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SOUTHERN RAILWAY

ELECTRICAL TRACTION DISTRIBUTION BRANCH MDU DIVISION

TENDER No. U-TRD-OT-26-27-IV-1

TENDER DOCUMENT – PART 2

Tender for

**MDU DIVISION – PROVISION OF POWER QUALITY RESTORERS
FOR AC TRACTION SYSTEMS AT THE TRACTION SUBSTATIONS
IN PALANI, GOMANGALAM, MANAMADURAI,
RAMANATHAPURAM and TENI**

Issued by

**Divisional Railway Manager (Electrical Traction Distribution),
Madurai Division, Southern Railway,
Madurai-625016**

INDEX

<u>1.0</u>	SPECIAL CONDITION (TECHNICAL)	<u>03</u>
<u>1.1</u>	SUPPLY OF MATERIALS	<u>03</u>
<u>1.2</u>	INSPECTION	<u>03</u>
<u>1.3</u>	GUARANTEE/ MAINTENANCE PERIOD	<u>04</u>
<u>1.4</u>	SPECIFIED RAILWAY STORES	<u>05</u>
<u>1.5</u>	RAILWAY STORES	<u>05</u>
<u>1.6</u>	LADDER TROLLEYS	<u>06</u>
<u>1.7</u>	TOWER WAGON	<u>06</u>
<u>1.8</u>	CONTRACTOR'S SUPPLY ITEM	<u>06</u>
<u>1.9</u>	TRAFFIC BLOCKS/ POWER BLOCKS	<u>06</u>
<u>1.10</u>	SAFETY MEASURE	<u>07</u>
<u>1.11</u>	PROVISIONAL ACCEPTANCE	<u>09</u>
<u>1.12</u>	DEFECTIVE EQUIPMENTS TO BE CHANGED	<u>09</u>
<u>1.13</u>	USE OF REJECETED EQUIPMENT	<u>10</u>
<u>1.14</u>	FINAL ACCEPTANCE	<u>10</u>
<u>1.15</u>	PENALTY CLAUSE	<u>10</u>
<u>1.16</u>	OTHER CUSTOM CONDITIONS	<u>11</u>
<u>1.17</u>	SPECIFICATIONS AND DRAWINGS	<u>12</u>
<u>2.0</u>	EXPLANATORY NOTES FOR ITEMS DESCRIBED IN THE SCHEDULE OF WORK	<u>13</u>
<u>2.1</u>	SECTION – I – GENERAL	<u>13</u>
<u>2.2</u>	SECTION – II – EXPLANATORY NOTE FOR EACH ITEM	<u>14</u>
<u>2.3</u>	SECTION – III – COMPREHENSIVE ANNUAL MAINTENANCE CONTRACT (CAMC)	<u>16</u>
<u>3.0</u>	GENERAL SPECIFICATIONS	<u>19</u>
<u>3.1</u>	SECTION-1 GENERAL	<u>19</u>
<u>3.2</u>	SECTION – 2 SWITCHING STATIONS, BOOSTER TRANSFORMER STATIONS AND L.T.SUPPLYTRANSFORMER STATIONS	<u>23</u>
<u>3.3</u>	SECTION-3 FOUNDATIONS	<u>24</u>
<u>3.4</u>	SECTION-4 STRUCTURES	<u>28</u>
<u>3.5</u>	SECTION-5 EQUIPMENTS, COMPONENTS & MATERIALS	<u>28</u>
<u>3.6</u>	SECTION-6 DESIGNS AND DRAWINGS	<u>33</u>
<u>3.7</u>	SECTION-7 ERECTION & INSTALLATION OF EQUIPMENT	<u>37</u>
<u>3.8</u>	SECTION-8 INSPECTION AND TESTING	<u>40</u>
<u>4.0</u>	PARTICULAR SPECIFICATIONS	<u>41</u>

1.0 SPECIAL CONDITIONS (TECHNICAL)

1.1. SUPPLY OF MATERIALS (EQUIPMENTS, FITTINGS& COMPONENTS)

All the materials/equipments/fittings/components required for successful completion of this work shall be procured only from RDSO/CORE approved sources. If for any item, no RDSO/CORE approved sources are available, the said item conforming to relevant RDSO specification/drawing shall be procured from other sources.

1.2. INSPECTION

1. Inspection and testing of the Power Quality Compensating Equipment shall be carried out as per RDSO Standard No. IS/RDSO-TI/0002:2023 or latest. All the testing equipments required for the testing of the installations supplied and erected by the successful tenderer shall be arranged by the successful tenderer during testing. As soon as power quality restorer and associated equipments are ready for inspection and testing, the contractor shall advise the Purchaser in writing. Those shall include the test which the Purchaser may like to conduct with a view to assure himself of the soundness of these equipments and their erection in compliance with these specifications. After completion of joint testing, joint inspection report has to be prepared and has to be submitted for approval of Electrical Inspector to Government of India (EIG) (PCEE/MAS). Any comments/remarks in the equipment proposed for commissioning communicated by EIG has to be rectified by the contractor before commissioning.
2. The inspecting Officer(s) for this contract shall be purchaser representative (RDSO/ RITES), as the case may be. Two weeks' notice must be given by the contractor to the Inspecting Officer to take up inspection. For the materials of purchase value Rs. 5.00 lakhs and above, inspection shall be done by RDSO/RITES. For materials of purchase value below Rs.5.00 lakhs, inspection shall be done by the consignee.
3. In special cases (to be indicated by the tenderer) where the inspection involves technical expertise or facility, that is ordinarily not available with the consignee, RDSO/RITES inspection may be insisted upon, even if the value of purchase order does not exceed Rs. 5 lakhs.
4. As per the extant standing instruction/policy all OHE items should be inspected only by RITES/RDSO.
5. Consequence of Rejection: On the materials/equipments/fittings/components being rejected by the inspecting Officer or his authorized representative, the contractor shall replace/redo the rejected portion of the work forthwith but in any event not more than 2 weeks. The contractor shall bear all the cost of such rejection including freight, unloading etc. The Contractors are not entitled to any extra time in the completion period on this account.
6. Inspection charges of the material **shall be borne by the Contractor**, whether the inspected material is finally utilized in the work or not.
7. In the case of Consignee inspection, all facilities for free and fair testing and inspection shall be arranged by the Contractor/Suppliers at their works.

1.3. Guarantee / Maintenance Period:

The Contractor shall also guarantee satisfactory working of the installations erected by him, for a period of 36 months from the date of Provisional Acceptance Certificate issued for each PQR. The guarantee for spares should be coincident with the guarantee for erected equipment. The said period is treated as the Maintenance period in this contract.

1. During the period of guarantee (Maintenance period) the contractor shall keep available an experienced Engineer and necessary equipment to attend to any defective installation resulting from defective erection and/or defects in the equipment supplied by the contractor. This engineer shall not attend to rectification of defects which arise out of normal wear and tear and come within the purview of routine maintenance work. The Contractor shall bear the cost of modifications, additions or substitution that may be considered necessary due to faulty material, design or workmanship for the satisfactory working of the equipment. The final decision shall rest with the Senior Divisional Electrical Engineer, Southern Railway, Madurai or his successor (s)/Nominee.
2. The entire power quality compensating equipment shall be given a guarantee of 3 years against all manufacturing and design defects including improper workmanship, erection etc. Any failures during the warranty period shall be attended to by the successful Tenderer promptly free of cost. Design improvements arising out of design deficiencies noticed during the warranty period shall be carried out free of cost by the successful Tenderer.
3. During the period of Guarantee the contractor shall be liable for the replacement at site of any parts which may be found defective in the fittings, Components and equipment, whether such equipment be of his own manufacture or those of this sub-contractor whether arising from faulty design, materials, workmanship or negligence in any manner in the part of the contractor provided always that such replaced items are promptly returned to the contractor if so required by him at his (contractor's) own expenses. In case of type defects in contractor's equipment and components detected during guarantee period, contractor shall replace all such items irrespective of the fact whether all such cost of repairs/service carried out on his behalf by the purchaser at site. In such a case, the contractor shall be informed in advance of the works proposed to be carried out by the purchaser.
4. If it becomes necessary for the contractor to replace or renew any defective portion of the fittings or components under the para aforesaid then the provision of the said para shall also apply to the portions of the fittings, components and equipments so replaced and renewed until the expiry of six months from the date of such replacement or of renewal or until the end of the above mentioned period (36 months), whichever is later. Such extension shall not apply in case of defects of a minor nature the decision of the Senior Divisional Railway Manager (Traction), Southern Railway, MDU or his successor/nominee being final in the matter. If any defect be not remedied within a reasonable time during aforesaid period, the purchaser may proceed to do the work at the contractor's risk, and expense, but without prejudice to any other rights and remedies which the purchaser may have against the contractor in respect of such defects or faults.
5. The repaired or renewed parts shall be delivered and erected at site free of charge to the purchaser.

6. Any materials, fitting or components supplied shall also be covered by the provisions of this paragraph. The liability of the contractor under the guarantee will be limited to re-supply of equipments, components and fittings. Such re-supply shall be effected at the contractor's depot or in the event of closure of the depot at the stores depot of the Engineer-in-charge of maintenance of overhead equipment of the section covered by the contract.

7. In the case of materials, components, fittings and equipments supplied by the purchaser, no liability will rest on the contractor for failures on account of defective materials or workmanship and for any consequential damages. Such defective materials if not yet erected on line will be returned by the contractor to the purchaser and quantities will be considered for the purpose of final reconciliation over and above allowance.

8. In order to ensure trouble free working after the warranty period, the CAMC will be awarded as part of this contract to the same Firm which executes the work for a period of 5 years from the date of expiry of the Guarantee period. Separate agreement will have to be executed in this regard before expiry of the warranty period.

9. During the period of Guarantee / Maintenance Period, maintenance of PQCE equipment to be done by the firm as per RDSO/latest guidelines.

1.4. SPECIFIED RAILWAY STORES

No materials will be supplied by Railway.

1.5. RAILWAY STORES

1. If any material/complete set of materials for a particular item in the agreement is supplied by the Railway either at the contractor's request or suo moto in order to prevent any possible delay in the execution of the works likely to occur due to the contractor's inability to make adequate arrangement for supply thereof or otherwise, recovery will be made from contractor's bill 'at the accepted rate in the agreement for that particular item (in case of complete set of material)' or 'the issue rate/market rate prevailing at the time of supply, whichever is higher (in case of any part/component forming part of a complete set of materials for a particular item)' plus 5% on account of initial freight and 2 % on account of incidental charges together with supervision charges at 12.5% of the total cost inclusive of material, freight and incidental charges. Freight between the Railway's source of supply and site of work shall be to the Contractor's account.

2. For example:

1.	The cost of material/ accepted rate	-	Say Rs.	100.00
2.	Initial freight @ 5%	-		5.00
3.	Incidental charges @ 2%	-		2.00
4.	Total	-		107.00
5.	Supervision charges @ 12.5%	-		13.38
6.	TOTAL	-		120.38

3. In the case of a part / component forming part of a complete set of materials for a particular item, the recovery will be made at the last purchase rate or at the budgetary rate obtained from an RDSO/CORE approved source within a period of 6 (six) months from the date of completion of the work.

4. If, however, the material required by the contractor is not available in Railway's stock or the Railway decides not to supply the same, be that for whatever reason, the Railway shall not be bound to arrange for the supply at cost quoted above, or at any other cost nor will this fact be accepted as an excuse for delay in execution of works.

