683 93717/75/92
Email-ID: ets_support@tcil-india.com

They may obtain further information regarding this tender from GM (Contracts) at the address given at Clause No.14.0 below from 10:00 hours to 17:00 hours on all working days till the last date of online submission of Bidding Documents.

For proper uploading of the bids on the portal namely https://www.tcil-india-electronictender.com (hereinafter referred to as the “portal”), it shall be the sole responsibility of the bidders to apprise themselves adequately regarding all the relevant procedures and provisions as detailed at the portal as well as by contacting M/s Telecommunications Consultants India Limited, New Delhi directly, as and when required, for which contact details are mentioned above. The EPI in no case shall be responsible for any issues related to timely or properly uploading/submission of the bid in accordance with the relevant provisions of Section: Instruction to Bidders of the Bidding Documents.

5.0 Bidders can download the bid document from the portal without paying document fees in advance, any time from 20:00 Hrs on 20.07.2017; however interested bidders have to pay tender fees for participating in the tendering and submitting the bid. For this purpose the interested bidders shall be required to pay ` 8,000/- (Rupees Eight Thousand only) as non-refundable document fees in the form of Demand Draft in favour of “Engineering Projects (India) Ltd.” payable at Guwahati.

6.0 E-Bids must be submitted/uploaded along with scanned copies of relevant documents as mentioned at clause no 2 of “Addendum to Instructions to Tenderers” under Single Stage Two Envelope Bidding Procedure on the TCIL portal on or before last date & time of online bid submission. Late bids will not be accepted. Under the above procedure, only first envelope (Technical Part) shall be opened in the presence of the bidders’ representatives who choose to attend in person at the address given below on scheduled date & time of bid opening or may be viewed by the bidders by logging in to the portal as per features available to them. Second envelope i.e. Price part shall be opened of technically qualified bidders.

The bid must be accompanied by an Earnest Money Deposit (EMD) of ` 23,000.00 (Rupees Twenty Three Thousand only) This can be either in the form of Crossed Demand Draft or Pay Order (in CTS form) of any Nationalized Bank/Scheduled Bank for the full amount of EMD payable favouring “Engineering Projects (India) Ltd.”, payable at Guwahati. The EMD shall be valid for minimum period of 150 days (one hundred fifty days) from the last day of submission of tender. Tenders submitted without EMD or inadequate amount of EMD shall be rejected. The bid shall be valid for 90 days from date of opening of Price Bid.

Tender fee, EMD (In original), Power of Attorney, NSIC/MSME(Registered under single point registration scheme of NSIC, Govt. of India, Ministry of MSME, New Delhi vide Gazette Notification dated 26.03.2012 along with the form of Memorandum-2 (with the concerned DIC) certificate in the appropriate category as applicable
under the present tender as per Clause No.1 (h) if bidder is claiming EMD/Tender fee exemption and Pass Phrase (Both for technical and financial bid in separate envelope) to decrypt the bid must be submitted in physical form at the address given at Clause No. 14.0 below on or before Last date and time of online bid submission. If the above documents are not received in time then their offer shall not be considered and EPI shall not be responsible for any postal delay in respect of submission of hard copy part of the bids.

7.0 The Terms & Conditions contained in the NIT and tender document shall be applicable.

8.0 The contractors currently under any litigation with EPI shall not be allowed to participate in this tender and in case a tenderer is found to conceal or neglect this stipulation in securing this work the work order or LOI issued to him shall stand automatically withdrawn and EMD submitted by him at the tendering stage or security deposit-cum-performance bank guarantee in absence of EMD shall stand forfeited.

9.0 The tenderers should note that the credentials such as certificates, authorizations etc. as submitted by them along with their offers shall be forwarded by EPI to Client for his opinion. The tenderers against whom client does not give satisfactory remarks or express reservation shall be rejected by EPI.

10.0 Even though an applicant may satisfy the eligibility criteria, EPI reserves the right for not issuing the tender document if he has record of poor performance such as abandoning work, not properly completing the work, delay in execution of work, poor quality of work, financial failure / weakness etc.

11.0 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.

12.0 The corrigendum or addendum, extension, cancellation of this NIT, if any, shall be hosted on the EPI's website/CPP portal as well as on TCIL portal http://www.tcil-india-electronic-tender.com the bidders are required to check these websites regularly for this purpose, to take into account before uploading/submission of tender. All Corrigendum and addendum are to be uploaded duly signed & stamped with tender documents as bid Annexure.
11.0 The Price Bid of those bidders who are found to be prima-facie techno-commercially acceptable based on the documents submitted at the time of bid submission and also against fulfillment of conditions at sl. no. 8 & 9 above shall be opened with prior intimation to them. Hence the intending bidders must furnish their e-mail id along with the techno-commercial part. However, it is made clear that the offer of the bidders shall be accepted subject to the confirmation of authenticity of the PQ documents/ EMD /Tender fee from the concerned department/ bank. In case the PQ documents such as work experience certificate, bank solvency certificate etc submitted by a bidder is found to be fake the EMD submitted by him shall be forfeited by EPI without making any reference to him. Further such a tenderer shall be at a risk of losing his right to participate in any tender called by EPI for a minimum period of one year.

12.0 In case of tie-tender, where two firms are bidding lowest, EPI reserves the right to split the work among these bidders and / or EPI will reserve the right to award the tender to any one of such bidder. The decision of EPI in this respect shall be final and binding on the tenderers.

13.0 EPI reserves the right to accept any tender or reject any or all tenders or split the work of tender or annul this tendering process without assigning any reason and liability whatsoever and to re-invite tender at its sole discretion.

14.0 Address for submission of documents in physical form:
   General Manager
   Engineering Projects (India) Ltd.
   North Eastern Regional Office
   4th Floor, Hindustan Tower,
   Jawahar Nagar, National Highway No.37,
   Guwahati (Assam) - 781022 (Tel No. 0361-2313687, Fax No.0361-2223617)

15.0 Contact details for site related quarries/ visit:
   Shri N. Shanta Singh, Manager Gr.II
   Engineering Projects (India) Ltd.
   IITG Campus, Guwahati.
   Phone No: +91-7005 687 437

General Manager
ADDITIONAL CONDITIONS OF CONTRACT (ACC)

1.0 The following Additional Conditions of Contract shall be read in conjunction with General Conditions of Contract (GCC) of EPI and other conditions of the tender documents. If there are any provisions in these Additional Conditions of Contract, which are at variance with the provisions of GCC and other conditions of the tender documents, the provisions in these Additional Conditions of Contract shall take precedence.

2.0 Engineering Projects (India) Limited has entered into an agreement for execution of the work for “Extension of Academic Complex Phase-V at IITG Campus”. The tender shall include (but not limited to) providing labour, tools and plants, machineries, transport and all other components including all materials (except those which are specifically excluded from scope/present tender as spelt out elsewhere in the tender documents) required for completion of construction work in the buildings as mentioned in the NIT.

3.0 The IIT Guwahati Campus is located on the North Bank of the river Brahmaputtra. This is accessible by road via NH 31 as well as via North Guwahati-Hajo Road from the junction point of North approach of Saraighat Bridge and Guwahati Hajo by-lane.

4.0 The word “Contractor” appearing anywhere in the GCC and the other tender documents shall mean the ‘sub-contractor’ i.e. the successful tenderer on whom the work under the present tender is awarded by EPI.

5.0 Clause no 3.0 of GCC shall stand amended as below:

The items of work given in the tender documents are for general guidance of the intending tenderers and the works shall be carried out by the successful tenderer i.e. the sub-contractor on item rate basis in conformity with the detailed drawing, technical specifications, additional conditions of the tender documents (including any addition/modification/alteration/deletion made from time to time therein found essential for completion of works). The work shall pertain to Design, Manufacture, Supply, Inspection, Installation, Testing and Commissioning of Panels in Academic Buildings. The sub-contractor shall be deemed to have satisfied himself before tendering as to the sufficiency and correctness of his tender for the works and of the rates and prices quoted in the brief specifications, drawings, scope of work and payment (billing) schedule, which rates and prices shall, except as otherwise provided, cover all obligations under the contract and all matters and things found necessary for proper completion and maintenance of the works. It shall be responsibility of the sub-contractor to incorporate the changes that may be in the scope of work envisaged at the time of tendering and as actually required to be executed. The sub-contractor has quoted his rates after
clearly studying the scope of work given in Tender Documents and getting fully satisfied with the various items and technical intricacies involved in the work under his scope of work as envisaged in the tender. EPI shall not entertain any claim of the contractor on account of error or omission by him in this respect except what is admitted by the client.

6.0 No mobilisation advance shall be paid and hence clause no. 8 shall stand deleted.

7.0 Safety Code:

General
Contractor shall adhere of safe construction practice and guard against hazardous and unsafe working conditions and shall comply with Owner’s safety rules as set forth herein. Prior to start of construction, Contractor will be furnished of Owner’s —Safety Codell for information and guidance, if it has been prepared.

First Aid and Industrial Injuries
(1) Contractor shall maintain first aid facilities for his employee and labours.
(2) Contractor shall make out side agreements for ambulance service and for the treatment of industrial injuries. Names of those providing these services shall be furnished to the Owner prior to start of construction and their telephone numbers shall be prominently posted in Contractor’s field office.
(3) All critical industrial injuries shall be reported promptly to the Owner, and a copy of Contractor’s report covering each personal injury requiring the attention of a physician shall be furnished to the Owner.

General Rules
Smoking within the battery area, tank farm or dock limits is strictly prohibited. Violators of the no smoking rules shall be discharged immediately

Contractors Barricades
(1) Sub-contractor shall erect and maintain barricades required in connection with his operation to guard or protect.
(a) Excavations.
(b) Hoisting areas.
(c) Areas adjudged hazardous Contractor’s or Owner’s inspectors.
(d) Owner’s existing property subject to damage by Contractor’s operations.
(e) Rail road unloading spots.
(2) Sub-contractor’s employees and workmen shall become acquainted with owner’s barricading practices and shall respect the provisions thereof.
(3) Barricades and hazardous areas adjacent to but not located in normal routes of travel shall be marked by red flasher lanterns at nights.

Scaffolding
(i) Suitable scaffolding should be provide for workmen for all works that safety be done from the ground or from solid construction except such short period work
as can be done safely from ladders. When a ladder is used an extra Mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable footholds and handholds shall be provided on the ladder shall be given an inclination not steeper than 1 in 4 (1 horizontal and 4 vertical)

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

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

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

(v) Safe- means of access shall be provided to all working platforms and other working places, every ladder should be securely fixed. No portable single ladder shall be over 9 metres in length while the width between side rails in rung ladder shall in no case be less than 30cms for ladder up to and including 3metres in length. For longer ladder this width should be increased at least 5 mm for each additional foot of length. Uniform steps spacing shall not exceed 30 cms. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the site of work shall be so stacked or placed to cause danger or inconvenience to any person or public. The Contractor shall also provide all necessary fencing and light to protect the workers and staff from accidents, and shall be bound to bear the expenses of defence of every suit, action or other proceedings of law that may be brought by any person for injury sustained owing to neglect of the above precautions and pay any damages and costs which may be awarded in any such suit or action or proceedings to any such person or which may with the consent of the Contractor be paid to compromise any claim by any such person.

Excavation and Trenching
All trenches 1.2 metres or more in depth shall at all times be supplied with at least one ladder for each 50 metres length or fraction thereof.
Ladder shall be extended from bottom of the trench to at least 1 metre above the surface of the ground. The sides of the trenches which are 1.5 metres in depth
shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides to collapse. The excavated materials shall not be placed within 1.5 metres of the edge of the trench or half of the trench width whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done.