5. If the contractor runs short of materials and such materials are available in the Railways stock, the materials may be supplied by the Railway on loan basis to the contractor, who will return these on receipt of the supplies or within 3 months whichever is earlier. This is subject to a written request and production of a standing indemnity bond by the contractor. If the contractor fails to return the materials within the above mentioned period, recovery will be made from the contractor's bill as detailed in clause No. 1 & 2 above.

1.6. LADDER TROLLEYS

The contractor may use light ladder trolleys on tracks for carrying out installation of droppers and adjustments of traction overhead equipment. The ladder trolleys shall not be more than 200 Kg and should be capable of being removed from the track easily and quickly.

1.7. TOWER WAGON

For final checking of OHE only, Tower Wagon will be spared by Railways free of charge. The Tower Wagon shall not be utilized for transportation of Contractor's materials or released materials including masts.

1.8. CONTRACTOR'S SUPPLY ITEMS:

- a) All the materials required for execution of this work has to be arranged by contractor.
- b) The contractor has to make his own arrangements for transporting men & materials to the site of work
- c) The contractor has to make his own arrangements for storing the materials proposed to be utilized by him. No responsibility will be taken by the Railways for the loss of contractor's materials.
- d) The contractor should have the expertise and all kinds of special tools/ equipments for execution of the work as per the schedule. The contractor has to make available all the tools and plants required for executing this work.

1.9. TRAFFIC BLOCKS / POWER BLOCKS

1) The Railway will make arrangement to obtain traffic blocks (herein after referred to as "blocks") necessary for the running and / operation of work trains and light ladder trolleys and track Lorries for works to be carried out along or adjacent to the track. The contractor shall, however carry out maximum amount of work possible without blocks. Works such as grouting of traction masts, muffing, and erection of brackets shall invariably be done without traffic blocks. Installation of droppers and adjustment of traction overhead equipment may also be permitted to be carried out with light ladder trolleys protected by banner flags in accordance with general and subsidiary Rules of Indian Railways, under power block, if necessary.

2) Blocks will normally be granted during day light hours; if however, it becomes absolutely necessary, block may be granted during night also. The contractor shall confirm that he will equip himself to carry out all construction work during night blocks, efficiently, by suitable special lighting equipments without any extra cost, if required to do so. The blocks granted will ordinary be on one

track at a time over a distance covered by one or two consecutive block sections. In case of blocks to be granted after sunset, the contractor will be informed at least 7 days in advance. The duration of blocks, normal and maximum, which would ordinarily be granted on different tracks and in different section, during day and / or night time. Blocks shall not be availed of by the contractor when it is not possible for him to complete the specified work within the block period granted by the Railway.

3) The contractor shall be levied with penalty as per Railway's prescribed rules in case of power block/ Line block burst as decided by Engineer in-charge.

4) All efforts will be made to sanction maximum power block. However, it depends entirely on nature of traffic. Hence, it shall not be made an excuse for delay in execution of work.

1.10. SAFETY MEASURE

1.10.1. Safety Rules to be followed during working

The contractor shall be solely responsible for the safety of all the staff deployed by him. In case of any injury or accident to the staff while on duty, the contractor is liable for their compensation. Railway will not take any responsibility in such cases.

The contractor shall provide badge, uniform safety belts, shock proof safety shoes, raincoats and helmets etc. to all his staff who are authorized to work on OHE.

The contractor shall have to take all necessary precautions to prevent possible electrical accidents due to proximity of adjacent live OHE, unless otherwise a power block is granted on the adjacent line. The contractor shall also take all precautions to protect his staff working on the line against traffic (running of trains involving both longitudinal and cross movements) on the working/adjacent lines.

1.10.2. Accident, Safety of Men and Material.

1. The contractor shall be fully responsible for ensuring safety at all times and shall bear the cost of all damages in cases of accidents/ unusual occurrences resulting in damages to Railway property.

2. The contractor shall not permit their staff to work on the posts carrying overhead conductors or any other current carrying parts unless he had received in writing the permit to work from the authorized Railway representatives. He shall have to ensure that the supply lines are dead and earthed before commencing the work on the overhead conductors or any other current carrying parts.

3. The Tenderer/Contractor must ensure the safety of the labourers engaged by him while executing the work and the Railway will not be responsible for any injury sustained by the labourers due to any accident or any other fatalities. The labourers should be fully aware of all the safe working practices on 25 kV AC Traction. The Contractor shall take all precautionary measures not only for protection of his own personnel moving about or working on the Railway premises, but also confirms to the rules and regulations of the Railways in this respect.

4. The contractor shall take all precautionary measures in order to ensure the protection of his own personnel moving or working on the Railway premises, but shall then conform to the rules and regulations of the Railway. If and when, in the course of the work there is likely to be any danger to persons in the employment of the contractor due to running traffic while working in the Railway

sidings and premises, the Contractor shall provide necessary protection i.e. Flagmen, Flag etc. required in block working. Competency for the above shall, however, be given by the Railway authorities. The purchaser shall remain indemnified by the contractor in the event of any accident occurring in the normal course of work, arising out of the failure of Contractor or his men to exercise reasonable precaution at all places of work.

5. Blasting of rock for foundation work shall be done only after due notice is given to the Railway and time/s and date/s for blasting operation agreed to by the Railway. Blasting, if required to be done in the vicinity of the track, shall not be undertaken until the Railway's flagmen on duty take necessary steps to protect trains and the track is adequately protected by the contractor against damages by blasted rock. The contractor shall follow detailed instructions, which will be issued to him regarding blasting operations in the vicinity of tracks.

6. During stringing operations, every care shall be taken to prevent conductors hanging low over tracks on which traffic block has not been given. All conductors shall be pulled out before traffic block is cleared so that such conductors do not infringe with moving traffic.

7. Ladder trolleys, if required, shall be used with caution. They shall not be put on track/s until purchaser's supervisor is on duty. The contractor shall provide his own flagman with flag for protection of the trolleys and the purchaser's representative authorities in writing for the trolleys to be put on the tracks, Ladder trolleys shall be promptly removed on instructions from the purchaser's representative and well in advance of trains. No claim shall rest on the purchaser in the event of a ladder trolley being run over by train. The flagmen for the above job will be provided by the contractor.

8. The contractor shall abide by all Railway regulations and Indian Electricity Rules, 1956 in force for the time being and ensure that the same are followed by his Representative, Agent or sub-Contractor or workmen. He shall give due notice to his employees and workers about provision of this para.

9. While working within station limits, especially on platform/passenger platforms, the contractor shall ensure that at all times sufficient space is left for free movement of passengers. He must cover and/or barricade the excavations carried out in such areas and continue to maintain these, till the work is completed, with a view to avoid any accident to public or to Railway staff.

10. The works must be carried out most carefully without any infringement of the Indian Railway Act or the General and Subsidiary Rules in force on the Railway, in such a way that they do not hinder Railway operation nor affect the proper functioning of or damage any Railway equipment, structure or rolling stock except as agreed to by the Railway provided that all damage and disfiguration caused by the contractor of any railway property must be made good by the contractor at his own cost failing which, cost of such repairs shall be recovered from the contractor.

11. If safety of track or tracks, drainage etc. is affected, as a consequence of works under taken by the contractor, the contractor shall take immediate steps to restore normal conditions. In case of delay, the Railway shall, after giving due notice to the contractor, in writing, take necessary steps and recover the costs from the contractor.

12. If at any time, the works to be carried out directly concern the safety of trains, the contractor staff must comply fully with the Railway regulation given to him by the authorized Railway staff. The contractor's employees and workers may for no reason operate any installations concerning train safety or train movement. They shall notify the authorized representative, of the Railway who will take all necessary steps in this regard.

13. The contractor shall be responsible for the safe custody of all equipment till provisional acceptance. Should the situation warrant posting of armed guards for protection from thefts, the same will be provided by the Railway, at his own cost and at his discretion. The contractor shall apply to the Railway explaining the circumstances under which posting of armed guards is considered necessary by him. At the same time, the details of the requirement and the number of personnel of armed guards, where and when required, shall also be furnished.

14. The contractor shall ensure the unauthorized, careless or inadvertent operation of switchgear, which may result in accident to staff and/ or damage to equipment, does not occur.

1.11. PROVISIONAL ACCEPTANCE

- 1) Provisional Acceptance Certificate (PAC) for each PQR equipment will be issued immediately after all tests are completed to the satisfaction of the purchaser, and after successful commissioning of the power quality restorer and proving by measurement that the harmonic levels and power factor are within the limits to the satisfaction of Railways. The measurements should be done by TANGEDCO or Government authorized agency or NABL accredited agency, measures and certifies that the level of harmonic and power factor under prescribed level by RDSO Specification. The cost of such power Quality measurement shall be borne by the contractor.
- 2) After completion of the work the contractor can seek the provisional acceptance certificate which shall be issued after the work completed as per point (1) above and its inspection by the authorized Railway Engineer-in-charge of the work.

1.12. DEFECTIVE EQUIPMENTS TO BE CHANGED

Notwithstanding the issue of Provisional Acceptance Certificate and partial or full use of any equipment of the completed equipment, or any portion thereof before it is finally taken over at the end of the guarantee period be found to be or to have become defective in course of usage by the Railway due to faulty material design or workmanship or otherwise fails to fulfill the requirement of the contract, and/or its purpose the purchaser shall normally give the Contractor prompt notice setting forth the particulars of each defects or failure and the contractor shall forth with make the defects good or modify or replace the equipment as may be directed by the purchaser's Engineer at his own cost in all aspect to make it satisfactorily with the said requirements. Should the Contractor fail to do within a reasonable time the service of the said notice upon him or should time not permit service of such notice the purchaser may repair or reject and replace the whole or part of such defective equipment as the case may be at the cost of the contractor. The contractor's fully liability under this clause shall be satisfied by the payment to the purchaser of the extra total cost if any of such replacement delivered and erected as provided for in the original contract, such extra cost being the ascertained difference between the price paid by the purchaser under the provisions above mentioned for such replacement and the contractors price for the plant so replaced plus the sum if

any, paid by the purchaser to the contractor in respect of such defective equipment. Should the purchaser not so replace the rejected equipment within a reasonable time the contractor's liability under this clause shall be satisfied by the repayment by the contractor of all moneys paid by the purchaser to him in respect of such rejected equipment. Rejected/ defective materials shall be returned to the contractor to the extent possible. Provisions of this para will apply only in respect of the equipments and components supplied by the contractor or his subcontractor.

1.13. USE OF REJECTED EQUIPMENT

In the event of such rejection as aforesaid, the purchase shall without prejudice to his other rights and remedies and in particular without prejudice to his rights under the clause just preceding, be entitled to the use of the rejected equipment for a time reasonably sufficient to enable him to obtain other replacement equipment. During such period if the rejected equipment is used commercially the contractor shall not be entitled to the payment on energisation until such rejected equipment is rectified and/or replaced, but the purchaser shall not be entitled to claim any damages arising out of rejected equipment in respect of such period.

1.14. FINAL ACCEPTANCE

The final acceptance of the PQR at each TSS shall take effect from the date of expiry of the period of guarantee (Maintenance period) of each TSS, provided that the firm has complied fully with his obligations against the contract as per the terms & conditions of the agreement.

After expiry of the period of guarantee for each PQR, a certificate of final acceptance for that PQR shall be issued by the purchaser, and the last of such certificate shall be termed the 'Last and final acceptance certificate'. The contract shall not be considered as completed until the issue of final acceptance certificate by the purchaser.

If on the other hand, the firm has not so complied with his obligations against the contract as per the terms & conditions of the agreement, the Railway may either extend the period of guarantee until the necessary works are carried out by the firm or carry out those works or have them carried out suomoto on behalf of the firm at the firm's expense. After expiry of the period of guarantee, a certificate of final acceptance shall be issued by the Railway.

1.15. PENALTY CLAUSE

1. While working, contractor's personnel should not smoke or consume any liquor or be in a state of intoxication. In case if it is noticed any time that they are either smoking or under influence of liquor, a penalty of Rs. 2,000/- per incident per person shall be imposed to the contractor and such persons will not be allowed for duty again.

2. Inspection at regular intervals will be done by Railway representative, if any safety violations observed penalty of Rs. 1000/- will be levied per incident.

3. The behavior of contractor or his staff (including supervisor) with Railway officials shall be courteous in the matters of execution of the contract. If a contractor staff is misbehaving with the Railway officials, a penalty of Rs.1000/- per each incidence per person will be levied and the particular contractor staff should be replaced with suitable new person. If contractor himself misbehaves with the Railway officials, a penalty of Rs.2000/- per each incidence / occasion will be levied. In case the

situation repeats further, the contract shall be terminated duly forfeiting PG and other dues if any payable against the contract. The failed contractor shall be debarred from participating in re-tender for that work. In this matter Sr.DEE/TRD/MDU's decision is final.

4. All the works shall be carried out by strictly following the safety measure mentioned in special conditions of contract and elsewhere in the tender document. If any damages and disfiguration caused to any Railway property by the Contractor due to the negligence of contractor's staff in carrying out the scheduled work, it shall immediately be brought to the notice of the concerned Railway official and it must be made good by the Contractor at his own cost failing which cost of such repairs / damages or detentions shall be recovered from the Contractor. Further non-reporting of such incidents within 15 minutes of happening will attract penalty as decided by Sr.DEE/TRD/MDU.

5. If Contractor fails to carry out the work as mentioned in agreement according to the need of Railway and if it causes loss or inconvenience to Railway, then a penalty of Rs.1000/- per incident (Occasion) shall be imposed.

6. PENALTY FOR BURSTING OF POWER BLOCK: Penalty will be levied at the rate of Rs.10,000/- for the first thirty minutes or part thereof and at the rate of Rs.5,000/- for every 15 minutes thereof, if the power block is busted by the contractor and the train services are affected. If the train services are not affected, the purchaser at his discretion may waive such penalty. Bursting of power block means the extra time taken above the granted power block period.

7. During Comprehensive Annual Maintenance contract (CAMC) for maintaining the PQR systems, if the contractor fails to attend the failure in time, they will be penalised suitably, upto a maximum of Rs.10,000/- per day or part of the day per sub-station, as decided by Sr.DEE/TRD/MDU, based on the severity of the consequence of delayed attention and this will be deducted from the contractor's maintenance contract bills.

8. If the Contractor fails to execute and complete the work within the time specified in the Agreement, or within any period of extension granted on account of the Railway, the penalty will be imposed as per the GCC.

1.16. OTHER CUSTOM CONDITIONS

1. Inspection: The work awarded to you will be inspected by the Senior Divisional Electrical Engineer, Traction Distribution, MDU Division, Southern Railways or his authorized representative at site, while in progress / after completion.

2. Guarantee / Maintenance period: - Warranty/Guarantee as per governing RDSO specifications. Warranty period is of Three Year from the date of Provisional Acceptance Certificate issued for each PQR as certified by concerned engineer in-charge of this work or Sr.DEE/TRD/MDU's authorized representative.

3. The contractor shall arrange at his own cost all tools, plants, and facilities as necessary for carrying out the work against schedule items in compliance with the specification.

4. The contractor's staff should not carry any unauthorized/dangerous/explosives within the Railway premises.

5. The contractor shall not be entitled to any extra payment due to hindrance resulting from normal Railway operations, such as delay on account of adequate number and duration of blocks not being granted, but the purchaser shall grant a reasonable extension of time to the contractor for delays beyond his control.
6. Supply of Material should be done with prior approval of Sr.DEE/TRD/MDU or his authorized representative by sending a sample one to this office. The contractor shall furnish to the Sr.DEE/TRD/MDU or his successor nominee during the first week and third week of every calendar month a progress report showing progress of finalization of designs and drawings materials and equipment received at site and the works carried out during the preceding month up to date progress of these items along with the total quantum of designs and drawings materials and equipments and the works required for the contract.
7. Safety should be ensured while working as per specifications and Norms as mentioned above especially while Painting TRD equipment.
8. Sr.DEE/TRD/MDU or his authorized representative has rights to test the sample of the supplied material during work Execution/Erection.
9. Any Ambiguity between Specification and Explanatory Notes, the decision of Sr.DEE/TRD/MDU or his authorized representative is treated as final.
10. The contractor shall in consideration with Railway submit a weekly power block programme for work, 7 days in advance of the work for which programme has been submitted. The contractor shall execute the work keeping to the approved time schedules.

1.17. SPECIFICATIONS AND DRAWINGS

The contractor may make his designs and drawings to suit the requirements to install the same without disturbing the existing arrangements and any hindrance to smooth functioning of the traction substation and train operation. The designs should be in accordance with RDSO Standard No. IS/RDSO-TI/0002:2023 for PQR or latest. For other items also the tenderer shall follow the standard general arrangement drawings and specification relating to the equipment components and fittings specified in the RDSO Specification. Copies of the above standard drawings are available for inspection in the drawing office of the Sr.DEE/TRD/MDU or his successor/nominee. The list of drawings and drawings mentioned are for guidance only and the latest of the same is to be considered at the time of procurement/execution.

2.0 EXPLANATORY NOTES FOR ITEMS DESCRIBED IN THE SCHEDULE OF WORK

The explanatory notes given below are for the general guidance of the Contractor. However, the work shall be carried out as per the instructions of Railways' site supervisor within the scope of work as specified in the explanatory notes.

2.1. SECTION – I – GENERAL:

Explanatory notes for various items of work included in the 'Schedule of Work' are given below:

1. The basic quantities of components and materials required to make up a unit of work for selected items are indicated for guidance only. There may be minor variations to suit erection but no adjustment in prices shall be made on that account. In estimating the prices for various items of work provision for loss and wastage in transit and erection should be provided for, over and above the basic quantities of components and materials required to make up a unit of work, indicated herein except where otherwise specified for materials supplied by the Railways.
2. In the explanatory notes given in Section-II of this chapter, the term 'small parts steel work' is meant to cover fabricated steel work made from rolled steel sections, complete with bolts and nuts and washers wherever required for fastening the small parts steel work to any structural member. The terms 'attachment' wherever used is intended to cover castings, forging, machined welded components or fittings which are attached directly to a structural member, or mounted on small parts steel work and shall include bolts and nuts fastening the attachment to the structural member of small parts steel work.
3. In the explanatory notes given in section-II of this chapter, the term 'bimetallic connection' is meant to cover any connection between a copper conductor and an aluminium conductor. The clamps used for such connections shall be made of a suitable aluminium alloy or copper alloy and the copper/ aluminium conductor shall be wrapped with a bimetallic aluminium/copper strip to prevent direct contact between aluminium and copper.
4. Special notes for measurements are included in section-II of this chapter under various items wherever necessary.

2.2. SECTION – II – EXPLANATORY NOTE FOR EACH ITEM:

Item No. 1 to 4 & 9, 10: Design, Manufacture, Supply, Erection, Testing and Commissioning of Power Quality Restorer with all accessories as per RDSO standard no. IS/RDSO-TI/0002:2023 or latest – **3 MVA Rating** at Palani Traction substation (PLNI/TSS), Ramanathapuram Traction substation (RMD/TSS) and Teni Traction substation (TENI/TSS).

The price shall cover the **design, manufacture, supply, erection, testing and commissioning** of Power Quality Restorer (Power Quality Compensating Equipment) of **minimum 3 MVA Rating (however, higher ratings shall also be acceptable)**, complete with all fittings and accessories as per relevant specification including all civil, mechanical and all electrical works such as terminal connectors and fixing bolts.

The price for erection shall include proper alignment of the equipment in a suitable position. It shall also cover the supply and erection of an enamelled number plate along with fixing bolts.

The Power Quality Compensating Equipment for 25 kV Railway Traction substation shall conform to RDSO Standard No. IS/RDSO-TI/0002:2023 or latest.

Item No. 5 to 8: Design, Manufacture, Supply, Erection, Testing and Commissioning of Power Quality Restorer with all accessories as per RDSO standard no. IS/RDSO-TI/0002:2023 or latest – **6 MVA Rating** at Gomangalam Traction substation (GMGM/TSS), Manamadurai Traction substation (MNM/TSS).

The price shall cover the **design, manufacture, supply, erection, testing and commissioning** of Power Quality Restorer (Power Quality Compensating Equipment) of **minimum 6 MVA Rating (however, higher ratings shall also be acceptable)**, complete with all fittings and accessories as per relevant specification including all civil, mechanical and all electrical works such as terminal connectors and fixing bolts.

The price for erection shall include proper alignment of the equipment in a suitable position. It shall also cover the supply and erection of an enamelled number plate along with fixing bolts.

The Power Quality Compensating Equipment for 25 kV Railway Traction substation shall conform to RDSO Standard No. IS/RDSO-TI/0002:2023 or latest.

Note:

1. Existing TSS schematic drawings provided in Tender Document Part-3 are for reference purposes only. The Contractor shall verify all site conditions, existing installations, dimensions, interfaces, and other relevant details before quoting and prior to finalizing the design and execution of the works. No claim arising out of any discrepancy between the reference drawings and the actual site conditions shall be entertained by the Railway.
2. Payment will be not made for supply portion separately.
3. Payment towards Supply, Erection, testing & commissioning of the Power Quality Compensating Equipments in any one of the TSSs will be made only after successful commissioning and proving by measurement that the harmonic levels and power factors are within the limits to the satisfaction of Railways. On completion of commissioning of Power Quality Restorer for any TSS, the

payment for PQR for that particular TSS will be made only after the TANGEDCO or Government authorized agency or NABL accredited agency for power quality measurement, measures and certifies that the level of harmonic and power factor under prescribed level by RDSO Specification. The cost of such power Quality measurement shall be borne by the contractor.

4. **In addition to deducting 5% of contract value (excluding CAMC cost) towards security deposit, firm shall provide BG for the 90% or 95% (as the case may be) * of the bill value. This 90% or 95% (as the case may be) * bank guarantee shall be given against each single payment made for each substation. The BG submitted for each TSS against the payment made for that TSS shall be released after one year from the date of issue of PAC or till TANGEDCO measures and certifies that both the Power factor and the total harmonic demand distortion for current (TDDi) are within the limit as per RDSO specification for that particular TSS, whichever is later. BG will be released after 18 months from date of PAC If TANGEDCO doesn't come up for measurement during the time and the BG shall be kept valid by the firm till it is released. The Warranty would still continue for 3 years.**

*If the payment for PQR for any TSS is made after releasing of the Performance Guarantee, the value of the BG submitted shall be 95% of the bill value, instead of 90%.