Demolition
(i) Before any demolition work is commenced and also during the progress of the work.
(a) All road and open areas adjacent to the work site shall either be closed or suitably protected
(b) No electric cable or apparatus which is liable to be a source of danger shall remain electrically charged.
(c) All practical precautions shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be so over-loaded with debris or materials as to render it unsafe.
(ii) All necessary personal safety equipment as considered adequate by the Engineer-in-charge, should be kept available for the use of the persons employed on the site and maintained in condition suitable for immediate use, and the sub-contractor shall take adequate steps to ensure proper use of equipment by those concerned.
(a) Workers employed on mixing asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective gloves.
(b) Those engaged in white washing and mixing or stacking of cement bags or any materials which are injurious to the eyes shall be provided with protective goggles.
(c) Those engaged in welding and cutting works shall be provided with protective face and eye shields, hand gloves etc.
(d) Stone breakers shall be provided with protective goggles and protective clothing, and seated sufficiently safe intervals.
(e) When workers are employed in sewers and manholes, which are in use, the sub-contractor shall ensure that the manhole covers are opened and are ventilated atleast for an hour before the workers are allowed to gate in to the manholes, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or board to prevent accident to the public.
(f) The sub-contractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 years are employed on the work of lead painting, the following precautions should be taken,
(1) No paint containing lead or lead product shall be used except in the form of paste or ready-made paint.
(2) Suitable face masks should be supplied for use by the workers when Paints are applied in the form of spray or a surface having lead paint dry rubbed and scrapped.
(3) Overalls shall be supplied by the sub-contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash them during and on cessation of work.

(iii) When the work is done near any place where there is a risk of drowning, all necessary safety equipment should be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision should be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

(iv) Use of hoisting machines and tackles including their attachments, anchorage and supports shall conform to the following standards or conditions:-

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

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

(c) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 12 years should be in charge of any hoisting machine including any scaffolding, which or give signals to the operator.

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

(e) In case of departmental machine, the safe working load shall be notified by the Engineer-in-charge. As regards his own machineries, the sub-contractor shall notify the safe working load of the machineries to the Engineer-in-charge whenever he brings any machinery to site of work and get it verified by the Engineers concerned.

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

(vi) All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near places of work.

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

(viii) To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangements made by the Contractor shall be open to inspection by the Welfare Officer, Engineer-in-Charge or safety Engineer of the administration or their representatives.

(ix) Notwithstanding the above clauses there is nothing in these to exempt the contractor from the operations of any other Act or rules in force in the Republic of India. The works throughout including any temporary works shall be carried out in such a manner as not to interfere in any way whatsoever with the traffic on any roads or footpaths at the site or in the vicinity thereto or any exiting works whether the property of the Administration or of a third party. In addition to the above, the sub-contractor shall abide by the safety code provision as per C.P.W.D. Safety Code and Indian standard Safety Code framed from time to time.

8.0 The clause no. 10.0 of GCC shall stand amended as below:
An amount @5% (Five percent) of the gross value of the running bill shall be deducted from each running bill by way of retention money. In case the EMD has been deposited by the sub-contractor in the form of demand draft, the said amount of EMD shall be adjusted first towards the retention money and further recovery of retention money shall commence when the upto date amount of retention money exceeds the amount of EMD deposited in the form of demand draft. The retention money shall become refundable to the sub-contractor at the end of the defects liability period free of any interest provided always that the sub-contractor has rectified all the defects arising during the defect liability period pertaining to his scope of work, EPI did not have to incur any expenditure in setting right the defects, if any, pertaining to the sub-contractor’s scope of work, the sub-contractor has demolished and removed all structures including foundations and withdrawn fully from the worksite and EPI has received the clearance certificate from the concerned Labour Enforcement Officer/RLC pertaining to the labour etc. deployed by him at the worksite or there is nothing on record against him in the local market affecting functions of EPI. In case EPI has been required to make any expenditure on any of these accounts EPI will keep the retention money till the time all these matters are settled in full including recovery of the expenses, if any, made by EPI from the retention money. Further the sub-contractor has to furnish a ‘No Claim’ certificate to EPI in confirmation of his having no claim on getting refunded the retention money to EPI at the time of claiming refund of retention money.

9.0 The following shall stand added to clause no. 11.0 of GCC:
Water: The contractor shall arrange water fit for the purpose of drinking and construction at his own cost. (Boring is permitted at site)
Power: Owner will supply power at a point near the work site at his discretion from where the contractor will make his own arrangement for distribution. All the works of the contractor shall be done as per Indian Electricity Act and Rules framed there under and approved by the Engineer-in-Charge. The temporary lines will be removed forthwith after the completion of the work or if there is any hindrance caused to the other work due to the alignment of these lines, the contractor will re-route or remove the temporary lines at his own cost. The contractor at his own cost will also provide suitable electric meters, uses, switches etc. These shall be in the custody and control of the Owner. The cost of power supply shall be payable to the Owner every month at the prevailing rates from time to time or will be deducted from the running account bills.

Owner, however, does not guarantee uninterrupted power supply and this does not relieve the contractor of his responsibility for the timely completion of various works as stipulated, nor any compensation shall be paid to the contractor or any failure or short supplies of Power. The contractor shall therefore make his own arrangement for standby power supply at his own cost.

10.0 Work in monsoon and dewatering
The completion of the work may entail working in monsoon also. The Contractor must maintain minimum labour force as may be required for the job and plan and execute the construction and erection according to the prescribed schedule. No extra rate will be considered such work in monsoon.
During monsoon and other period, it shall be the responsibility of the Contractor to keep the construction work site free from water at his own cost.

11.0 Work on Sundays and holidays
For carrying out our work on Sundays and holidays, the Contractor will approach the Engineer-in-Charge or his representative at least two days in advance and obtain permission in writing.

12.0 General conditions for construction and erection mark
The working time at the time of work is 48 hours per week. Over time work is permitted in cases of need and the Owner will not compensate the same. Shift working at 2 or 3 shifts per day will become necessary and the sub-contractor should take this aspect in to consideration for formulating his rates for quotation. No extra claims will be entertained by the EPI on this account.

The Sub-Contractor must arrange for the placement of workers in such a way that delayed completion of the work or any part thereof for any reason whatsoever will not effect their proper employment.EPI will not entertain any claim for idle time payment whatsoever

13.0 Setting out works
The Engineer-in-Charge of Owner shall furnish the Contractor with only the four
corners of the work site and a level bench mark and the Contractor shall set out the works and shall provide efficient staff for the purpose and shall be solely responsible for the accuracy of such setting out.

The Contractor shall provide, fix and be responsible for the maintenance of all stakes, templates, level marks, profiles and other similar things and shall take necessary precautions to prevent their removal or disturbance and shall be responsible for the consequence of such removal or disturbance should the same take place and for their efficient and timely reinstatement. The Contractor shall also be responsible for the maintenance of all existing survey marks, boundary marks, distance marks and centre line marks, either existing or supplied and fixed by the sub-contractor. The work shall be set out to the satisfaction of the Owner. The approval thereof or joining with the sub-contractor by the Owner in setting out the work shall not relieve the sub-contractor or any of his responsibilities.

Before beginning the works, the sub-contractor shall at his own cost, provide all necessary reference and level posts, pegs, bamboo, flags, ranging rods, strings and other materials for proper layout of the work in accordance with the scheme for bearing marks acceptable to the Owner. The Centre, longitudinal or face lines and cross lines shall be marked by means of small masonry pillars. Each pillar shall have distinct marks at the centre to enable a theodolite to be set over it. No work shall be started until all these points are checked and approved by the Engineer-in-Charge in writing but such approval shall not relieve the sub-contractor of any of his responsibility. The Contractor shall also provide all labour, material and other facilities, as necessary, for the proper checking of layout and inspection of the points during construction.

Pillars bearing geodetic marks located at the sites of units of works under construction should be protected and fenced by the sub-contractor.

On completion of works, the sub-contractor must submit the geodetic documents according to which the work was carried out.

14.0 Responsibility for level and alignment

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

It is highly possible that there shall be more than one agency working at the same time at the site. The sub-contractor shall at all times remain bound to co-ordinate with the agencies, deployed by EPI for the above works, including providing free access and making required provisions for them in execution of works pertaining to their portion of works. He shall also remain bound to ensure uninterrupted progress of work by these agencies in a peaceful and smooth manner. He shall also remain bound to make the required changes/additions/alterations in the works done by him to accommodate the items under the scope of work of such other
agencies deployed by EPI or the client. The sub-contractor is deemed to have made the estimated allowances in this respect while quoting his rates at the tendering stage.

All the drawings provided at the tendering stage are for general guidance only and the works shall be carried out as per the drawings and instructions issued by the Owner from time-to-time. EPI shall not entertain any claim of the sub-contractor on account of any omission or any error by him on this account.

Further even though EPI shall take all care to attach all the drawings as issued by the client it shall be the responsibility of the sub-contractor to interpret the drawings for completion of the works under this contract. EPI shall not give any design or bill of quantities except what are being provided with the tender documents. EPI shall not entertain any claim of the sub-contractor on account of any omission or any error by him on this account.

The list of minimum tools, plant and machinery to be provided by the sub-contractor within the period mentioned against the respective item is given at Annexure-A.

15.0 The following shall stand added to the clause no 13 and 14 of GCC:

The amount paid by EPI or recoveries effected from EPI's bills on account of taxes and duties including labour cess and royalty by client proportionate to the sub-contractor's portion of works shall be recovered from the amount due to him by way of reduction in payable amount and in such cases no certificate in this regard shall be issued by EPI.

Further the rates quoted by the contractor/sub-contractor shall be deemed to be include all taxes and duties except GST which shall be reimbursed to him subject to raising of tax invoice and filing of return and payment of tax as per GST law, failing which EPI shall no be able to honour his claims for any payment. The contractor/sub-contractor has quoted his rates knowing fully well that submission of return and display of the same on GSTN portal is mandatory.

16.0 The clause no 9.0 of GCC of EPI shall stand amended as under:

"Within 10 (ten) days from the date of issue of letter of Intent or within such extended time as may be granted by EPI in writing, the Contractor shall submit to EPI a Security Deposit cum Performance Bank Guarantee in the form appended, from any Nationalised bank / Scheduled Bank equivalent to 5% (five percent only) of the Contract Value for the due and proper execution of the contract. This bank guarantee shall remain valid up to 90 (ninety) days after completion of works.

In case the Contractor fails to submit the Security Deposit cum Performance Guarantee of the requisite amount within the stipulated period or extended period, letter of intent will stand withdrawn and EMD of Contractor shall be forfeited.

17.0 Clause no. 76.0 of GCC shall stand amended as below:
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 thereunder and for the time being in force shall apply to the arbitration proceedings and Arbitrator shall publish his Award accordingly.

17.2 Clause no.76.2 ARBITRATION BETWEEN CENTRAL PUBLIC SECTOR ENTERPRISES INTER SE / GOVERNMENT OF INDIA DEPARTMENTS / MINISTRIES

i) In the event of any dispute or difference relating to the interpretation and application of the provisions of the contract, such dispute or difference shall be referred by either party to the arbitration as per the instructions (Office Memorandum / Circulars) issued by Govt. of India from time to time with regard to arbitration between one Government Department and another one Government Department and a Public Sector Enterprise and Public Sector Enterprise inter se.

ii) Subject to any amendment that may be carried out by the Government of India from time to time, the procedure to be followed in the arbitration shall be as is contained in D.O. No. F.No.4(1)/2013-DPE (PMA)/FTS-1835 dated 11.04.2017 of Department of Public Enterprises, Ministry of Heavy Industries and Public Enterprises, Govt. of India or any modification issued in this regard.

18.0 The clause nos. 17.0, 18.0& 19.0 of GCC of EPI shall stand amended as under:

Insurance charges for insurances to be taken by EPI for the project like Contractor’s All Risk Policy, Erection All Risk Policy including transit and third
party liability shall be borne by the sub-contractor in proportion to his contract price. However, the sub-contractor shall take insurance cover at its own cost towards Workman Compensation Act for its own workers and employees engaged by it for the works under the present tender/sub-contract within 10 days of issuance of Letter of Intent by EPI and shall furnish documentary proof of the same to EPI. In case the sub-contractor fails to do so, EPI shall be at liberty to withhold all payments to the sub-contractor till the submission of such documentary evidence or take the required insurance policy under the Workman Compensation Act and recover the cost of the insurance premium(s) paid in this respect by EPI to the insurance company from the sub-contractor’s bill(s). Notwithstanding payment of such insurance premiums and the resulting recovery thereto the sub-contractor shall remain bound to assist EPI in follow up with the insurance company in case of any claim related to the sub-contractor’s scope of work. EPI is not liable to pay any claim of the sub-contractor if it is not paid by insurance company due to any reasons whatsoever. The insurance company providing such insurance cover must be approved by IRDA.