5. In the event of any equipment failure or some such thing, affecting it's performance and leading to levy of surcharges by TANGEDCO towards poor harmonic control, from the date of issue of Provisional acceptance certificate till the expiry of the warranty period, then the Firm has to make good for the losses suffered by the Railways and the BG/ Performance guarantee (PG), Security Deposit (SD), given by the Firm against the payments received by them will act as security against this.

6. PQR shall be capable of maintaining the power factor between 0.95 lag to 0.95 lead at all loading conditions and to limit the total harmonic demand distortion for current (TDDi) within the maximum permissible limit as per Cl. 5.3 of IEEE 519-2014 (for system nominally rated above 69 Kv through 161Kv) or latest . In any case, till the expiry of the warranty period, any penalty paid by the railways towards poor power factor and harmonic surcharge, if any, that will have to be made good by the Firm against the BG/PG/SD with Railways. In case, even after the PQR is commissioned, and the TANGEDCO is continuing to collect harmonic surcharge based on their previous assessment conducted before commissioning of PQR, till it's next assessment of harmonics level, in any TSS, such surcharges need not to be compensated by the contractor. However, when TANGEDCO measures the harmonic level in the next opportunity and continues to collect surcharge because of the unacceptable level of harmonics, the firm shall have to compensate the surcharge including the surcharges collected from the Railways during the period between commissioning of PQR and day in which the TANGEDCO measures the harmonics level i.e. the surcharges imposed by the TANGEDCO shall have to be borne by the firm against the security with Railways, till TANGEDCO measures and certifies that both the Power factor and the total harmonic demand distortion for current (TDDi) are within the limit as per RDSO specification. The firm shall pursue the TANGEDCO for measurement of Power Quality, as soon as the commissioning of the PQR system is completed.

7. In order to ensure trouble free working after the warranty period, the CAMC will be awarded

as part of this contract to the same Firm which executes the work for a period of 5 years from the date of expiry of the Warranty period. Separate agreement will have to be executed in this regard before expiry of the warranty period.

8. The Contractor shall submit the relevant **Quality Assurance Test Certificates pertaining to building works, foundation works, and soil examination** whenever required by the Purchaser.

2.3. SECTION – III – COMPREHENSIVE ANNUAL MAINTENANCE CONTRACT (CAMC):

1. In order to ensure trouble free working after the warranty period, the CAMC will be awarded as part of this contract to the same Firm which executes the work for a period of 5 (Five) years from the date of expiry of the warranty period.

2. It is mandatory for the tenderers to quote the year-wise rate for comprehensive maintenance for a period of Five years after expiry of the warranty period. Though the rates quoted are binding, Railway reserves the right to enter into an agreement and proceed with the CAMC just before the expiry of the warranty period depending upon the prevailing situation at that point of time.

3. Separate agreement will have to be executed in this regard before expiry of the warranty period. The payment for each year towards CAMC is fixed and same will be paid once a year after compliance as per CAMC agreement. **During CAMC period all the materials/spares and manpower shall be provided by the tenderer for maintaining/repairing the equipments supplied by the tenderer.**

4. **Since the CAMC cost forms part of the Capitalized Cost calculation of the PQR system, the tenderer shall quote and submit the CAMC cost for each TSS as part of the Financial Bid attachments. Failure to quote the CAMC cost for any TSS shall render the offer liable for summary rejection.**

The detailed guidelines for entering into CAMC is given below

Guidelines for Comprehensive Maintenance Contract for power quality restorer

1. The genesis of entering into maintenance contract is to ensure 100% functioning of all equipment's, supplied by the contractor. The Scope of work includes maintenance of all equipment's supplied by the contractors including replacement of spares.

2. Railway Staff will associate during the periodical maintenance work (typically Quarterly maintenance) but sole responsibility of maintenance and attending of breakdown will be of the firm. The detailed schedule of maintenance as considered necessary would be finalized in the maintenance contract agreement which will be signed between the purchaser and the Tenderer. All the equipment failures shall be attended in a time bound manner based on the severity of failure so as to avoid penalty by TANGEDCO. If the contractor fails to attend the failure in time, they will be penalised suitably, upto a maximum of Rs.10,000/- per day or part of the day per sub-station, as decided by Sr.DEE/TRD/MDU, based on the severity of the consequence of delayed attention and this will be deducted from the contractor's maintenance contract bills.

3. The firm shall furnish details of their service engineers along with their names local address, telephone numbers, mobile phone numbers, etc., for contacting at any time especially during

breakdown. In case the nominated engineer is not available for any reason alternate arrangement shall be made by the firm and shall be notified to Railways immediately.

4. The Contractor shall keep available an experienced engineer at **Palani, Manamadurai and Teni** with necessary equipments/tools to attend any defective equipment's. This engineer shall be available at Palani, Manamadurai and Teni during working hours of 09:00 hours to 17:00 hours, on each day during the period of CAMC. The tenderer shall provide the residential address of the engineer along with his Mobile number so as to contact him in case of emergency at any time of the day. Any failures will be reported to Contractor's Engineer, who will in turn take immediate action to attend the failure. The above-mentioned locations are subject to change as per the instructions of SrDEE/TRD/MDU.

5. The payment for each year towards CAMC is fixed and the same will be paid once in a quarter after compliance as per CAMC agreement.

6. Every quarterly, at all substation harmonics level to be measured and has to be kept within permissible limit as per specification No.IS/RDSO-TI/0002:2023 or latest and the same to be submitted to Sr.DEE/TRD/MDU or their authorised representative. If harmonics level exceeds the permissible limit contractor has to take immediate action to bring the harmonics level with in the limit while doing so contractor has to maintain the power factor with in permissible limit as specified in the specification. All the cost required to bring the harmonics within permissible limit has to be borne by the contractor.

7. If harmonics level/power factor as prescribed in the specification is **not maintained in any particular sub-station for any month then the CAMC payment for the particular sub-station will not be paid. In addition, Penalty as levied by TANGEDCO for a particular sub-station has to be borne by the contractor.**

8. Any modification, up gradation of power quality restorer falls within the scope of the maintenance contract and the contractor should be capable of executing the work.

9. Each case of failure or breakdown of any component, the contractor will have to explain, remedial action taken and preventive measures to be taken avoid recurrence. In case any design problem is noticed, the same will have to be rectified immediately by the firm without any charges. Each case of failures, that shall be clearly documented in a format to be finalized in consultation with the purchaser and a periodical report (monthly) must be prepared and submitted to Sr.DEE/TRD/MDU, in the following format.

S.No.	Location	Failure Occurred		Failure Rectified		Total Duration	
		Date	Time	Date	Time	Day	Hours

10. Railways will supply no materials for maintenance or replacement during the maintenance contract period and the contractor shall arrange the same.

11. Quarterly payment will be made at the end of every quarter on pro rata basis. Payment will be arranged by Sr.DFM/MDU. While submitting the bills the following details duly signed by SSE/Rlys and contractor shall be submitted.

S.N o.	Location of sub station	Last Schedule Maintenance Date	Next Due date of Schedule maintenance.	Actual Date of Schedule maintenance.

12. Contractor's Service engineer shall be well trained to follow safety measures while working with the equipment's. Railways representative shall jointly sign the preventive maintenance/breakdown maintenance report.
13. Contractor shall provide guarantee for the units/cards/equipment's serviced by the contractor for a period of 6 months from the date of re-commissioning of the unit/card/equipment.
14. All the charges towards repair/service of the defective modules relating to the power quality restorer shall be borne by the contractor only.
15. The contractor and Sr.DEE/TRD/MDU or his successor will sign a contract agreement for governance of the maintenance contract based on these guidelines.
16. A separate performance guarantee (PG) for this CAMC work shall be submitted at the rate of 5% of the total CAMC value before signing the agreement for CAMC. The PG shall be given in the form of Bank guarantee (BG) or in other forms as mentioned in the GCC. If the PG is submitted in the form of BG, it shall be as per the format available in Annexure and it shall remain valid for the complete CAMC period plus 60 days.
17. Security deposit as per GCC will be deducted at the rate 5% of the CAMC value.
18. Proforma for Quoting rates for CAMC is in Appendix O.

3.0 GENERAL SPECIFICATIONS

3.1. SECTION – 1GENERAL

3.1.1. INTRODUCTION

This part deals with general information and criteria for design, manufacture, supply, erection, testing and commissioning of Power Quality Compensating Equipment per RDSO Standard No. IS/RDSO-TI/0002:2023 for PQR or latest for Traction substation.

3.1.2. SCOPE OF WORK

Provision of Power Quality Restorers for AC Traction Systems at the Traction Substations in Palani, Gomangalam, Manamadurai, Ramanathapuram and Teni for Harmonic suppression and higher power factor

Modification to existing equipments/structures:

1. While erecting the PQR, if existing ballasts spread in the TSS to be removed, it has to be removed and kept aside properly for re-laying. Any deficiencies or ballasts for new equipments to filled with 20 mm ballast to the depth of 100 mm uniformly.
2. If extra fencing to be provided or existing fencings to be relocated including provision of extra entrance for the TSS , it should be done by the firm at their own cost.
3. If existing structures or foundations are infringing the erection of PQR, it may be relocated after the approval of the purchaser at their own cost.
4. If existing cables/cable trenches are to be rerouted for erection of PQR with their associated equipments, it shall be done after the approval of the purchase at their own cost.
5. Since these TSSs are unmanned and located in remote areas, an **adequate number of surveillance cameras shall be installed inside the control room and in the outdoor equipment area**. The camera system shall be integrated with an NVR equipped with a hard disk capable of storing a minimum of 30 days of recorded data.
6. If not able to maintain the power factor as per the RDSO specification, provision to be made in the PQR system to issue close/open commands to fixed capacitor banks for maintaining the unity power factor with IGBT or any further improved/advanced electronic switching to meet the PF and harmonics requirement. The same shall be carried out by the contractor at their own cost after obtaining approval from the purchaser.

3.1.3. DEFINITIONS

The following definitions shall apply for the purpose of this specification, in addition to definitions applicable to standard equipment:

- a. “Grid Sub-Station” means the Sub-Station of a power supply authority which is connected to the grid network in the area and from which 110kV power is supplied to the Railway for electric traction.
- b. “Interrupter” means the single pole single phase non-automatic circuit breaker capable of interrupting normal full load current.
- c. “Return Feeder” means the conductor of the feeder line from a Traction Sub-Station to the corresponding feeding station which is connected to the earth terminal of the 110/27 kV traction transformer secondary winding.
- d. “Traction Overhead Equipment” means the Overhead conductors and other associated equipment and structures erected over the track to supply power to the electric locomotives.
- e. “Traction Sub-Station” means the 110/25 kV Sub-Station for supply of power to traction Overhead Equipment (installed by the Purchaser) in accordance with this specification.

- f. "25 kV feeder" means the conductor or feeder line from the Traction Sub-Station to the corresponding feeding station and which is connected to the unearthed terminal of the 110/27 kV traction transformer secondary winding.
- g. "Feeding station" means the 25 kV interruptors and other associated equipment as also structures erected near the track, within or outside the Sub-Station boundary, for feeding different sections of the traction Overhead Equipment.

3.1.4. SYSTEM PARTICULARS

- a. Power will be received at 110 kV and stepped down to 25 kV by means of single phase traction transformers. On the primary side the traction transformers will be connected across two phases of the 110 kV, 3 phase system. On the secondary side one terminal of the transformer will be solidly earthed and also connected to the return conductor the other terminal will be connected to the traction Overhead Equipment through 25 kV switch gear.
- b. The traction Sub-Stations will normally be unattended and all switching operations will be carried out by remote control from a Remote Control Centre.

3.1.5. CLEARANCES

- a. No part of the installation which is ordinarily live shall be erected at a height less than
1. 4.6 m on the 110 kV side
 2. 3.8 m on the 25 kV side
- b. Clearances between any live part and parts at earth potential (or parts likely to be earthed) shall not be less than 1800 mm and 500 mm for 110 kV and 25 kV respectively.
- c. On the 110 kV side clearance between phases shall not be less than 2 m. the centre distance of 110 kV bays shall not be less than 9 m.
- d. The layout of the Sub-Station shall be such as to provide suitable clearances to permit work on the equipment in one bay safely with adjacent bay alive.

3.1.6. EARTHING

- a. Earthing of Traction Sub-Stations shall generally comply with the code of practice of earthing IS : 3043-1987 or latest and RDSO's code of practice ETI/PSI/120(2/91) with A&C slip no. 1 or latest except where otherwise specified. The earthing system also confirm to Indian Electricity Rules with latest amendments.

b. EARTHING SYSTEM

At each Sub-Station two separate earth circuits will be provided. One for earthing the HT equipment and the other for earthing the LT equipment inside the control room.

c. HT EARTHING GRID.

A combined resistance of earthing system, in any sub-station shall not be more than 0.5 ohms. To ensure this, the HT earthing grid shall be formed by means of bare mild steel rods of appropriate size as indicated in Clause (d) below buried at a depth of about 600 mm below the ground level and connected to earth electrodes by means of two separate and distinct connections made with 75mm x8mm *Galvanised MS Flats. The connection between *Galvanised MS flat and *Galvanised MS rod shall be made by welding, while that between, the earth electrodes and the MS flats through MS links by bolted joints. As far as possible the earthing grid conductor shall not pass through the foundation block of the equipments. All crossings between longitudinal conductors and transverse conductors shall be joined by welding. The transverse and longitudinal conductors of the earthing grid conductor shall be suitably spaced so as to keep the step and touch potentials within acceptable

limits. The overall length of the earthing grid conductor shall not be less than the calculated length as per the code of practice. The earth electrodes shall be provided at the outer periphery of the grid as indicated in the sketch as per RDSO specification No: ETI/PSI/120 (9/91) with A & C slip No:1 or latest. The earth electrodes shall be embedded as far away as possible from each other. Mutual separation between, them shall usually be not less than 6m. The Contractor shall submit detailed design calculation for the earthing system and obtain approval for the design/drawings.

d. Earthing grid conductor.

The size of the earthing grid conductor shall be decided based on the incoming system voltage and fault level. The size of the grid conductor for fault level up to 12000MVA will be 32mm dia and above 12000 up to 16000MVA 36mm dia and above 16000 up to 20000 MVA, 40mm dia MS rod respectively.

e. EARTH ELECTRODES.

The earth electrodes shall normally be of mild steel galvanised perforated pipe of not less than 40mm nominal bore of about 3m length provided with a spike at one end and welded lug suitable for taking directly *Galvanised MS flat of required size at other end. The pipe shall be embedded vertically into the ground as far as possible except in case of hard rock, it may be buried inclined, the inclination being limited to 30 degree from the vertical. The connection of *Galvanised MS flats to earth electrode shall be made through MS links by bolted joints. If the value of earth resistance specified may not be achieved with a reasonable number of electrodes connected in parallel such as in rocky soil or soil of high resistivity, the earth surrounding the electrodes shall be chemically treated by alternative layers of finely divided coke, crushed coal or charcoal and salt at least 150mm all around. However, coke treatment shall be used only where absolutely necessary and such electrodes shall not be situated within 6m of other metal work. In high embankments, use of electrodes longer than 3 m shall be considered so as to reach the parent soil to achieve earth resistance as specified.

f. SYSTEM EARTHING:

One terminal of the secondary winding of each traction transformer shall be earthed directly by connecting it to the earthing grid by means of a 75mm x 8mm *Galvanised MS flat, and to the buried rail by means of another *Galvanised 75mm x 8 mm MS flat. One designated terminal of the secondary of each potential, current and LT supply transformer shall also be connected to the earthing grid by means of two separate distinct earth connections made with 50mm x 6 mm *Galvanised MS flat.

g. EQUIPMENT EARTHING

The metallic frame-work of all outdoor equipments such as transformers, circuit breakers, Interruptors & Isolators as well as all steel structures shall be connected to the earthing grid by means of two separate and distinct connections made with *Galvanised MS flat of size 50mm x 6 mm upto 10000 MVA and 75mm x 8 mm *Galvanised MS flat above 10000 MVA up to 20000 MVA. Equipments on the secondary side of the traction power transformer and steel structures shall be connected to the earthing grid by means of two separate and distinct connections made with *Galvanised MS flats of size 50mm x 6mm. One connection shall be made with the nearest longitudinal conductor while the other shall be connected with the transverse conductor.

h. EARTHING INSIDE THE CONTROL ROOM

An LT earth circuit shall be provided inside the control room by means of 50 mm x 6 mm *Galvanised MS flat and connected to the main earth grid by two independent connections also made with 50 mm x 6 mm *Galvanised MS flat. The metallic frame work of control panels, LT AC and DC distribution

boards, battery chargers, remote control equipment cabinets, etc. shall be connected to the earth ring by means of 8 SWG galvanised steel wire.

i. EARTHING OF LIGHTNING ARRESTORS

In addition to the earth electrodes provided for the main earthing grid, an independent earth electrode shall be provided for each lightning arrestor. The earth electrode shall be connected to the ground terminal of the lightning arrestor as well as the main earthing grid by means of two separate and distinct connections made with 50 mm x 6 mm *Galvanised MS flat for 25 KV side lightning arrestor, and with 75mm x 8 mm *Galvanised MS flat for the primary side lightning arrestor. The earth electrode shall be provided as close as possible to the lightning arrestor and the connection shall be as short and straight as possible avoiding unnecessary bends. For lightning arrestors provided for the traction transformers, there shall also be a connection as direct as possible from the ground terminal of the lightning arrestor to the frame of the transformer being protected by means of two separate and distinct connections made with 50mm x 6mm *Galvanised MS flat for 25kV side arrestor and with 75mm x 8mm *Galvanised MS flat for primary side arrestor.

j. EARTHING OF FENCING UPRIGHTS AND PANELS

Each metallic fencing uprights shall be connected to the main earthing grid by means of two separate and distinct connection made with 50mm x 6mm *Galvanised MS flat. In addition, all the metallic fencing panels shall be connected to the uprights by means of two separate and distinct connections made with 6 SWG GI wire.

k. METHOD OF JOINTING

All the joints between the MS flats, MS rods or between MS flat and MS rods shall be made by welding only. No soldering shall be permitted. For protection against corrosion, all the welded joints shall be treated with red lead and afterwards thickly coated with bitumen compound.

3.1.7. EARTH SCREEN

The area covered by outdoor Sub-Station equipment shall be shielded against direct strokes of lightning by an Overhead earth screen comprising 45 tonne quantity 7/9 SWG or 19/2.5 mm galvanised steel stranded wire strung across pinnacles of the metallic structures as indicated in the drawings. The earth screen wires shall be fixed not less than 2.5 m above the live conductors so as to provide an angle of protection, not exceeding 30° to the equipment/bus bar below and shall be solidly connected to the Sub-Station earth circuit by means of 50mm x 6mm *Galvanised MS flats.

Note for Galvanised MS Flat:

1. *The galvanization shall be done as per RDSO specification No. ETI/OHE/13(4/84) with ACS 1 to 4 ensuring quality of zinc, base metal, surface preparation and galvanizing as per relevant standards as given in the above RDSO specification. The weight of the zinc coating to be adopted is 750 g/m².
2. *In case during installation, if galvanization is damaged due to hole drilling, welding, cutting, handling, etc., the rectification shall be done as per clause 8 of RDSO specification No. ETI/OHE/13(4/84) with ACS 1-4 (using zinc based solder/zinc based paints).

3.2. SECTION – 2 SWITCHING STATIONS, BOOSTER TRANSFORMER STATIONS AND L.T.SUPPLY TRANSFORMER STATIONS

3.2.1. CLEARANCES

No part of the installations which is live at 25 KV shall be erected at a height less than 3 m from the datum level. Clearance between any part live at 25 kV and any part at earth potential (or part likely to be earthed) shall not normally be less than 500 mm. This clearance may be reduced under special circumstances but in no case static clearance shall be less than 320 mm and any dynamic vertical and horizontal clearance 270 mm and 220 mm respectively. The clearance between any part live at 3 KV and any part at earth potential (or part likely to be earthed) shall be not less than 150 mm under static condition and 70 mm under dynamic conditions.

3.2.2. SETTING OF GANTRIES

The gantries are normally aligned parallel to the track. The minimum distance of the face of the gantry from the centre line of the nearest track is referred to as the setting of the gantry. The setting shall normally be 3.5 m. setting of the individual gantries of different stations will be furnished by the Purchaser.

3.2.3. DATUM LEVEL

The datum level will be furnished level of the gantry mast foundation. All vertical dimensions shall be stated with respect to this datum level. Datum levels of individual stations will be indicated on the location and connection diagrams.

3.2.4. MOUNTING OF EQUIPMENT AND BUSBAR ARRANGEMENT

The interrupters and isolators shall be mounted in such a way that these can be manually operated conveniently by a person standing in the ground. The indicators showing the 'OPEN' or 'CLOSED' position of the equipment shall be so arranged as to be visible from out-side the fencing enclosure on the side of the main gantry.

3.2.5. FENCING & ANTICLIMBING DEVICES

Every switching station, together with its associated control cubicle shall be enclosed by fencing except at feeding station that are located within the traction substation premises. The fencing shall have an anti-climbing device also at top.

At booster transformer and L.T. supply transformer stations suitable anti-climbing devices consisting of galvanized steel clamp fixtures shall be mounted in each most. The device shall be fitted below the transformer supporting beam or steel work.

Extension to the fencing panels at switching stations and Anti climbing device would be required.

3.2.6. NUMBERING

Each booster transformer Circuit breaker, interrupter, potential transformer L.T. supply transformer and isolator shall carry an enamelled number plate of approved design as per specification No. ETI/OHE/53 (10/84) with addendum and corrigendum slip No. 3 of 12/84 or latest. The purchaser will furnish the actual numbers to be allocated to the various equipments.

3.2.7. INTERLOCKING ARRANGEMENTS

An interlock shall be provided between each interrupter and its associated double pole isolator to prevent operation of the isolator from the open to the closed position or vice versa unless the interrupter is locked in the open position and to prevent operation of interrupter either manually or

by remote control unless the isolator is locked in the open or closed position. The interlocking device shall consist of a lock combined with an electrical contact to make or break the remote control circuit on the operating mechanism of the interrupter and a lock for the isolator operating mechanism and interlock key for the two locks.

3.2.8. EARTHING AND BONDING ARRANGEMENTS

Bonding and Earthing of all the equipment's and control room in substation have to be done as per bonding and earthing code of AC traction manual

3.2.9. CABLE CONNECTIONS

(a) All PVC cables provided out-door shall be either laid in the trenches or neatly clamped to the structures as approved by the Purchaser.