Employee State Insurance Act

The sub-contractor agrees to and does hereby accept full and exclusive liability for compliance with all obligations imposed by the Employees State Insurance Act, 1984, and the sub-contractor further agrees to defend, indemnify and hold Owner harmless from any liability or penalty which may be imposed by the Central, State or Local authority by reason of any asserted, violation by sub-Contractor of the Employees State Insurance Act, 1948, and also from all claims, suits or proceeding that may be brought against the Owner arising under, growing out of or by reasons of the work provided for by this contract whether brought by employees of the sub-contractor, by third parties or by Central or State Government authority or any political sub-division thereof.

The sub-contractor agrees to fill in with the Employee’s State Insurance Corporation, the Declaration Forms, and all forms which may be required in respect of the sub-contractors’ employees, whose aggregate remuneration is such amount as prescribed under the Employees State Insurance Act, 1948 from time to time and who are employed in the work provided for or those covered by ESI from time to time under the Agreement. The sub-contractor shall deduct and secure to deduct the employee's contribution as per the first schedule of the Employee’s State Insurance Act from wages and affix the Employee’s contribution Cards at wages payment intervals. The sub-contractor shall remit and secure the to remit to the State Bank of India, Employee’s State Insurance Corporation Account, the Employees contribution as required by the Act. The sub-contractor agrees to maintain all cards and records as required under the Act in respect of employees and payments. Any expenses incurred for the contributions, making contributions or maintaining records shall be to the sub-contractor’s account.
The Owner shall retain such sum as may be necessary from the total contract value until the sub-contractor shall furnish satisfactory proof that all contributions as required by the Employees State Insurance Act, 1948, have been paid.

19.0 The following shall stand added to the clause no 20 of GCC:
The sub-contractor shall keep EPI indemnified against all claims, damages, compensation and expenses payable, if any, in consequence of any accident, or injury sustained by any workman or any other person employed by the sub-contractor.

20.0 The following shall stand added to Clause no 21.0 and 23.0 including their sub-clauses of the GCC:
Notwithstanding the fact that EPI may have obtained or may be in the process of obtaining a valid license under the Contract labour (Regulation and Abolition) Act 1970 and Contract Labour Act (R & A) Central Rules 1971 and amended from time to time and registration under Building and other Construction Works (Regulation of Employment and Conditions of Service) Act 1996 and Building and Other Construction Workers' Welfare Cess Act 1996 from the relevant office of the RLC and continues to have them until the completion of work including the maintenance and defect liability period, the sub-contractor shall at all times remain bound to comply with and observe the provisions of the all laws and regulations pertaining to the deployment of contract labour. He shall also extend all assistance to EPI during inspection of the officials of such law enforcing agencies including the rectification of defects/ observations (if any) made/pointed out during the visit(s) of the officials of the said ALC/RLC under jurisdiction of whom the work site shall be covered.

21.0 The following shall stand added to the clause no 27.0 including its sub-clauses of GCC of EPI:
The sub-contractor, within 10 days of issuance of LOI (Letter of Intent) to him shall depute at least one graduate electrical engineer with 10 years of post-qualification experience or two persons having diploma in electrical engineering with 15 years of post-qualification experience and adequate number of supervisors.

22.0 The clause no 28.3 of the GCC stands modified as under:
The sub-contractor shall bear the cost of construction or maintenance of the facilities as mentioned under this clause proportionate to his value of the works/sub-contract awarded to him provided, however, that the cost of construction of the office shall not exceed Rs. 2,000/- (Rupees Two Thousand only) and amount not exceeding Rs. 1,000/- per month till completion of work for maintenance of facilities i.e. stationary, letter head, visiting card, one post paid mobile connection, internet connection. Further the sub-contractor has to bear the proportionate cost of the Project sign board (type and format given at Annexure-3).
23.0 The following shall stand added to the clause no 31.0 of the GCC:
   The sub-contractor shall take a suitable policy in compliance with the Workmen’s Compensation Act 1923 within 10 days of issuance of LOI and keep it valid till completion of works or till the time he is required to keep his workmen at the worksite whichever is later and produce a copy of the receipts of the premium paid by him in this regards as and when asked by EPI.

24.0 No secured advance shall be paid to the sub-contractor and hence clause no. 35.0 of GCC shall stand deleted.

25.0 The following shall be added to the clause no 36.0 of the GCC:
   The measurement of the works as certified/recorded by the client for the portion of works executed by the sub-contractor shall be final and binding on the sub-contractor. The contractor shall remain liable to provide all assistance at the time of recording the measurements by the client.

26.0 Payments: The clause no 37.0 of the GCC stands modified as under:
   Payments as and when received by EPI from the Client for the sub-contractor’s portion of work shall be released to him within seven working days of its receipt by EPI and after making the recoveries towards facilities mentioned at clause 22.0 hereinabove and other recoveries.
   All running payments shall be regarded as ‘on account’ payments only and not as payments for work actually done and completed and/or accepted by EPI or Owner and shall not preclude the recovery for bad, unsound work and imperfect or unskilled work to be removed and taken away and reconstructed or re-erected or to be considered as an admission of the due performance under the agreement or the accruing of any claim nor shall it conclude, determine or affect in anyway the powers of EPI under these conditions or any of them as to the final settlement and adjustments of the accounts or otherwise or in any other way vary/affect the contract.
   The final bill payment to the sub-contractor shall be released only after receipt of corresponding payment from client and when the sub-contractor submits all other clearances, approvals, certificates etc. as per agreement of EPI with the client for the “Works” and as per statutory requirement.
   The sub-contractor shall have no claim on EPI in case the payments are delayed by the client due to any reason whatsoever.

27.0 The clause no. 43.2 shall stand amended as below:
   The sub-contractor shall execute the works so as to complete the works within the stipulated completion time and submit a programme showing deployment of resources for completion of the works within the said completion time including achievement of the milestones.
28.0 The following shall be added to clause no 52.6 of GCC:

The field testing laboratory to be established by the sub-contractor at his cost shall be equipped with the minimum number of testing equipment as per annexure-B

29.0 The following provisions shall supersede that of clause no 69 of GCC wherever applicable:

No claim on account of extra / substituted / variation of items etc. pertaining to the sub-contractor’s portion of work save and except what is admitted and paid by Client, shall be entertained or admitted by EPI. Any claim by the sub-contractor, if not paid by the Client, whatsoever be the reason shall not be admitted by EPI. The amount, if at all admitted and paid by the Client for the sub-contractor’s portion of work, shall be paid to him after making a provision of 10% (ten percent) towards EPI’s overhead and administrative charges. The provision of this clause shall equally apply to the decrease in the rate of item by the owner. EPI’s decision in this respect shall be final and binding on the sub-contractor. But under no circumstances sub-contractor shall suspend the work on the non-settlement of rates under this clause.

Further the quantity given in the Price Bid/ Bill of Quantity can vary individually or collectively up to ± 20% of the contract price without any change in the rates.

30.0 Recovery for delay in completion:

In case the project execution is delayed beyond the contractual scheduled completion period due to reason attributable to the sub-contractor, the staff and site office expenses of EPI for extended period shall be paid by him to EPI at the rate of Rs. 10,000/- per month. This shall be in addition to the facilities provided by the sub-contractor to EPI and the other recoveries, if applicable as per clause no 72 (including its sub clauses) of GCC and Penalties etc. if any, levied by Client for the works pertaining to the sub-contractor’s scope of work. The decision of EPI in this regard shall be final & binding on the party.

31.0 Responsibility of materials

The sub-contractor shall be responsible for obtaining all approvals from Client with regard to quality of materials & workmanship and measurements etc. for their portion of work. All such approvals shall be in the name and title of EPI. The sub-contractor shall be responsible for reconciliation of issued material with Client/EPI, if any, and the sub-contractor shall make arrangements for safe up keeping / custody of the material and final reconciliation is also to be done by the sub-contractor. In case there is any shortfall of any issued items during reconciliation, recovery at double the cost of materials prevailing at that time of recovery shall be made from the sub-contractor’s due payment.
32.0 Dealing with Owner etc
The sub-contractor will not deal directly with Client and all the correspondence in matters regarding bills, claims, interpretation of the specifications, conditions and all matters related to the contract with Client, Client’s Consultants, all other agencies including Government and Statutory bodies etc. shall be done through EPI only. The sub-contractor shall prepare and submit expeditiously all bills, claims, details, clarifications, documents, information, etc. as required by EPI/Client for proper execution and successful completion of the “Works”.

33.0 Interpretation
Issues related to interpretation and claims, if any, related to the sub-contractor’s scope of work, arising out of contract between EPI and Client shall be referred with full justification by the sub-contractor to EPI for settlement with Client including arbitration with Client, if inescapable, and outcome of such a settlement shall be binding on the sub-contractor. EPI at its option may associate the sub-contractor in the above process of settlement for his portion of work. The cost & expenses on arbitration with Client shall be shared by EPI and the sub-contractor in proportion of his offer and EPI's mark up towards its overheads & profits. In case the award/settlement with the Client is in favour of EPI, ninety percent of the award/settlement amount shall be shared between EPI and sub-contractor in proportion of sub-contractor’s contract price with EPI and EPI’s mark up towards its overheads & profits. The balance ten percent of the award/settlement amount shall be retained by EPI towards its administrative charges. In case the award/settlement is against EPI, the entire damages/counterclaims imposed, if any, shall be borne by the sub-contractor alone and the sub-contractor shall have no claim whatsoever against, EPI in such a settlement. Further, EPI shall have no liability towards any claim of the sub-contractor, which is not paid by the Client.

34.0 No claim for non-approval
In case of non-approval of sub-contractor’s association for the Project by the Client and/or by the corporate office of EPI due to any reasons whatsoever at any stage of the “Works”, the sub-contractor shall have no claim on EPI.

35.0 Inspection and responsibility
The work executed by the sub-contractor shall be subject to audit and quality control checks from Quality Control Division & Technical Audit of EPI, Client, and Inspecting Agency of the Client and Chief Technical Examiner of Central Vigilance Commission, Govt. of India. In the eventuality of any defect/substandard works as brought out in the report or noticed otherwise at any time during execution, maintenance period etc., the same shall be made good by the sub-contractor without any cost to EPI. In case the sub-contractor fails to rectify the defect/substandard work within the time period stipulated by EPI, EPI shall get it rectified at
the risk and cost of the sub-contractor and shall recover the amount from the dues of the sub-contractor.

36.0 Actions for false information
EPI has agreed to associate the sub-contractor on the basis of details regarding his experience profile, financial standing, credentials, fulfilment of statutory obligations, etc. by him to EPI. In case, at a later stage if it is found that the sub-contractor has submitted incorrect, false details and credentials resulting in apprehensions on the capabilities of the sub-contractor with regard to quality & timely completion of works, financial capabilities etc, EPI can terminate this order solely at its option. In this eventuality the sub-contractor shall be liable for the losses suffered by EPI and further the sub-contractor shall have no claim on EPI, whatsoever.

37.0 Non-applicability of concessions or exemptions
However, if EPI is granted some concession or exempted from certain obligations by Client, by virtue of EPI being a Public Sector Company, the same concessions / exemptions shall not be applicable to the sub-contractor. The decision of EPI in this regard including interpretation of terms & conditions shall be final & binding on the sub-contractor.