(b) TERMINATION OF CABLES-The cable shall be terminated neatly and all the cores arranged and dressed properly. Suitable indexed terminal strips or ferules shall be provided at all terminals to facilitate maintenance.

3.3. SECTION-3 FOUNDATIONS

3.3.1. SCOPE

This chapter deals with the designs of foundations and anchor blocks for traction structures carrying overhead equipment (including those of bridges), structures at switching stations and booster stations and other concrete work. It also deals with the specification for concrete.

The Contractor shall submit the relevant Quality Assurance Test Certificates pertaining to building works, foundation works, and soil examination whenever required by the Purchaser.

3.3.2. DESIGN OF FOUNDATION

(a) SOLID PRESSURE

For design of foundations for traction structures carrying overhead equipment the Contractor shall determine the type and allowable bearing pressure of soil at suitable intervals and adopt the type and mix of foundations, suitable for particular locations with the help of the approved employment schedules. In cases of particularly weak soil, the bearing pressure may have to be determined for each location where so advised by the Purchaser.

Soil bearing pressure, using suitable method should be determined generally for every 5Kilometre interval or less wherever change of soil is encountered. In general IS code of practice (IS: 6403) should be followed. In addition at every 250 m the solid bearing pressure should be determined by dial gauge type penetrometers. Dial gauge type penetrometers shall also be made available by the Contractor at each foundations site so as to facilitate cross check at each individual location.

For design of foundations for masts and gantries at switching stations and booster stations the Contractor shall determine the type and allowable bearing pressure of soil at the locations of such stations and shall prepare designs for the foundations suitable for each location to suit the bearing pressure of the soil in consultation with the purchaser.

(b) STRUCTURES CARRYING OVERHEAD EQUIPMENT

Foundations for traction structures carrying overhead equipment shall be either of the side bearing, side gravity or medium gravity new pure gravity type according to their location, formation of the sub grade and bearing pressure of the soil. In new filled up soil or cinder

Formation, pure gravity sand-filled core foundations or foundations with cast-in-situ reinforced concrete piles or cantilever types foundation with counter weights or guyed foundations may be adopted.

(c) MASTS FABRICATED STRUCTURES AT SWITCHING STATIONS

Foundations for the masts of gantries at switching stations shall be of the pure gravity type the base of which shall rest on consolidated soil.

(e) FENCING POSTS

Foundations for fencing posts shall rest on consolidated soil if the depth of unconsolidated soil is less than 1.5 m below the datum level and shall be rectangular parallel piped in shape. If the depth of unconsolidated soil is more than 1.5 m the foundation block shall rest on reinforced concrete piles cast-in-situ or reinforced concrete foundation may be adopted as desired by the Purchaser.

(f) TYPICAL DESIGN

Typical designs and drawings of side bearing and new pure gravity and side gravity type foundations are included in the drawings listed. Employment schedules for standard foundations for traction structures for various locations and types are also included in the drawings listed.

(g) SPECIAL FOUNDATIONS

In the case of foundations at locations not covered by the employment schedules furnished by the Purchaser, the Contractor shall prepare special designs and furnish full design calculations justifying the choice of the type of foundations for such locations. In black cotton soil specially pile foundations of under reamed type as per RDSO's standard designs (Reference RDSO's Drawing No. ETI/C/006 2 Mod. 'A') or any other approved design may have to be cast at limited locations for trial purpose. The tenderer may furnish the technical details of alternative design construction methods proposed to be adopted and their previous background/experience if any. The decision of the Purchaser with regard to feasibility and suitability of adoption of the alternative design for each type of foundation will be final.

(h) EQUIPMENT PEDESTALS: Pedestals for interrupters and L.T. supply transformers where required, shall be of mass concrete with the base resting on consolidated soil.

(i) CABLE TRENCHES: The cable trench shall rest on original ground if the depth of unconsolidated soil is less than 0.5 m. If the depth of the unconsolidated soil is more than 0.5 m the cable trench shall be made of reinforced cement concrete of approved design supported at suitable intervals on concrete pillars.

3.3.3. EARTH PRESSURE

(a) GUIDING INFORMATION

Subject to Para 3.2.2 (a) above, the following allowable bearing pressures may generally be expected for various kinds of soil. The information is given for general guidance only.

i) Average good soil in banks and cuttings 11,000 kg/ sqm
 ii) Moorum soil in cuttings 22,000 kg/sq.m
 iii) New Banks and bad soils in banks and cuttings 5000 kg/sqm
 iv) Black cotton soil pure gravity foundation shall normally be adopted. However, under reamed pile foundations may be adopted at the option of the Purchaser in limited locations for trial purpose. In the case of dry black cotton soil, the soil should be subjected to a bearing pressure as close as possible but not exceeding 16,500 kg/sqm the depth of the foundation block being not less than 2.8 m. In the case of wet black cotton soil the soil should be subjected to a bearing pressure as close as possible but not exceeding 8000 kg/sqm. In the case of hard rock a hole should be blasted in the rock or by means of any other drilling and pneumatic method and the mast sealed into it with concrete.

3.3.4. CONCRETE

For all OHE/Feeder/Switching stations, Concrete for foundations shall be nominal mix of grade M.15 obtained by mixing cement, coarse aggregate, fine aggregate and water in accordance with proportions given vide Table 3 of IS: 456.2000 reproduced below. For grouting, muffing, embedding of structures in foundations and for cable trenches at switching stations also nominal mix concrete M.20 obtained by mixing materials in proportions as indicated in Table - 3 of IS: 456 - 2000 shall be used. Volume batching may be adopted vide clause 9.2.2 of IS: 456 - 1978 reproduced below: IS: 456-2000

PROPORTIONS FOR NOMINAL MIX CONCRETE

Grade of Concrete	Total quantity of aggregate by mass per 50 kg of Cement to be taken as the sum of the individual masses of the fine and coarse aggregates max	Proportion of fine aggregate coarse aggregate (by mass)	Quantity of water per 50 kg of cement mass
M5	800 KG	Generally 1:2 but subject to an upper limit of 1:1 1/2	60 Litres
M 7.5	625		45
M 10	480		34
M 15	350		32
M 20	250		30

NOTE:

1. The proportions of the fine to coarse aggregate should be adjusted from upper limit to lower limit progressively as the grading of the fine aggregate becomes finer and the maximum size of coarse aggregate becomes larger Graded coarse aggregate shall be used.

2. For every 50 m³ of concrete casted, sample three test cubes of size 15x15x15 cm shall be made and shall be tested for crushing strength after 28 days at any government approved agency/colleges. The cost involved shall be borne by the contractor. Further, without the test results for each 50 m³ sample, payment for foundation for that batch will not be made.

Example: For an average grading of the fine aggregate (that it is zone II of Table 4 of IS: 383-1970*) the proportions shall be 1:2 1/2, and 1:2 for maximum size of aggregate 10 mm and 20 mm respectively.

* Specification for coarse and fine aggregates from nature sources for concrete (second revision)

"In case uniformity in the materials used for concrete making has been established over a period of time, the proportioning may be done by volume batching, provided periodic checks are made on mass/volume relationships of the materials where weight batching is not practicable the quantities of fine and coarse aggregate (not cement) may be determined by volume. If the fine aggregate is moist and volume batching is adopted allowance shall be made for bulking in accordance with IS: 2386 (Part-iii) - 1973".*

* Method of test for aggregate for concrete Part-III specific gravity, density, voids, absorption and building.

In judging the acceptability of the materials quality of concrete and the method of work, the Purchaser will generally observe the provisions of the "Indian Standard code of Practice of Plain and Reinforced Concrete, IS: 456 - 1978. The crushing strength of concrete shall not be less than the limits given below:

Crushing strength of 15 cm cubes by works test.

	Concrete	At 7 days age	At 28 days age
a)	M.10	70 Kg/cm ²	100 kg/cm ²
b)	M.15	100 Kg/cm ²	150 kg/cm ²

NOTE:

(a) Test specimen of works tests shall be taken at the site of work from mixture of concrete ready for pouring into the foundation hole. All tests shall be carried out in accordance with IS; 516 1969 or its latest version. The sample of concrete from which test specimens are made shall be representative of the entire batch.

(b) Age is reckoned from the day of casting.

3.3.5. SIZE AND GRADING OF AGGREGATES

The graded coarse aggregate 20 mm nominal size table 2 of IS: 383-1970) shall be used for foundation, grouting muffs and embedding shall be of 20 mm graded nominal size as per table 2 of IS: 383-1970 (Specification for coarse and fine aggregate from natural sources for concrete). Fine aggregate shall be graded from 10 mm downwards. The maximum size of aggregate for under reamed pile foundation shall be 20 mm graded nominal size.

3.3.6. SAND CORED FOUNDATIONS

After erection of masts in sand cored foundations the corehole of the foundation blocks shall be filled with dried sand and covered with a layer of bitumen of 80 mm thickness below 30 mm from top level of the block. A hemisphere shaped muff shall be provided on such foundations in lieu of standard type.

3.3.7. SINKING OF CONCRETE SHELLS

Where the water table is high one or more section of reinforced concrete shells may have to be sunk before casting concrete. The size of each shell be 1200 mm outside dia * 50 mm thick * 600

high reinforced with 6 mm (1/4") dia rods spaced 150 mm apart, both longitudinally and circumferentially the concrete shall be of grade M. 15

3.3.8. TYPE OF FOUNDATION BLACK COTTON SOIL

The foundations in dry black cotton soil should be of type BC or NBC or any other type as approved by the Purchaser.

3.3.9. CEMENT:

The cement to be used in the construction of PCC/RCC structure should of Ordinary Portland Cement to IS:269 of latest version or Portland Pozzolana cement (fly ash based) as per IS: 1489,Pt-I,1991 ,3rd rev or its latest version

3.4. SECTION-4 STRUCTURES

3.4.1. SCOPE

This chapter deals with the design of steel structures and steel work for overhead equipment, switching stations, booster transformer stations and L.T. Supply transformer stations and the specifications for steel and pre-stressed concrete trial mast.

3.4.2. GENERAL

The steel structures may be of riveted, bolted or welded construction as convenient for installation. The thickness of smallest steel section used shall not be less than 6 mm (or ¼"). Legs of gantry structures/portals and supporting steel work and uprights or bus bar supports shall generally be embedded in concrete foundation blocks and for equipment and in special cases secured by means of holding down bolts.

3.4.3. DESIGN

- a. All the steel structures like gantries/portals, other supporting members, small parts steel work etc. shall be galvanised after fabricated with a minimum value of average mass of zinc coating being not less than 1000 g/m² as per RDSO's specification No. ETI/OHE/13(4/84) with Amendment No. 3 (4/ 1990).
- b. All designs for special steel work shall be furnished by the Contractor, for approval of the Purchaser. Designs for steel structures shall except where otherwise provided, comply with the "Indian Standard Code of Practice for use of Structural steel in General Building Construction" – IS : 800-1984 or latest, other relevant IS specifications and statutory regulations.
- c. For purposes of designs, all possible loads, which may occur in the worst combination, shall be considered.

3.4.4. STEEL

Steel conforming to IS: 2062:2011 226-1975 shall be used for all fabricated steel work. Steel should be to designation STRUCTURE: ST: 42-S.