(Signature and seal of the Tenderer)
## LIST OF MINIMUM TOOLS, PLANT AND MACHINERY

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>Description</th>
<th>Minimum numbers required</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Portable Grinder (Electric)</td>
<td>Two nos.</td>
<td>As and when instructed</td>
</tr>
<tr>
<td>2.</td>
<td>Portable Welding Machine</td>
<td>Two nos.</td>
<td>-do-</td>
</tr>
<tr>
<td>3.</td>
<td>DG Set 5 KVA (Minimum)</td>
<td>One no</td>
<td>15 days</td>
</tr>
<tr>
<td>4.</td>
<td>Portable Gas Cutting Sets with hoses and regulator</td>
<td>Two nos.</td>
<td>As and when instructed</td>
</tr>
<tr>
<td>5.</td>
<td>Pipe Threading Machine</td>
<td>Two nos.</td>
<td>-do-</td>
</tr>
<tr>
<td>6.</td>
<td>Pipe Bending Machine (Hydraulic)</td>
<td>One no</td>
<td>-do-</td>
</tr>
<tr>
<td>7.</td>
<td>Portable Drilling Machine suitable for drilling of different sizes</td>
<td>Two nos.</td>
<td>-do-</td>
</tr>
<tr>
<td>8.</td>
<td>Power Hacksaw</td>
<td>One no</td>
<td>-do-</td>
</tr>
<tr>
<td>9.</td>
<td>Hydraulic Crimping Machine</td>
<td>One no</td>
<td>-do-</td>
</tr>
<tr>
<td>10.</td>
<td>Hand Crimping Tools</td>
<td>Two nos.</td>
<td>-do-</td>
</tr>
<tr>
<td>11.</td>
<td>Portable Electric Blowers</td>
<td>Two nos.</td>
<td>-do-</td>
</tr>
<tr>
<td>12.</td>
<td>Portable Vacuum Cleaners</td>
<td>Two nos.</td>
<td>-do-</td>
</tr>
<tr>
<td>13.</td>
<td>Miscellaneous items such as slings, pulleys, tarpaulins, wooden sleepers, ladders etc</td>
<td>Assorted</td>
<td>-do-</td>
</tr>
<tr>
<td>14.</td>
<td>Tool kit for electricians</td>
<td>Two sets</td>
<td>25 days</td>
</tr>
<tr>
<td>15.</td>
<td>D-spanners, Ring spanners, allen keys etc of assorted size</td>
<td>As required</td>
<td>-do-</td>
</tr>
<tr>
<td>16.</td>
<td>Cutting, twisting and combination pliers</td>
<td>Three nos.</td>
<td>10 days</td>
</tr>
<tr>
<td>17.</td>
<td>Screw drivers-both star headed and plain headed of different sizes</td>
<td>Two sets</td>
<td>As and when instructed</td>
</tr>
<tr>
<td>18.</td>
<td>Dewatering pump sets (diesel engine driven)</td>
<td>-do-</td>
<td>-do-</td>
</tr>
</tbody>
</table>

**Note:**

(a) The period mentioned above shall be reckoned from the date of start of commencement of work as mentioned under this tender.

(b) The quantities and list of equipments indicated are tentative and can be increased/amended 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 contract documents.

(c) The sub-contractor will not be allowed to take out equipments from the site without the written permission of Engineer-in-Charge.

(Signature and seal of the Tenderer)
### ANNEXURE-B

**LIST OF MINIMUM TESTING EQUIPMENT**

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>Description</th>
<th>Minimum numbers required</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Insulation tester 0-500-1000 V hand driven</td>
<td>One no</td>
<td>10 days</td>
</tr>
<tr>
<td>2</td>
<td>Insulation tester 2500/5000 V motor driven</td>
<td>One no</td>
<td>10 days</td>
</tr>
<tr>
<td>3</td>
<td>Phase sequence indicator</td>
<td>One no</td>
<td>20 days</td>
</tr>
<tr>
<td>4</td>
<td>Earth megger</td>
<td>One set</td>
<td>10 days</td>
</tr>
<tr>
<td>5</td>
<td>Single phase variac</td>
<td>One set</td>
<td>15 days</td>
</tr>
<tr>
<td>6</td>
<td>3 Phase Variac</td>
<td>One no</td>
<td>20 days</td>
</tr>
<tr>
<td>7</td>
<td>AVO-meter/multimeter</td>
<td>One no</td>
<td>10 days</td>
</tr>
<tr>
<td>8</td>
<td>Portable ammeter, wattmeter, voltmeter, PF meter</td>
<td>One set</td>
<td>7 days</td>
</tr>
<tr>
<td>9</td>
<td>LUX METER</td>
<td>One set</td>
<td>30 days</td>
</tr>
<tr>
<td>10</td>
<td>Clip on meters of different ranges</td>
<td>18 nos.</td>
<td>10 days</td>
</tr>
<tr>
<td>11</td>
<td>Tachometer</td>
<td>One set</td>
<td>15 days</td>
</tr>
<tr>
<td>12</td>
<td>Kelvin’s double bridge</td>
<td>-do-</td>
<td>As and when instructed</td>
</tr>
<tr>
<td>13</td>
<td>DC high pot test kit</td>
<td>-do-</td>
<td>-do-</td>
</tr>
<tr>
<td>14</td>
<td>Electrical weighing scale (upto 2 kg)</td>
<td>-do-</td>
<td>-do-</td>
</tr>
</tbody>
</table>

**Note:**

a) The period mentioned above shall be reckoned from the date of start of commencement of work as mentioned under this tender.

b) The quantities of equipment 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 contract documents.

c) The sub-contractor will not be allowed to take out equipment from the site without the written permission of Engineer-in-Charge.

(Signature and seal of the Tenderer)
TECHNICAL SPECIFICATION: ELECTRICAL WORKS

The intent of this chapter of the specification is to define the general technical requirements of electrical works.

1.0 STANDARDS
The work shall be carried out in conformity with this specification, the relevant specifications / code of practice of the Bureau of Indian Standards approved, drawings and instructions of the Engineer-in-Charge or his authorized representative issued from time to time. In addition to the above, all works shall conform to the requirements of the following:

a) Indian Electricity Act and Rules.
b) Regulations laid down by Chief Electrical Inspector of the state, power supply authority.
c) Relevant Indian Standards and National Electrical Code.
d) Any other regulation laid down by the local authorities.

Specification of items / works including definition of terms, measurement, classification etc. not covered in this specification shall be governed by the latest General Specification for Electrical works of CPWD.

2.0 EQUIPMENT SPECIFICATIONS
All materials, fittings, applications, accessories to be supplied by the Contractor shall be of best quality and shall conform to the specification given hereunder. The equipment shall be manufactured in accordance with the current Indian Standards Specification. Samples of all materials before being used shall be procured by the Contractor to the Engineer-in-Charge or his authorized representatives. The material shall be used / installed only after approval by the Engineer-in-Charge.

2.1 Switches
All switches for wiring shall be manufactured in accordance with IS:3854 and shall be piano type unless otherwise specified.

2.2 Receptacles
Only three pin-type receptacles manufactured in accordance with IS:1293 shall be used with third terminal connected to the earth. All receptacles shall be provided with a switch mounted on the same enclosure. Receptacles shall be of flush mounting type except for the rating above 15/16 amps unless otherwise specified.

2.3 Outlet / Switchboard boxes
Outlet boxes for socket, switches fixtures and regulators etc. shall be of minimum 18 gauge (for size up to 20 cm x 30 cm) and 16 gauge (for size above 20 cm x 30 cm) or specified in the schedule of items. Junction / outlet boxes shall be used in roof slab where concealed wiring has been adopted. The junction / outlet / switch boxes shall be painted with anticorrosive paint before installation. Cover plates shall be of Formica or approved equivalent with colour to suit the wall. Cover plates shall be fixed by cadmium plated brass screw and suitable c.p. brass cup washers. An earth terminal with stud and washers shall be provided in each MS box for termination of protective earth conductors.

2.4 Conduit and Fittings
Conduits shall be of metallic or non-metallic type as specified:

a) All rigid metallic conduit pipes shall be of steel and be ISI marked. The minimum wall thickness shall be 1.6 mm (16 SWG) upto 32 mm dia and 2 mm (14 SWG) above 32 mm dia. The conduit
shall be solid drawn or reamed by welding and finished with galvanised or stove enameled surface.
b) All non-metallic conduit pipes and accessories shall be of suitable material complying with IS:2509-1973 and IS:3419-1976 for rigid conduits and IS:6946-1973 for flexible conduits. The interior of the conduits shall be smooth and free from obstructions. The rigid pipes shall be ISI marked. The minimum wall thickness of the rigid non-metallic conduits shall be 1.6 mm upto 25 mm dia conduit.
c) No conduit less than 20 mm in diameter shall be used.
d) All metallic conduit accessories shall be only threaded type, pin grip or clamp type accessories are not acceptable.
e) Accessories for non-metallic rigid type of conduits shall be normally of grip type.

2.5 Casing and Capping
a) Casing and capping shall be of good quality PVC, free from defects like deformations, unevenness, blisters, cavities, etc.
b) The casing shall be of square or rectangular body with top of the side walls suitable for tightly fitting slide-in type capping with double grooving. All surfaces shall have smooth finish inside and outside.

2.6 Wires and Cables
a) Wiring cables
   - Wires shall be PVC insulated 1100 V grade as per IS:1554.
   - Conductors shall be of stranded copper.
   - The smallest size of conductor for lighting circuits shall have a nominal cross-sectional area of not less than 1.5 sq.mm, while minimum size of power wiring shall be 2.5 sq.mm.
   - All wires shall be ISI marked.
b) Flexible cable
   - Flexible cables shall be PVC insulated having a minimum size of 14/0.0193 mm.
   - All flexible wires shall be mechanically protected by tough rubber or PVC sheath.
c) Underground cables
   Power cables: Power cables for use in 415 V system shall be of 1100 V grade, aluminium stranded conductor, PVC insulated, PVC sheathed single wire armoured and overall PVC sheathed. All power cables for 11 kV and 33 kV shall be aluminium conductor, XLPE insulated, screened, PVC bedded galvanized steel flat armoured (non-magnetic material in case of single core cable) and PVC sheathed cable. All 415 V cables shall conform to IS:1554 and HT cables shall conform to IS:7098. Unarmoured cables will be used only where specified.
   Control cables: Control of cables shall be 1100 V grade, 2.5 sq.mm copper conductor, PVC insulated, PVC sheathed, single wire armoured with overall PVC sheathed as per IS:1554.
d) Communication cables
   Communication cables shall comprise 1 pair unarmoured, 2-pair, 5-pair and multi-pair armoured cable of size as specified in the schedule. Minimum conductor size shall be 0.5 mm dia for telephone system and 0.71 for other communication system.

2.7 Switchgear and Control Gear
a) General
   - All items of switchgears and distribution boards shall be metal clad type except those forming part of cubicle type switch boards.
   - The types, ratings and make of the switchgear and protective gear shall be as specified in this specification and the schedule of works.
RCCBs (ELCBs) shall conform to the ratings specified in the schedule of works.
- Each distribution boards shall have one independent and separate terminal block each for the neutral and the earth conductors.
- Each distribution boards shall be provided with earthing terminals for body earthing – one for single phase and two for three-phase.
- All DBs (single phase or three phases) shall be of 4, 6, 8 or 12 ways as specified. Number of ways as stated above, in case of three phase DB shall mean ways per phase.
- Bus-bars used shall be of electrolyte copper of appropriate size.

b) MCB Type Distribution Board (MCBDB)
- MCB type distribution boards shall be either single phase or 3-phase type horizontal or vertical, depending upon whether outgoing circuits are single phase or 3 phased /1 phase.
- All MCBDBs shall have provision for accommodating MCB type isolators and RCCB (ELCB) at incoming in single pole or multiple configurations.
- All MCBDBs unless specifically mentioned and/or having different circuit configuration than the standard manufacturing range shall be factory fabricated and completely pre-wired and ready for installation at site.
- MCBDBs shall be fabricated out of 1.6 mm thick sheet steel with stove enameled paint finish and shall be wall mounted type if not specified otherwise.
- The boards shall have adequate provision for entry of incoming and outgoing cables / wires through knockout holes with or without detachable plates.

c) Medium Voltage Switchboard
Medium voltage switchboards or MV switchgear panels shall be as per the schedule of items and as per the following specific requirements in addition to the general requirements as per the latest editions of applicable Indian Standards.
The switchboard shall be free-standing, metal enclosed, compartmentalized, modular type, dust and vermin proof suitable for indoor installation. Switchgear enclosure shall provide degree of protection not less than IP-31 as per IS:2147. The switchgear shall be assembled out of vertical panels of uniform height not exceeding 2450 mm. The maximum height of the operating handle / switches shall not exceed 1800 mm and minimum height not below 300 mm.
The switchgear shall be designed to ensure maximum safety during operation, inspection, connection of cables, relocation of outgoing circuits and maintenance with the energized bus-bar system and without taking any special precautions. The switchgear shall permit maximum interchangeability and shall be extensible on either side.
The switchboard shall be sheet steel clad with the frame fabricated out of 14 SWG cold rolled sheet steel and doors / covers out of 15 SWG cold rolled sheet steel; having integral base frame for each vertical panel. All hardware shall be corrosion resistant. All joints and connections of the panel members shall be made of galvanized, zinc passivated or cadmium plated high quality steel bolts, nuts and washers, secured against loosening. The switchgear shall be suitable for bottom cable entry. Provision for incoming connection through busduct shall be made as per requirement of the specification and schedule of rates. Individual circuit breakers, switch fuse units, MCCBs, bus-bars, cable termination compartment shall be housed in separate enclosed compartments separated from each other by metallic barriers. Circuit breaker panel shall be in single front execution only. Not more than two breaker cubicles shall be housed in single vertical panel except for the incomer and bus-coupler, which shall each be housed in independent vertical panels. Motor starters, switch fuse units, MCCBs shall be in suitable arrangement in single or double front as specified in the schedule of items. All auxiliary devices for control, indications, measurement and protection such as push-button, control and selector switches, indicating lamp, metering instruments protective relays except bimetallic relays shall be mounted on the front side of the respective compartment. Components requiring frequent inspection during operation shall be
easily accessible. Main bus-bars shall be of high conductivity aluminium or electrolytic copper as specified having uniform current rating throughout their length. Horizontal and vertical bus-bars shall be sized depending upon the maximum expected current and to limit the maximum operating temperature at specified design ambient temperature to 85°C for normal operating condition and to 200°C for short-circuit condition considering installation in a poorly ventilated area. Adequately sized auxiliary copper / aluminium bus-bars running horizontally in a separate enclosure shall be provided for space heaters, control supply and metering requirements. Necessary tee-off connections shall be used for distributing auxiliary supply to each vertical panel. All bus-bars shall be colour coded and designed to withstand specified short circuit currents for one second. Aluminium earth bus with 300 sq.mm minimum size or equivalent copper bus shall be provided throughout the length of the switchboard with provision for interconnecting to earth grid. All non-current carrying metallic parts of the mounted equipment shall be earthed. Door and movable parts shall be earthed using flexible copper connections. Inside the switchboards the wiring for power, control, signaling protection and instrument circuits shall be done with PVC insulated copper, conductors having 660 / 1100 V grade insulation. Minimum size of the control wire shall be 1.5 sq.mm copper for circuits having fuse rating 10 Amps or less. For control circuit with higher fuse rating min 2.5 sq.mm copper conductor shall be used. —Elmex‖ type terminals shall be acceptable for wiring upto 10 sq.mm size and for conductors larger than 10 mm², bolt type terminals with crimping lugs shall be provided. Each wire shall be terminated at a separate terminal. A minimum of 10% spare terminal shall be provided for all CT terminals. For modules rated above 100 amps., preferably copper strip connection shall be used. The air circuit breakers shall be fully draw-out type, Circuit breaker panel shall have three distinct positions : viz – ‘service’, ‘test’, ‘full out’ position complete with necessary safety interlocks, scraping, earth connection, shutters, safety barriers and suitable guides for easy movement of the trolley. Access to the cables shall be from the rear side after opening the door of the separate cabling compartment. Circuit breakers shall be trip free type having anti-pumping features and electrically operated mechanism suitable for control supply specified in the schedule of items / specification. Circuit breaker trip coils shall be rated for satisfactory operation with 50% to 110% of rated voltage and the closing coil shall be rated for 85% to 110% of the rated voltage. All switch fuse units shall be load break, heavy duty, air break type (double break) with the operating handle mounted on compartment door, complete with necessary interlocking mechanism. All fuses shall be non-deteriorating HRC cartridge, pressure fitting link type. All relays shall be back connected, draw-out type suitable for flush mounting and fitting with dust tight covers along with hand reset type built in flag indication. Current transformers for metering shall have an accuracy class 1.0 and instrument safety factor less than 5. Protective current transformers shall have an accuracy class 5 P and accuracy limit factor greater than 10. All indicating instruments shall be flush mounting type and of 96 x 96 mm square pattern, except the digital instruments. Digital instruments if required shall be as per schedule of items / specific technical specifications. All control / selector switches shall be rotary back connected type having a cam operated contact mechanism. 2.8 Miniature Circuit Breaker a) Miniature circuit breakers shall be of approved make and rating as specified. b) Ll series MCBs shall be used only for normal lighting circuits. c) G11 series MCBs shall be used for all motor loads, air conditioners, halogen and other discharge lamps and all power circuits.
2.9 Moulded Case Circuit Breaker
a) Moulded case circuit breakers shall be of approved make. Adjustable type MCCBs shall be used unless otherwise specified in the schedule of items / specific technical specification.
b) Current rating and the short circuit rating of the MCCBs shall be as per schedule of items.

2.10 Medium Voltage Bus-duct
a) Enclosure
The enclosure of the medium voltage bus-duct shall be of 14 SWG sheet steel with removable cover in one side and shall be totally enclosed, dust and vermin proof. The cover shall be fitted with dust preventing gaskets, secured with sufficient number of cadmium plated iron screws to ensure that the cover is dust tight. Suitable openings shall be provided for cable / conduit entries as required.

The enclosure shall be painted with one coat of primer paint after cleaning the surface and after dressing and degreasing. Two coats of finish paint shall thereafter be applied by spray painting process. This shall be done in the works before bringing the materials to site.

b) Bus-bars and Supports
Bus-bars shall be made of electric grade copper conforming to relevant Indian Standards and shall be supported on robust non-hygroscopic insulators at regular intervals to withstand the specified short circuit current. Bus-bars shall be suitably insulated with PVC sleeves / tapes. An aluminium / copper earth bus of suitable size to be specified shall be run along the bus-duct having necessary provision for connection to the earthing network.

3.0 Building Wiring System
Wiring system to be adopted shall be as specified under specified technical requirements and shall conform to the general requirements as specified hereunder.

3.1 Conduit Wiring System
A. General
a) Surface or concealed conduit wiring system with ERW or GI or polyethene conduit as specified shall be adopted.
b) Conduit work whether surface or concealed shall be completed before the cables are drawn in.
c) Conduit pipes shall be jointed by means of screwed couplers and screwed accessories (in case of metallic conduits) only. In case of non-metallic conduits joints shall be properly sealed.
d) All bends in the wiring system shall be done either by bending the pipes neatly without any crack or by inserting suitable accessories like bends, elbows or similar fittings. Radius of bends in conduit pipes shall not be less than 7.5 cm.
e) All metallic parts of conduits and accessories in recessed wiring system shall be painted with anticorrosive paint before their installation.
f) In all conduit wiring system, a protective earth conductor as specified shall be drawn inside the conduit to provide for earthing of non-current carrying metallic parts of the installation. Earth wires shall be terminated in the switch boxes and / or the earth terminal blocks at the DBs. In case, the earth wire specified is of large size which may not be possible to be carried inside the conduits may also be laid external to the conduit subject to approval of the Engineer-in-Charge. In case of the metallic conduits entire conduit system shall be electrically and mechanically continuous.
g) Maximum number of PVC insulated 650 / 1100 V grade cables that can be drawn in one conduit is given size wise in Table-1, which shall not be exceeded. Conduit sizes shall be selected accordingly.
h) When crossing through expansion joints in buildings, the conduit sections across the joint may be through flexible conduits of the same size as the rigid conduit.

B. Additional Requirements for Surface Conduit Wiring System
a) Conduit pipes shall be fixed by heavy gauge non-metallic saddles in case of non-metallic conduits and 24 gauge (up to 25 mm dia) / 20 gauge (for larger dia) steel saddles in case of metallic conduit system.
b) Saddles shall be fixed at an interval not more than 60 cm in case of non-metallic conduits and not more than 1 m in case of metallic conduit. However, on either side of the couplers or bends or similar fittings, saddles shall be fixed at a distance of 30 cm (for metallic conduit) / 15 cm (for non-metallic conduit) from the surface of such fittings.
c) Where conduits are required to be laid along the trusses / joist etc., the same shall be secured by means of saddles / girder clips etc. as per instruction /approval of the Engineer-in-Charge.
d) In all the cases when conduits are laid in masonry / concrete work, saddles shall be properly secured by inserting polyethylene plugs approved by the Engineer-in-Charge.

C. Additional Requirements for Recessed Conduit Wiring System
a) Fixing of Conduits in RCC works.
  i) The conduit pipes shall be laid in position and firmly secured to the steel reinforcement bars by steel binding wires before concreting is done.
  ii) Instead of using standard bends or elbows the conduit itself should be bent in long radius to facilitate easy drawing of conductors.
  iii) Inspection and junction boxes should be suitably located to avoid long conduit runs and such boxes shall be properly identified to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.
  iv) Special care shall be taken in laying the conduits and during the concreting work to avoid damage to the conduits.

b) Laying of conduit in wall
  i) Conduits shall be laid in the wall before plastering work in neatly made chase.
  ii) The conduits shall be secured by means of staples / saddles / J-hooks at intervals not more than 60 cm.
  iii) The joints between the conduits and the switch boards / distribution boards shall be properly sealed.

### TABLE – 1

MAXIMUM PERMISSIBLE NUMBER OF 650 / 1100 V GRADE CABLES THAT CAN BE DRAWN INTO RIGID CONDUITS

<table>
<thead>
<tr>
<th>Size of cable Nominal Cross-sec.</th>
<th>Size of conduit, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sectional Area mm</td>
<td>20</td>
</tr>
<tr>
<td>1.5</td>
<td>(1)</td>
</tr>
<tr>
<td>2.5</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>—</td>
</tr>
<tr>
<td>10</td>
<td>—</td>
</tr>
<tr>
<td>16</td>
<td>—</td>
</tr>
</tbody>
</table>
3.2 Casing Wiring System

Casing wiring system may be adopted as specified by using metallic or PVC casing and capping. All specifications for casing wiring system shall be as per the General Specifications for Electrical Works (Part-I internal), 2005 of CPWD.

3.3 Earthing

a) Materials

i) Earth electrodes shall be any of the following type as specified.
   a) Pipe / rod earth electrode
   b) Plate earth electrode
   c) Strip electrode

Pipe electrode shall be of G.I. heavy class with minimum 38 mm dia and 2.5 m long as per details shown in the drawing. Rod electrodes may be of steel or copper of 2.5 m minimum length. Minimum dia shall be 16 mm in case of steel and 12.5 mm in case of copper. The electrodes shall have no joints.