3.5. SECTION-5 EQUIPMENTS, COMPONENTS & MATERIALS

3.5.1. GENERAL

This chapter deals with the details and specifications of the equipments, components and materials to be used for traction overhead equipment, switching stations, booster transformer stations

and L.T. supply transformer stations. This chapter does not cover structures and foundations. In general based on the specifications issued by various bodies, such as Indian Standard Institution, British Standards Institution etc. Specifications have been issued by the Purchaser. Such specifications may be bought separately from the Office of the Purchaser.

3.5.2. COMPLIANCE WITH STANDARD SPECIFICATION

In the technical specifications of equipments components and materials, references are made to the following standard specifications:

- i) International Electro Technical Commission (abbreviated as IEC) publications.
- ii) British standards (abbreviated as BS)
- iii) Indian Standards (abbreviated as IS)

Tenderers may however offer equipment in accordance with the appropriate national standard specifications of the country of manufacture but such officers will be treated as deviations and should be quoted for in the manner specified in the tender document. English rendering of the text and illustrations to the national deviations from IEC, Britain or Indian Standards in question shall also be submitted. In case of doubt the Purchaser shall decide the clause and specification applicable and the contents of the specification and standard mentioned above shall guide such decisions.

3.5.3. QUALITY ASSURANCE

The provisions of Part I for quality assurance will apply including facilities to be provided by the manufacturer .

3.5.4. PROTOTYPE TESTS

Prototype test shall be carried out as per RDSO Standard No. IS/RDSO-TI/0002:2023 or latest.

(a) FITTING, COMPONENTS AND MATERIALS

All the fittings, components and materials to be supplied by the Contractor in terms of this contract the requisite number of proto type of components shall be supplied free of cost to the Purchaser for tests and approval. The tests will be conducted in a laboratory selected by the Purchaser.

(b) EQUIPMENTS

This comprises inspection and tests conducted on the first equipment of a specified manufacturer, which the Purchaser considers sufficient to prove that the design is in conformity with the specification at the manufacturer's Factory. The type tests shall be conducted on each equipments as indicated in the individual specifications, in the presence of the Purchaser's representative. The Contractor shall arrange to get these conducted at his own cost.

(c) RESPONSIBILITY

Any testing and approval by the Purchaser of proto types shall in no way absolve the contractor of his responsibility under the terms of the contract for the equipment supplied and erected.

3.5.5. INSPECTION TESTS

These comprise inspection and tests conducted at the manufacturer's factory for ensuring quality of manufactured items as part of the quality Assurance Programme. Acceptance test for all types of insulators shall be done by RDSO's authorized inspection authority or by consignee representative as desired by purchaser.

3.5.6. TESTS CERTIFICATES

Three copies of the test certificates of successful prototype tests carried out at the manufacturer's factory on all equipments shall be furnished to the Purchaser within a month after completion of the

prototype tests. Three copies of the routine tests carried out on each equipment shall also be furnished after the equipment is passed by the Purchaser's representative for inspection.

3.5.7. INTERCHANGEABILITY

All equipments components and fittings shall be inter-changeable and supplies shall be in accordance with the Purchaser's designs unless otherwise specifically approved by him. Components such as fuses, indication lamps etc. should be replaceable with substitutes available indigenously as far as possible.

3.5.8. INSULATION LEVEL

Interrupters, Potential Transformers line indication type, 42 KV Lightning Arrestors and their equipment shall be suitable for insulation levels indicated in the relevant specifications.

3.5.9. TECHNICAL SPECIFICATIONS

The following specifications (latest revision) will govern supply and testing of various items of equipment and material except where otherwise specified in the Tender Papers or Purchaser's specifications which are listed in Annexure - I .

Standard specifications

General requirements for the supply of metals & metal products	IS : 1387-1967
Tin bronze castings	IS : 306-1983 (Grade G2)
Control cables (PVC insulated)	IS : 1554 (part I) – 1988
Structures & steel work	IS : 800-1984, IS2062-1992
Structural steel (standard quality)	IS : 226-1975
Coarse and fine aggregate from natural sources for concrete.	IS :383-1970
Code of practice for general construction of plain and reinforced concrete	IS : 456-1978
Method of tests for strength of concrete	IS : 516-1959
Insulator	IS 731-1972
All aluminum conductor	IS: 398 (Pt.I) - 1996
Material for aluminum tubular busbar	IS: 5082 - 1998
Dimensions for Aluminum Tubular bus bar	IS: 2673 - 1979
Aluminum bronze castings	IS: 3091- 1965
Malleable iron castings	IS: 2108 - 1977
Aluminum castings	IS: 617 – 1994 (Grade 4600)

Copper bus bar	RE/30/OHE/5 (11/60): IS: 613 - 1984
25 KV single and double pole isolator	ETI/OHE/16 (1/94) with A&C slip No 1(6/2000)
25 kV/240 V, 10 KVA LT Transformer	ETI/PSI/15 (11/92) with A&C slip No. 2 of 3/200

3.5.10. NOMENCLATURE & MARKING

(a) All components and fittings supplied by the Contractors shall bear the respective identification number and a mark to identify the source of supply except in the case of galvanized tubes, bolts and nuts and/or any other fittings as may be agreed to by the Purchaser.

(b) In case of insulators galvanized steel tubes stainless steel wire rope and conductors name of manufacturer shall be specified in "As Erected" drawings for identification.

3.5.11. STEEL WORK AND PROTECTION AGAINST RUST

(a) GALVANIZING

All ferrous materials and fittings shall be hot dip galvanized according to the specification ETI/OHE/13 (4/84) with A&C slip No. 1, 2 & 3. If minor modifications which would damage the protective coat, become necessary at site, these shall be carried out with the approval of the Purchaser and in a manner to be specified by him in accordance with specification no. ETI/OHE//13(4/84) with Amendment No. 1 (May 1986) or latest

(b) PAINTING

Some components or parts may, with the approval of the Purchaser, be protected only by paint and parts so protected shall be given two coats of composite Aluminum primer and two coats of Aluminum paints. The second coat of Aluminum Paint shall be applied after erection.

(a) All insulators except Disc type insulators those on return conductors and earth wires shall be of the solid core type. Disc insulators shall be used on return conductors and earth wires or other locations as desired by the Purchaser. All solid core insulators shall conform to ETI/OHE/15 (9/91) A&C slip no. 1, 2&3.

3.5.12. TERMINAL CONNECTORS FOR EQUIPMENTS

Isolators, interrupter, potential Transformer line indication type, lightning Arrestor, Fuse Switch, Booster Transformer and LT supply Transformer shall be supplied by the Contractor along with the terminal connectors suitable for taking jumper/ bus bar as required. However, strips shall be provided by the Contractor for bimetallic connections wherever required.

BUSBAR

(a) No splicing will normally be allowed in the tubular bus bars unless the length of the bus bar exceeds 6 m.

(b) GENERAL

The bus bar shall be clean, smooth, mechanically sound and free from surface and other defects. Provision shall be made where necessary to allow for expansion and contraction of bus bars caused by temperature variation. The open ends of bus bars shall be covered by suitable tube caps, wherever the tubular bus bars are required to be bent, the radius of the bend shall be not less than 200 mm.

(c) JOINTS

The joints in bus bars shall be mechanically and electrically sound so that the temperature rise is not abnormal.

(d) All aluminum joints shall be thoroughly cleaned and smeared with suitable corrosion inhibiting joint compound before and after assembling the joint. Similar procedure shall be followed for connecting the equipment terminals to the aluminum busbars with bi-metallic connectors.

3.5.13. CABLING

(a) CABLE FOR LT SUPPLY

240 VAC supply from LT supply transformer at Switching stations shall be brought and terminated on the L.T. AC distribution board in the remote control cubicles at the switching stations by XLPE insulated PVC sheathed aluminium conductor armoured power cable of aluminum cable of size 2 core x 70 sq. mm as per ISS: 7098 heavy duty, 1100 V with ISI markings (for 10 kVA LT Transformer). All indoor wiring on walls shall be taken through PVC conduct pipes neatly fixed. The pipes shall be of ISI make and appropriate size.

(b) CONTROL INDICATIONS CIRCUITS

All other cables for control and indication at switching stations shall be 1100-V grade PVC insulated and sheathed unarmoured (heavy duty) complying with (IS: 1554 (Part I) 1976). RDSO/CORE specification The cables shall be provided as indicated in the Table below:

Sl. no	Purpose	Run	Circuit voltage	No. of cores /section	No. of Cables required
1)	Control & Indication of Circuit Breakers	From Each Circuit Breaker to control board	110 V DC	10 x 2.5 sq.mm	Three cables to be used
2)	Transformer alarm/ trip circuits & tap changer control	From each 110/25 kV transformer to control board	110 V DC	10 x 2.5 sq.mm	Five cables to be used
3)	Transformer protection (bushing current transformer connections)	From each 110/25 kV transformer to control board.	110 V DC	4 x 4.0 sq.mm	One cable for each bushing CT to be used
4)	Current transformer & neutral connections	From each CT to control board.	110 V DC	2 x 4.0 sq. mm	One cable for each core of CT/Neutral CT
5)	PT connections	From each PT to control board	110 V AC	2 x 2.5 sq. mm	One cable to be used
6)	110 v DC supply	(i) Connection between battery chargers & DC distribution board	110 V DC	4 x 4 sq mm	One cable to be used with two cores connected in parallel

		(ii) Connection between batteries & DC distribution board	110 V DC	4 x 4 sq mm	One cable to be used with two cores connected in parallel
		(iii) Connection from distribution board to control board.	110 V DC	4 x 4 sq mm	Two cables to be used with each circuit breaker and one cable for DC supply to control boards.

i) Notwithstanding the sizes of cables give above the Tenderer shall assure himself that the various cables would suit the ratings of equipment offered by him.

(c) SPECIFICATION: All indoor wiring on walls shall be taken through PVC conduit pipes (Concealed wiring). The pipes shall be of ISI make and appropriate size. The cables shall be resistant to decay, abrasion, acids alkalis and other corrosive materials.

3.5.14. INSTRUCTIONS AND TECHNICAL BOOK

The Contractor shall supply 6 copies of booklets containing manufacturer's instructions for operation and maintenance of each of the items of equipment the supply of which is covered by the contract. In addition, 6 copies of detailed schedule of components, catalogues and drawings of all parts of equipment shall also be supplied.

3.6. SECTION-6 DESIGNS AND DRAWINGS

3.6.1. GENERAL

- (a) This chapter deals with the procedure for approval of designs and drawings.
- (b) In all drawings, as far as possible only such symbols as are in international use, shall be used.

3.6.2. CONTRACTOR'S DRAWINGS

- (a) The contractor shall submit to the purchaser for approval except where otherwise specified below, all detailed designs and drawings which are necessary to ensure correct supply of equipment's, components and materials and to enable correct and complete erection of sub-stations in an expeditious and economic manner.

(b) RESPONSIBILITY

It is to be clearly understood that all original designs and drawings shall be based on a thorough study. General designs and dimensions shall be such that the contractor is satisfied about the suitability of the designs for the purpose. The Purchaser's approval will be based on these considerations and notwithstanding the purchaser's acceptance, the ultimate responsibility for the correct design and execution of the work shall rest with the contractor in terms of the conditions of contract.

3.6.3. STANDARDS FOR DRAWINGS

All designs, legends notes on drawings and schedules of materials shall be in English and shall be prepared in the metric system. All designs and drawings shall confirm to as per latest specification and shall be prepared preferably in CAD only.