Plate electrodes may be of galvanised iron / steel or copper. In case of galvanized iron or steel thickness shall not be less than 6.30 mm, which in case of copper plate electrodes, thickness shall not be less than 3.15 mm. Minimum size of plate electrodes for both GI and copper shall be 60 cm x 60 cm. Strip electrodes shall not be smaller than 25 mm x 1.6 mm if of copper and 25 mm x 4 mm if of galvanized iron. If round conductors are used as earth electrodes, their cross sectional area shall not be smaller than 3.0 sq. mm. if of copper and 6 sq.mm. if of G.I.

ii) The main earthing conductor (from earth electrode to the main switch board or earth bus) shall be of G.I. or copper as specified. The sizes shall also be as per specification. However, in no case the size of the main earthing conductor be less than
   a) 5 mm dia (6 SWG) for G.I. or 4 mm dia (8 SWG) for copper wire.
   b) 25 mm x 4 mm in case of G.I. strip.
   c) 20 mm x 3 mm in case of copper strips.

iii) The earth continuity or loop earthing conductor shall be of copper, aluminium or G.I. as specified. The minimum size of the earth continuity conductor shall be as follows :
   a) 2 mm dia (14 SWG) in case of bare copper (1.5 mm² in case of insulated)
   b) 2.24 mm dia (13 SWG) in case of bare aluminium 2.5 mm² in case of insulated
   c) 2.5 mm dia (12 SWG) in case of G.I.

iv) Installation

   a) Electrodes shall be as far as practicable, be embedded below permanent moisture level to a depth of at least 1.25 m. If rock is encountered, the depth of burial may be less than the specified value, subject to approval of the Engineer-in-Charge. In such case, the electrodes may be buried inclined to the vertical with inclination not more than 30° from the vertical.
b) In case where more than one electrode has been specified, the distance between two electrodes shall preferably be not less than twice the length of the electrode.

c) Plate electrodes shall be buried such that its top edge is at a depth not less than 1.5 m from the surface of the ground.

d) Earth electrode normally shall not be located closer than 1.5 m from any building and should not be installed in proximity to a metal fence to avoid the possibility of the fence becoming live due to voltage gradient of the electrodes. If the metal fence is unavoidable, it should be earthed.

e) The strip electrodes shall be buried in trenches or ditches not less than 0.5 m deep and the length of the buried conductor shall be sufficient to give the required earth resistance. It shall, however, be not less than 15 m.

3.4 Installation of Fixtures / Fan

i) Fixtures shall be firmly supported from the structures, support clamps, etc., may be bolted or welded to the existing steelwork or metal inserts. In case of concrete structures, where metal inserts are not available, fixtures will be fixed to or supported from concrete surfaces with the help of anchor fastener. In such cases special care shall be taken to see that anchoring is firm. In case of concrete structures, the finest weights shall be supported by nylon sleeve / steel sleeve anchors inserting in neatly drilled holes or appropriate size as shown in the typical drawing. Nylon or steel sleeve / rawl plugs should be inserted by making 1.5˝ deep, 0.25 dia, cylindrical hole using electric hand drill. In no case wooden plugs shall be allowed. This procedure shall be followed for fitting all types of electrical fittings, switchboard, conduits etc. on surface in wall / ceilings.

ii) Fan clamps shall be of suitable design according to the nature of construction of the ceiling on which these clamps are to be filled. In all cases the fan clamps shall be fabricated from new metal of suitable sizes and they shall be as close fitting as possible. Fan clamps for reinforced concrete roof shall be buried with the casting and due care shall be taken that they shall serve the purpose. Fan clamps for wood beams shall be of suitable flat iron fixed on two sides of the beam and according to the size and section of the beam one or two mild steel bolts passing through the beam shall hold both flat iron together. Fan clamps for steel joints shall be fabricated from flat iron to fit rigidly to the bottom flange of the beam. Care shall be taken during fabrication that the metal does not crack while hammering to shape. In cases where false ceiling exists, the fans shall be firmly connected to the structure / ceiling and not to the false ceiling.

3.5 Lightning Protection

i) Lightning protection shall be done in accordance with the tender specification, IS:2309-1989 and National Electrical Code.

ii) The materials for the air-termination, down conductors etc. for the lightning protective system shall be copper or G.I., as per specification. Recommended shape and minimum sizes of the conductors for use above ground and below are given below:

<table>
<thead>
<tr>
<th>Materials and shape</th>
<th>Minimum size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round copper wire</td>
<td>6 mm dia</td>
</tr>
<tr>
<td>Stranded copper wire</td>
<td>50 mm²(or 7/3.0 mm dia)</td>
</tr>
<tr>
<td>Copper strip</td>
<td>20 x 3 mm</td>
</tr>
<tr>
<td>Round galvanised iron</td>
<td>8 mm dia</td>
</tr>
</tbody>
</table>
Galvanised iron strip: 20 x 3 mm

Shape and minimum size of conductors for use below ground:
- Round copper wire: 8 mm dia
- Copper strip: 32 x 6 mm
- Round galvanised iron wire: 10 mm dia
- Galvanised iron strip: 32 x 6 mm

iii) Air Termination

1. Air termination network may consist of vertical, horizontal or a combination of both vertical and horizontal conductors.
2. Vertical conductors shall project at least 30 cm above the object and shall have one point.
3. Horizontal air termination shall be so interconnected that no part of the roof is more than 9 m away from the nearest horizontal conductors.
4. Horizontal air terminations should be laid down the contours such as ridges, parapets and edges of flat roofs and where necessary over flat surfaces in such a way as to join each air termination to the rest and should themselves from closed network.
5. All metallic finials, chimneys, ducts, vent pipes, railings, gutters and the like, on or above the main surface of the roof of the structure shall be bonded to and form part of, the air termination network. If portions of a structure vary considerably in height any necessary air termination of air termination network of the lower portions, in addition to their own conductors be bonded to the down conductors of the taller portions.
6. All air terminals shall be effectively secured against overturning either by attachment to the object to be protected or by means of substantial braces and fixings which shall be permanently and rigidly attached to the building.

iv) Down Conductors

1. The number and spacing of the down conductors shall be as per the tender specification as directed by the Engineer-in-Charge. However, there shall be minimum 2 down conductors for structures up to 400 sq.m area and one extra down conductor for every additional 300 sq.m or part thereof.
2. Down conductors should be distributed round the outside walls of the structure. They shall preferably be run along the corners and other projections. Lift shafts shall not be used for fixing down conductors.
3. Down conductors shall be laid in such a way that they follow the most direct path possible between the air termination and the earth termination, avoiding sharp bends, upturns and kinks. Joints shall as far as possible be avoided in down conductors. Adequate protection may be provided to the conductors against
mechanical damage. Metal pipes should not be used as protection for conductors.

4. Metal pipes leading rain water from the roof to the ground may be connected to the down conductors. Such connections should have disconnecting joints for testing purpose.

5. Any extended metal running vertically through the structure should be bonded to the lightning conductor at the top and the bottom unless the clearances are in accordance with IS:2309-1989.

6. Where the provision of suitable external routes for down conductors is impracticable or inadvisable, as in buildings of cantilever construction, from the first floor upwards, down conductors may be used in an air space provided by a non-metallic, non-combustible internal duct. Any covered recess not smaller than 75 x 15 mm or any vertical service duct running the full height of the building may be used for this purpose, provided it does not contain an unarmoured or non-metal sheathed cable.

v) Joints and bonds

a) Joints
The lightning protective system shall have as few joints in it as necessary. In the down conductors below ground level these shall be mechanically and electrically effective and shall be so made as to exclude moisture completely. The joints may be clamped, screwed, bolted, crimped, riveted or welded. With overlapping joints the length of the overlap should not be less than 20 mm for all types of conductors. Contact surfaces should first be cleaned and then inhibited from oxidation with a suitable non-corrosive compound. Joints of dissimilar metal should be suitably protected against bimetallic action and corrosion. In general, joints for strips shall be tinned, soldered, welded or brazed and at least double-riveted. Clamped or bolted joints shall only be used on test points or on bonds to existing metal, but joints shall only be of the clamped or screwed type.

b) Bonds
External metal on or forming part of a structure may have to discharge the full lightning current. Therefore, the bond to the lightning protective system shall have a cross-sectional area not less than that employed for the main conductors. On the other hand, internal metal is not so vulnerable and its associated bonds are at most only likely to carry a portion of the total lightning current, apart from their function of equalising potential. These latter bonds may, therefore, be smaller in cross-sectional area than those used for the main conductors. All the bonds should be suitably protected against corrosion. Bonds shall be as short as possible.

c) Testing Points
Each down conductor shall be provided with a testing point in a position convenient for testing but inaccessible for interference. No connection, other than one direct to an earth electrode, shall be made below a testing point. Testing points shall be phosphorbronze, gunmetal, copper or any other suitable material.

d) Earth Terminations

1. Each down conductor shall have an independent earth termination. It should be
capable of isolation for testing purposes. Suitable location for the earth termination shall be selected after testing and assessing the specific resistivity of the soil and with due regard to reliability of the sub-soil water to ensure minimum soil moistness.

2. Water pipe system should not be bonded to the earth termination system. However, if adequate clearance between the two cannot be obtained, they may be effectively bonded and the bonds should be capable of isolation and testing. The gas pipes, however, should in no case be bonded to the earth termination system.

3. It is recommended that all earth terminations should be interconnected. Common earthing besides equalising the voltage at various earth terminations also minimises any risk to it of mechanical damage.

e) Earth Electrodes
   Earth electrodes shall be constructed and installed in accordance with section 3.3.

f) Fasteners
   Conductors shall be securely attached to the building or other object to be protected by fasteners which shall be substantial in construction, not subject to breakage and shall be made of galvanised steel or other suitable material. If fasteners are made of steel, they should be galvanised to protect them against corrosion. If they are made of any other material suitable precautions should be taken to avoid corrosion. Some samples of fasteners are shown in IS:2309-1969.

g) Earth Resistance
   Each earth termination should have a resistance in ohms to earth not exceeding numerically the product of 10 and the number of earth terminations to be provided. The whole of the lightning protective system should have a combined resistance to earth not exceeding 10 ohms before any bonding has been effected to metal in or on the structure or to surface below ground.

3.6 Testing of Wiring Installation
   After completion of wiring a general inspection is carried out by the Engineer-in-Charge or his representative to verify that the provisions of the specification and Indian Electricity Rules, 1956 have been complied with. After inspection, the following tests shall be carried out before an installation or an addition to the existing installation is put into service:
   a) The insulation resistance shall be measured by applying between earth and the whole system of conductor or any section thereof with all fuses in place and all switches closed and except in earthed concentric wiring, all lamps in position or both poles of installation otherwise electrically connected together, a DC voltage of not less than twice the working voltage, provided that it does not exceed 500 volts for medium voltage circuits. Where the supply is derived from thee-wire (AC or DC) or a polyphase system the neutral pole of which is connected to earth either direct or through added resistance, the working voltage shall be deemed to be that which is maintained between the outer or phase conductor and the neutral.
b) The insulation resistance in mega-ohms of an installation measured as in (a) shall be not less than 50 divided by the number of points on the circuit, provided that the whole installation need not be required to have an insulation resistance greater than 1 M ohm.

c) Control rheostats, heating and power appliances and electric signs, may, if desired, be disconnected from the circuit during the test, but in that event the insulation resistance between the case or framework, and all live parts of each rheostat, appliance and sign shall be not less than that specified in the relevant Indian Standard specification or where there is no such specification shall be not less than 0.5 M ohm.

d) The insulation resistance shall also be measured between all conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire to the neutral on to the other pole of phase conductors of the supply. Such a test shall be made after removing all metallic connections between the two poles of the installation and in these circumstances the insulation resistance between conductors of the installation shall be not less than that specified in (b).

e) On completion of an electrical installation (or an extension to an installation) a certificate shall be furnished by the Contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority. In addition to this a completion certificate, as enclosed under Appendix – I.

Earthing

For checking the efficiency of earthing the following tests are recommended.
   a) The earth resistance of each electrode is measured.
   b) The earth resistance of earthing grid is measured
   c) All electrodes are connected to the grid and the earth resistance of the entire earthing system is measured.
   These tests shall preferably be done during the summer months.

4.0 Cable Laying

4.1 Route

i) Before the cable laying work is undertaken, the route layout of the cable shall be submitted to the Engineer-in-Charge and the work shall be undertaken only after approval of the route layout.

ii) a) Whenever cables of different voltages are laid following points shall be noted while laying along well demarcated or established roads, the LV / MV cables shall be laid further from the kerb line than HV cables.
    b) Cables of different voltages and also power and control cables shall be kept in different trenches with adequate separation. Where available space is restricted such that this requirement cannot be met, LV / MV cables shall be laid above HV cables.
    c) Where cables cross one another, the cable of higher voltage shall be laid at a lower level than the cable of lower voltage.

iii) Proximity to communication cables
Power and communication cables shall as far as possible cross each other at right angles. The horizontal and vertical clearance between them shall not be less than 60cm.

4.2 Methods of Laying
The cables shall be laid direct in ground, pipe, closed or open ducts, cable trays or on surface of wall etc. The method(s) of laying required shall be specified in the tender / schedule of work.

4.3 Laying direct in ground
i) This method shall be adopted where specified in the schedule of works. Normally this method shall be adopted when the cable route is through open ground, along roads, lanes, etc. and where no frequent excavations are likely to be encountered and where re-excavation is easily possible without affecting other services.

ii) Trenching
a) Width and depth of the trench shall be as shown in the drawing. When more than one tier of cables is unavoidable and vertical formation of laying is adopted, the depth of the trench shall be increased by 30 cm for each additional tier to be formed.
b) The trenches shall be excavated in reasonably straight lines. Wherever there is a change in the direction, a suitable curvature shall be adopted complying with the minimum bending radius specified in Table - 11. Where gradients and changes in depth are unavoidable, these shall be gradual. The bottom of the trench shall be level and free from stones, brick bats etc.

<table>
<thead>
<tr>
<th>System voltage</th>
<th>Minimum bending radius</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single core</td>
</tr>
<tr>
<td></td>
<td>Unarmoured</td>
</tr>
<tr>
<td>11 KV</td>
<td>20 D</td>
</tr>
<tr>
<td>22 KV</td>
<td>25 D</td>
</tr>
<tr>
<td>33 KV</td>
<td>30 D</td>
</tr>
</tbody>
</table>

D is the overall diameter of the cable.

The excavation should be done by suitable means – manual or mechanical. The excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench.

c) Adequate precautions should be taken not to damage any existing cable(s), pipes or any other such installations in the route during excavation. Wherever bricks, tiles or protective covers or bare cables are encountered, further excavation shall not be carried out without the approval of the Engineer-in-Charge.

Existing property, if any, exposed during trenching shall be temporarily supported adequately as directed by the Engineer-in-Charge. The
trenching in such cases shall be done in short lengths, necessary pipes laid for passing cables therein, if required. If there is any danger of a trench collapsing or endangering adjacent structures, the sides should be well shored up with sheeting as the excavation proceeds. Where necessary, these may even be left in place when backfilling the trench.

Excavation through lawns shall be done in consultation with the department concerned.

iii) Laying of Cable in Trench

a) Sand cushioning
The excavated trench shall be provided with a layer of clean, dry sand cushion of not less than 8 cm in depth, before laying the cables therein. However, sand cushioning may not be provided for MV cables, where there is no possibility of any mechanical damage to the cables due to heavy or shock loading on the soil above if so specified in the tender document and as per approval of the Engineer-in-Charge. Sand cushioning shall however be invariably provided in the case of HV cables.

b) The cable drum shall be properly mounted on jacks, or on a cable wheel at suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum without failure and that the spindle is horizontal in the bearings so as to prevent the drum creeping to one side while rotating.

c) The cable shall be pulled over in rollers in the trench steadily and uniformly without jerks and strain. The entire cable length shall be far as possible laid off in one stretch. PVC / XLPE cables less than 120 sq.mm size may be removed by Flaking i.e. by making one long loop in the reverse direction.

Note:
For short runs and sizes up to 50 sq.mm of MV cables, any other suitable method of direct handling and laying can be adopted without strain or excess bending of the cables.

d) After the cable has been so uncoiled, it shall be lifted slightly over the rollers beginning from one end by helpers standing about 10 m apart and drawn straight. The cable shall then be lifted off the rollers and laid in a reasonably straight line.

e) Testing before covering
The cables shall be tested in presence of the Engineer-in-Charge for continuity of cores and insulation resistance and the cable length shall be measured, before closing the trench.

f) Sand covering
Cables laid in trenches in a single tier formation shall have a covering of dry sand of not less than 17 cm above the base cushion of sand before the protective cover is laid. In the case of vertical multi-tier formation, after the first cable has been laid, a
sand cushion of 30 cm shall be provided over the base cushion before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30 cm as stated above. Cables in the top most tier shall have a final sand covering not less than 17 cm before the protective cover is laid.

Sand covering as stated above need not be provided for MV cables where a decision is taken by the Engineer-in-Charge as per sub-clause (iii-a) above, but the inter tier spacing should be maintained with soft soil instead of sand between tiers and for covering.

Sand cushioning shall however be invariably provided in the case of HV cables.

g) Extra loop cable
At the time of original installation, approximately 3 m of surplus cable shall be left on each terminal end of the cable and on each side of the underground joints. The surplus cable shall be left in the form of a loop. Where there are long runs of cables such loose cable may be left at suitable intervals as specified by the Engineer-in-Charge. Where it may not be practically possible to provide separation between cables when forming loops of a number of cables as in the case of cable emanating from a substation, measurement shall be made only to the extent of actual volume of excavation, sand filling etc and paid for accordingly.

h) Mechanical protection over the covering
Mechanical protection to cables shall be laid over the covering to provide warning to future excavators of the present of the cable and also to protect the cable against accidental mechanical damage by pick-axe blows etc. as follows:

i) Unless otherwise specified, the cables shall be protected by second class brick of nominal size 22 cm x 11.4 cm x 7 cm or locally available size, placed on top of the sand (or, soil as the case may be). The bricks shall be placed breadth-wise for the full length of the cable. Where more than one cable is to be laid in the same trench, this protective covering shall cove all the cables and projects at least 5 cm over the sides of the end cables.

ii) Where bricks are not easily available, or are comparatively costly, there is no objection to use locally available material such as tiles or slates or stone /cement concrete slabs. Where such an alternative is acceptable, the same shall be clearly specified in the tender specifications.

iv) Backfilling
a) The trenches shall be then backfilled with excavated earth, free from stones or other shall edged debris and shall be rammed and watered, if necessary in successive layers not exceeding 30 cm depth.
b) Unless otherwise specified, a crown of earth not less than 50 mm and not exceeding 100 mm in the centre and tapering towards the sides of the trench shall be left to allow for subsidence. The crown of the earth, however, should not exceed 10 cms. so as not to be a hazard to vehicular
traffic.
c) The temporary restatements of roadways should be inspected at regular
intervals, particularly during wet weather and settlements should be made
good by further filling as may be required.
d) After the subsidence has ceased, trenches cut through roadways or other paved areas shall be
restored to the same density and materials as the surrounding area and repaved in accordance
with the relevant building specifications to the satisfaction of the Engineer-in-Charge.
e) Where road berms of lawns have been cut out of necessity, or kerb stones displaced, the same
shall be repaired and made good, except for turfing /asphalting, to the satisfaction of the Engineer-
in-Charge and all the surplus earth or rock shall be removed to places as specified.

v) Laying of single core cables
a) Three single core cables forming one three phase circuit shall normally be held in close trefoil
formation and shall be bound together at intervals of approximately 1 m.
b) The relative position of the three cables shall be changed at each joint at the time of original
installation, complete transposition being effected in every three consecutive cable lengths.

vi) Route markers
a) Location
Route markers shall be provided along with the runs of cable at locations approved by the
Engineer-in-Charge and generally at intervals not exceeding 100m. Markers shall also be provided
to identify change in the direction of the cable route and locations of underground joints.
b) Plate type marker
Route markers shall be made out of 100 mm x 5 mm G.I. / aluminium plate welded /bolted on 35
mm x 35 mm x 6 mm angel iron, 60 cm long. Such plate markers shall be mounted parallel to and
at about 0.5 m away from the edge of the trench.
c) CC marker
Alternatively, cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20
mm in size) as shown in figure 2 shall be laid flat and centered over the cable. The concrete
markers, unless otherwise instructed by the Engineer-in-Charge, shall project over the surrounding
surface so as to make the cable route easily identifiable.
d) Inscription
The words IITG-MV / HV CABLE as the case may be shall be inscribed on the marker.

4.4 Laying in Pipes / Closed Ducts
i) In locations such as road crossing, entry in to buildings, paved areas etc., cables shall be laid
in pipes or closed ducts. Stone ware pipes, GI, CI or spun reinforced concrete pipes shall be
used for cables as specified in the schedule of works.
ii) Following guide of the pipe fill shall be used for sizing the pipe size:
   a) 1 cable in pipe : 53% full
   b) 2 cables in pipe : 31% full
   c) 3 or more cables : 43% full
   d) Multiple cables : 40% full
iii) Where cables pass through foundation walls or other underground structures,
the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures, the electrical contractor shall determine their location and obtain approval of the Engineer-in-Charge before cutting is done.

iv) At road crossings and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends.

v) At road crossings, the top surface of pipes shall be at a minimum depth of 1m from the pavement level. When pipes are laid cutting existing road, care shall be taken so that the soil filled up after laying the pipes is rammed well in layers with watering as required to ensure proper compaction. A crown of earth not exceeding 10 cm should be left at the top.

After the subsidence has ceased, the top of the filled up trenches in road ways or other paved areas shall be restored to the same density and material as the surrounding area in accordance with the direction of the Engineer-in-Charge (Civil) up to his satisfaction.

vi) All G.I. pipes shall be laid as per layout drawings and site requirements. Before fabrication of various profiles of pipe by hydraulically operated bending machine (which is to be arranged by the Contractor), all the burrs from the pipes shall be removed. G.I. pipes with bends shall be buried in soil / concrete in such a way that the bends shall be totally concealed. For G.I. pipes buried in soil, bitumen coating shall be applied on the buried lengths. Installation of G.I. pipes shall be undertaken well before paving is completed and necessary coordination with paving agency shall be the responsibility of Electrical Contractor. The open ends of pipes shall be suitably plugged with G.I. plugs after they are laid in final position. G.I. plugs shall be supplied by the Contractor at no extra cost.

4.5 Laying in Open Ducts

a) Open ducts with suitable removable covers (RCC slabs or chequered plates) are generally provided in substations, switch rooms, plant rooms, workshops etc. for taking the cables. The cable ducts should be of suitable dimensions for the number of cables involved.

b) Laying of cables with different voltage ratings in the same duct shall be avoided. Where it is inescapable to take HV & MV cables same trench, they shall be laid with a barrier between them or alternatively, one of the two (HV / MV) cables may be taken through pipe(s). Splices or joints of any type shall not be permitted inside the ducts.

c) The cables shall be laid directly in the duct such that unnecessary crossing of cables is avoided.

d) Where specified, cables may be fixed with clamps on the walls of the duct or taken in hooks / brackets / cable trays through in ducts.

e) Where specified, ducts may be filled with dry sand after the cables are laid and covered as above, or finished with cement plaster, specially in high voltage applications.

4.6 Laying on Surface

The method may be adopted in places like switch rooms, workshops, tunnels, rising (distribution) mains in buildings etc. This may be necessitated in the works of additions and / or alternations to the existing installation, where other
methods of laying may not be feasible. Cables may be laid in surface by any of the following methods as specified:

a) Directly clamped by saddles or clamps
b) Supported on cradles
c) Laid on troughs / trays, duly clamped.

4.7 Laying on Cable Tray
This method may be adopted in places like indoor substations, air-conditioning plant rooms, generator rooms etc. or where long horizontal runs of cables are required within the building and where it is not convenient to carry the cable in open ducts. This method is preferred where heavy sized cables or a number of cables are required to be laid. The cable trays may be either of perforated sheet type or ladder type as specified.

4.8 Jointing
i) Location
a) Before laying a cable, proper locations for the proposed cable joints, if any, shall be decided, so that when the cable is actually laid, the joints are made in the most suitable places. As far as possible, water logged locations, carriage ways, pavements, proximity to telephone cables, gas or water mains, inaccessible places, ducts, pipes, racks etc. shall be avoided for locating the cable joints.
b) Joints shall be staggered by 2 m to 3 m when joints are to be done for two or more cables laid together in the same trench.

ii) Joint pits
a) Joints pits shall be of sufficient dimensions as to allow easy and comfortable working. The sides of the pit shall be well protected from loose earth falling into it. It shall also be covered by a tarpaulin to prevent dust and other foreign matter being blown on the exposed joints and jointing materials.
b) Sufficient ventilation shall be provided during jointing operation in order to disperse fumes given out by fluxing.

iii) Safety precaution
a) A caution board indicating —CAUTION – CABLE JOINTING WORK IN PROGRESS— shall be displayed to warn the public and traffic where necessary.
b) Before jointing is commenced, all safety precautions like isolation, discharging, earthing, display of caution board on the controlling switchgear etc. shall be taken to ensure that the cable wound not be inadvertently charged from live supply. Metallic armour and external metallic bond be connected to earth. Where —Permit to Work— system is in vogue, safety procedures prescribed shall be complied with.

iv) Jointer
Jointing work shall be carried out by a licensed / experienced (where there is no licensing system for jointers) cable jointer.
4.9 Testing

i) Testing before laying
All cables, before laying, shall be tested with a 500 V megger for cables of 1.1 KV grade, or with a 2500 / 5000 V megger for cables of higher voltage. The cable cores shall be tested for continuity, absence of cross phasing, insulation resistance from conductors to earth / armour and between conductors.

ii) Testing before backfilling
All cables shall be subjected to the above mentioned tests, before covering the cables by protective covers and backfilling and also before taking up any jointing operation.

iii) Testing after laying
After laying and jointing, the cable shall be subjected to a 15 minutes pressure test. The test pressure shall be as given in Table – III. DC pressure testing may normally be preferred compared to AC pressure testing.

<table>
<thead>
<tr>
<th>Working Volts in KV</th>
<th>AC 15 minutes test</th>
<th>DC 15 minutes test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Between conductors</td>
<td>Conductor to earth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Between conductors</td>
</tr>
<tr>
<td>Up to 1.1</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>3.3</td>
<td>6.0</td>
<td>3.5</td>
</tr>
<tr>
<td>6.6</td>
<td>12.0</td>
<td>7.0</td>
</tr>
<tr>
<td>11</td>
<td>20.0</td>
<td>11.5</td>
</tr>
<tr>
<td>22</td>
<td>40.0</td>
<td>23.0</td>
</tr>
<tr>
<td>33</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

In the absence of facilities for pressure testing as above, it is sufficient to test for one minute with 1,000 V megger for cables of 1.1 KV grade and with 2500 /5000 V megger for cables of higher voltages.

4.10 Measurement
All measurement will be made as per guidelines laid under the latest edition of the General Specifications for Electrical works (Part – I and II) of CPWD. All the works in progress will be jointly measured by the representatives of the Engineer-in-Charge of the Owner and EPI and the Sub-contractor shall remain bound to render all assistance during such recording of the measurements. The measurements such recorded shall be binding on the Sub-contractor. He shall have no claim other than what has been jointly recorded or certified by the Owner.
4.10 Specific Technical Requirements:

a) All wiring for light and power circuits shall be in PVC conduits recessed or exposed in wall/ceiling as instructed by the Engineer-in-charge.

b) All wires for point wiring and the single core wires specified for sub main and circuit wirings shall be 1.1 KV grade PVC insulated FR copper multi-strand wires of approved brand. The underground cables indicated in the drawings shall however, be PVC insulated and sheathed armoured aluminium underground cables of approved brands.

c) All 6A receptacles shall be flush type and shall have 5 pins with 1 pin for earth connection and 2 pins each for phase and neutral connections. 16A receptacles shall have 6 pins (suitable for connecting both 6A and 16A plug tops) with 2 pins each for phase, neutral and earth connections.

d) Samples of all the materials to be used in the work shall be submitted to the Superintending Engineer (Elect.), IITG for approval. No material other than those approved by the IITG shall be used in any of the works.

In case of any materials other than those approved by the SE (Elect.) is detected, the same shall be replaced by the Tenderer with the approved quality, free of cost, failing which, the owner shall have right to withhold all pending bills due to the Contractor, until the rectification/replacement work is completed.

e) All materials, equipments and accessories shall be of makes listed as enclosed. Makes of any item(s) not specified under the list, but required in the work shall be approved by the Engineer-in-Charge prior to use in the works.

LIST OF APPROVED MAKES OF MATERIALS:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Materials</th>
<th>Manufactures / Brand names</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Conduits pipes &amp; accessories –</td>
<td>BEC / AKG (ISI marked)</td>
</tr>
<tr>
<td></td>
<td>MS</td>
<td>BERLIA / AKG</td>
</tr>
<tr>
<td></td>
<td>PVC</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Bushes</td>
<td>Rubber / PVC of superior quality.</td>
</tr>
<tr>
<td>3.</td>
<td>Wire (Copper conductor)</td>
<td>FR copper wire (FINOLEX / HAVELLS / RR KABEL /ANCHOR)/BERLIA/NICCO/V-GUARD/Gloster</td>
</tr>
<tr>
<td>4.</td>
<td>Cable (underground)</td>
<td>GLOSTER / CCI / INCAB / INDUSTRIAL CABLES /RPG / UNIVERSAL / NICCO / HAVELLS / POLYCA/ CRYSTAL / FINOLEX/KEI</td>
</tr>
<tr>
<td>5.</td>
<td>Cover plate</td>
<td>Hylum sheet 3 mm thick of colour &amp; design as approved</td>
</tr>
<tr>
<td>6.</td>
<td>Cover plate fan box</td>
<td>Formica of approved shade 2 mm thick</td>
</tr>
<tr>
<td>7.</td>
<td>Switch &amp; Socket -</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flash Piano type -</td>
<td>ANCHOR / KOLORS / GOLDMEDAL/HPL/HAVELLS (ISI) or equiv.</td>
</tr>
<tr>
<td></td>
<td>Modular type -</td>
<td>MK / CRABTREE / LEGRAND / SCHNEIDER /PHILIPS</td>
</tr>
<tr>
<td>8.</td>
<td>Switch fuse unit (HRC Type) (re-wirable type)</td>
<td>ENGLISH ELECTRIC/L&amp;T / SIEMENS/CONTROL&amp;SWITCHGEAR</td>
</tr>
<tr>
<td>9.</td>
<td>a) Fuse bases for HRC fuse for feeder pillar</td>
<td>SIEMENS / L&amp;T / STANDARD</td>
</tr>
<tr>
<td></td>
<td>b) HRC fuses</td>
<td>E.E. / L&amp;T / SIEMENS</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Brands</td>
</tr>
<tr>
<td>---</td>
<td>-------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>10.</td>
<td>MCB</td>
<td>LEGRAND/SIEMENS/ SCHNEIDER / L&amp;T / ABB / HAVELLS / HAGER</td>
</tr>
<tr>
<td>11.</td>
<td>Distribution Board MCB type</td>
<td>LEGRAND/SIEMENS/ SCHNEIDER / L&amp;T / ABB / HAVELLS / HAGER</td>
</tr>
<tr>
<td>12.</td>
<td>Telephone cables</td>
<td>DELTON / FINOLEX / POLYCAP</td>
</tr>
<tr>
<td>15.</td>
<td>Screws</td>
<td>Good quality brass screws</td>
</tr>
<tr>
<td>16.</td>
<td>Ceiling Rose</td>
<td>ANCHOR / MK / GOLDMEDAL / KOLORS</td>
</tr>
<tr>
<td>17.</td>
<td>ELCB / RCCB</td>
<td>LEGRAND / SIEMENS / L&amp;T / ABB / HAVELLS / SCHNEIDER / HAGER</td>
</tr>
<tr>
<td>18.</td>
<td>MCCB</td>
<td>GE/L&amp;T/SCHNEIDER/CONTROL &amp; SWITCHGEAR/CROMPTON GREAVES/ABB/C&amp;S/HAVELLS/LEGRAND / HAGER</td>
</tr>
<tr>
<td>19.</td>
<td>Air Circuit Breaker</td>
<td>L&amp;T/SIEMENS/SCHNEIDER/ CROMPTON GREAVES/ABB/CONTROL &amp; SWITCHGEAR.</td>
</tr>
<tr>
<td>20.</td>
<td>Industrial type Metal clad sockets &amp; plugs</td>
<td>LEGRAND/SIEMENS/ SCHNEIDER / L&amp;T / HAVELLS / ABB.</td>
</tr>
<tr>
<td>21.</td>
<td>Meter, Metering, Equipment &amp; C.T.s</td>
<td>A) AUTOMATIC ELECTRIC B) CONZERV C) RISHAV D) MECO E) HPL</td>
</tr>
<tr>
<td>22.</td>
<td>Electronic Energy Meter</td>
<td>HPL / CONZERV / L&amp;T / RISHAV</td>
</tr>
<tr>
<td>23.</td>
<td>Exhaust Fan</td>
<td>ALSTOM / ORIENT / CROMPTON / HAVELLS</td>
</tr>
<tr>
<td>24.</td>
<td>Ceiling Fan</td>
<td>ORIENT/CROMPTON/BAJAJ/HAVELLS / BERLIA</td>
</tr>
<tr>
<td>25.</td>
<td>Electronic Step Fan Regulator</td>
<td>ANCHOR / KOLORS / MK or equiv.</td>
</tr>
<tr>
<td>26.</td>
<td>Lugs</td>
<td>DOWELLSII crimping type</td>
</tr>
<tr>
<td>27.</td>
<td>MDBs / BDBs / SDBs</td>
<td>CPRI approved vendors, having facilities for powder coated finish and antirust treatment by seven/ eight tank process (vendor detail shall be submitted for approval)</td>
</tr>
<tr>
<td>28.</td>
<td>APFC Panel</td>
<td>SCHNEIDER/L&amp;T or equivalent subject to approval.</td>
</tr>
<tr>
<td>29.</td>
<td>Bus-bar trunking system</td>
<td>Control &amp; Switchgear or equiv. Subject to approval</td>
</tr>
<tr>
<td>30.</td>
<td>Light fittings</td>
<td>Makes &amp; catalogue reference shown in the BOQ or equivalent from the brands--Philips/ Crompton/ Bajaj/ Wipro/ Havells – subject to approval.</td>
</tr>
</tbody>
</table>
List of mandatory test to be carried out by the panel manufacturer:

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dimensional &amp; visual checks as per approved drawing.</td>
</tr>
<tr>
<td>2.</td>
<td>BOQ checks as per approved drawing.</td>
</tr>
<tr>
<td>3.</td>
<td>Operational checks as per approved drawing.</td>
</tr>
<tr>
<td>4.</td>
<td>Paint thickness &amp; Paint shade checks as per approved drawing.</td>
</tr>
<tr>
<td></td>
<td>High Voltage Test at 3.0 KV for 60 sec.</td>
</tr>
<tr>
<td>a)</td>
<td>Between Phases</td>
</tr>
<tr>
<td>b)</td>
<td>Between Phases &amp; Earth</td>
</tr>
<tr>
<td>c)</td>
<td>Between Neutral to Earth</td>
</tr>
<tr>
<td>5.</td>
<td>Insulation Resistance test with Megger at 500VDC</td>
</tr>
<tr>
<td>a)</td>
<td>Between Phases</td>
</tr>
<tr>
<td>b)</td>
<td>Between Phases &amp; Earth</td>
</tr>
<tr>
<td>c)</td>
<td>Between Neutral to Earth</td>
</tr>
</tbody>
</table>

The supplier shall furnish relevant descriptive and illustrative on switchgears and associated equipment and the following for approval before manufacture of the panel:

a) Complete assembly drawing of the panel showing plan, elevation and typical section views and locations of cable bases, bus bar chamber, metering compartment and terminal blocks for external wiring connections.

b) Typical and recommended schematic diagrams and control wiring.

c) Foundation plan showing location of foundation channels, anchor bolts, and anchors, floor plans and openings for cables etc.

d) B.O.M

All routine tests specified in IS 8623-1993 with upto date amendments shall be carried out and test certificates submitted while offering for inspection by EPI/Owner prior dispatch.