3.6.4. BASIC DESIGNS

(a) STANDARD DESIGNS

Where the contractor adopts designs and drawings conforming to the standard designs, drawings, and specifications of the RDSO for basic arrangements, equipment's, bus bar junctions, connectors and terminals, he shall verify such designs, drawings and employment schedules and satisfy himself that these are correct and based on latest approved drawings before use. Within two months of the issue of Letter of Acceptance of Tender the contractor shall indicate to the purchaser, the list of standard basic arrangement, components and fittings drawings and employment schedules, which he will adopt for the purpose of work.

(b) DEVIATIONS

Normally deviations from the standard drawings of the Purchaser will not be accepted. However, in exceptional cases where the contractor desires to suggest improvements as a results of his experience or other development, he shall justify his proposals with supporting explanatory design details and notes.

(c) In cases where standard designs, drawings or employment schedules do not cover requirement of special locations or site conditions, the contractor shall submit his own designs or drawings along with supporting calculations and notes for scrutiny and approval of the Purchaser.

(d) Such special designs shall generally be in conformity with basic designs furnished by the Purchaser and in accordance with the specifications. If the contractor wishes to adopt special designs which do not conform to the general basic designs of the Purchaser, he shall submit alternative designs and drawings justifying his proposals.

DETAILED DRAWINGS

The contractor shall submit the drawings which are mentioned in the RDSO Standard No. IS/RDSO-TI/0002:2023 or latest.

Further, The Contractor shall submit for approval the following drawings.

a. Cross-section drawings for each Sub-Station indicating the transverse and longitudinal cross-section of the soil along the centre line of the equipment, bus bar supports and cable trenches. These drawings shall be prepared after an accurate survey at site and shall indicate the nature of the soil, its bearing capacity, compactness and in case of loose soil, cross section of the parent soil. In the preparation of the drawings, care shall be taken to show all obstructions to be removed, such as telegraph posts, underground pipes, cables etc. after collection of such information from the site.

b. General arrangement drawings and schematic drawings for each Sub-Station indicating the general arrangement of all equipment, run of bus bars, position of pedestal insulators and steel frame work. The drawings shall also give a schematic connection diagram wherever required. The drawings shall include an elevation view of the Sub-Station transverse cross section and plan views. The drawings shall have a schedule of all equipment required at the Sub-Station along with drawing references of the details of these equipment.

Structural drawings for each supporting steel frame work or pedestal. The drawing shall include one elevation view of the steel frame work assembly from behind, a transverse cross section and plan view. In the assembly each component member shall be marked with its reference number. The drawing shall also have a schedule of components members along with drawing references of various members. The weight of the component members shall also be indicated. The drawings shall be prepared for the various structural components. An individual drawing shall be made for each component and this shall include all fixing bolts, nuts and washers whose sizes will be mentioned on the drawings. Unit weight of the components shall also be given in the drawings.

c. Foundation layout and cross section drawings for each Sub-Station indicating layout of all foundations in plan, longitudinal and transverse cross sections of various foundations thorough centre line of gantry/portal legs, various equipment bus bar supports, fencing up right and cable trenches. All foundations shall be marked serially on the drawing indicating the volume of concrete for each foundation block.

d. Earthing layout drawing for each Sub-Station indicating the layout of full earthing system in plan. The drawing shall show the location of earth electrodes and mark the runs of earthing leads and connections to equipment, gantry/portal columns, fencing up rights, structural supports etc. All components shall be marked with their reference numbers. For further details of the run of conductors and connections, separate drawings which may be common to all Sub-Stations may be made and references to those drawings marked on the layout. A schedule of components shall be made out in the drawing giving drawing references of components. The necessary design calculations for the proposed earthing system of the Sub-Station shall also be submitted by the Contractor for Purchaser's approval.

e. Cabling and wiring diagrams for each Sub-Station indicating the schematic arrangement and physical disposition of equipment, run of cables and wires for inter-connections between various equipment indoor and outdoor, colour coding and the index scheme adopted for terminals. The drawings shall also indicate the sizes of wires and grades of insulation. The quantity of various cables required shall be indicated on the drawings.

f. The Equipment and Busbar Layout, Cable Trench Layout, and TSS Layout drawings, along with the details of the existing arrangements, shall be submitted to the Purchaser for approval.

g. Equipment drawings applicable to all Sub-Stations complete with drawings of components parts except the ones for the equipment to be supplied by the Purchaser. Drawings should be dimensioned and should indicate:

- i. Fixing or mounting hole dimensions and arrangement.
- ii. Net weight of the equipment.
- iii. Characteristics and ratings including those of motors and resistors, etc.
- iv. Schematic and detailed circuit diagrams.
- v. Overall dimensions and other important dimensions.
- vi. Height and disposition of all exposed live parts, height of the bottom most point of al bushings and insulators.
- vii. Notes explaining the operation of the equipment.

h. General drawings applicable to all Sub-Stations. These drawings shall include the drawings or sketches made for study of clearances, isolator alignment details, number plates of various equipment, caution or instruction boards, non-standard bus bar connectors, clamps and Unit price bolts for cable mounting etc.

i. On receipt of approval of relevant drawings for each Sub-Station, the following schedules of quantities relating to each Sub-Station shall be submitted within a fortnight of receipt of approval.

- i. Schedule of foundations, showing volume of each type and total volume.
- ii. Schedule of steel work, types, weights of each member and total weight.
- iii. Schedule of quantities of various items of work of Schedule.

j. The above drawings, along with the details of the existing arrangements, shall be submitted to the Purchaser for approval.

SUBMISSION OF DESIGNS AND DRAWINGS

a. The submission of designs and drawings for approval shall be done in the manner indicated below. In every case the Contractor shall send all correspondence, calculations, Explanatory Notes, other documents and drawings, in triplicate to the design Office of the Purchaser. In case the Contractor wish to deviate from standard drawings he should submit to the Purchaser revised drawings with full details deviation sought explaining the necessity of deviation, calculations and other supporting documents. The Purchaser, if satisfied about the necessity and adequacy of deviations, shall refer the matter to RDSO for necessary approval.

a. On receipt of Purchaser's approval to the Contractor's drawings and Schedule of Quantities, the Contractor shall submit original tracings of these drawings and schedules for the signature of the Purchaser in token of approval within 7 days of the receipt of approval. On receipt of these tracings from the Purchaser the Contractor shall submit 6 copies for distribution to field officers and other Departments within 7 days of receipt of approved tracings.

In all the above case, the Contractor has the option to supply only five copies of the approved drawings provided one of them is a transparent paper print.'

c. Drawings approved by the Purchaser shall not be modified without prior consent in writing from the Purchaser. Drawings incorporating approved modifications shall be resubmitted for formal approval of the Purchaser in the same manner as original drawings.

COMPLETION DRAWINGS AND SCHEDULES

After completion of works, all drawings and designs submitted by the contractor and approved by the purchaser shall be made upto date incorporating actual supply and erection particulars including the name of make of insulators, galvanized steel tubes, stainless steel wire rope etc. The make of conductors shall be specified in the 'As erected' OHE layout plans, SED and other relevant drawings for identification.

Such drawings and schedules shall then be verified and corrected, if necessary, by the contractor jointly with the Purchaser's representatives. All verified and corrected drawings shall be supplied in **Seven sets plus one original and one of which shall be in transparent** paper print or in reproducible tracing cloth or any other durable material approved by the Purchaser. Before or on the date of the CRS inspection/energization, both soft (PDF & CAD version) and hard copies of relevant as erected drawings should be submitted.

3.7. SECTION-7 ERECTION & INSTALLATION OF EQUIPMENT

3.7.1. SCOPE

This chapter deals with the method of erection and installation of equipment, including casting of foundations and erection of structures.

3.7.2. METHOD OF ERECTION

All work shall be done in accordance with standard acceptable methods of erection and installation of electrical equipment.

3.7.3. INSPECTION

All erection and installation work shall be subject to inspection by the Purchaser to ensure that the work is done in accordance with specifications, approved designs and drawings and is of the best quality suitable for the purpose.

3.7.4. MEASUREMENT

All measurements for location of structures and foundations shall be made with the aid of the steel tapes.

3.7.5. BOLTS, NUTS ETC.

All bolts, nuts and lock nuts, screws, locking plates, split pins etc. shall be properly tightened and secured. No bolt may project more than 10mm beyond the nut/lock nut after full tightening. Contractor shall carryout systematic inspection of this aspect of work after the installation is completed and prior to offering completed Sub-Station to the Purchaser for inspection and testing.

3.7.6. DAMAGE TO GALVANISING / PAINTING

The loading, transport and erection of all galvanized/painted material shall be handled with care to avoid damage to galvanizing painting. If galvanizing/painting is damaged in spite of all care taken, the damaged part or component shall be put for inspection, to obtain permission from the Purchaser to carry out.

3.7.7. FOUNDATIONS

a. Location

The location of each foundation shall be correctly set out in accordance with the approved foundation layout drawings in the presence of the Purchaser's Representative

b. Method of Installation

The foundation bolts for erection of gantries, portals and other supporting frames if any, shall be grouted into the foundation in cored holes left in foundation blocks for gantry legs or other steel work to be embedded. In any case, the method of casting foundation blocks and erection of gantries, portals and other supporting frames shall be subjected to the approval of the Purchaser.

c. Concreting

All concreting or grouting shall be done in accordance with details given in tender document with ballast graded for the purpose specified. The concrete shall be pure and tamped properly in accordance with the method approved by the Purchaser. The Contractor shall arrange to provide concrete testing samples for tests as and when required by the Purchaser to determine the crushing strength after 28 days' curing. Testing shall be arranged by the Contractor at his own cost.

d. Foundation level

The top of all foundations and anchor block shall always be above the level of the ground and of adequate height, not less than 15 cm to afford reasonable protection during rainy season. The top of foundation shall be finished to make a smooth surface sloping 1/20 outwards to drain rain water.

- (i) Suitable grooves or niches shall be provided in the foundation blocks at the time of casting, to enable embedment of earth strips without calling for chipping of the blocks subsequently.
- (ii) Conduits of approved size should be embedded in the foundation blocks even in the initial stages, to avoid chipping and braking of the foundation blocks for embedment subsequently.
- (iii) All foundation will be cast in the presence of the Purchaser's Representative with regard to fixed datum level.

3.7.8. STRUCTURES

a. Erection

The structures shall be embedded in the foundation blocks for the correct length specified in approved drawings.

b. Alignment

The legs of gantries and other supporting frames shall be carefully aligned to enable easy and good assembly of top booms and other fabricated steel work.

3.7.9. EQUIPMENT

The installation of the equipment shall be carried out strictly in accordance with the instructions issued by the manufacturer. The equipment shall be levelled carefully before being fixed finally in position. The bushings of insulators shall be protected adequately during erection of equipment to avoid chipping or damage to the porcelain.

The following methods shall be adopted for mounting the various equipment.

	Equipment	Method of mounting
(i)	Step down transformer 25 kV/433V	The transformer shall be plinth mounted.
(ii)	25kV circuit breakers.	On fabricated steel supports erected on concrete foundations.
(iii)	Isolators, potential transformers, Current Transformer, LT supply transformers, 25 kV fuse switches and lightning arrestors	On steel supports mounted on concrete foundations.
(iv)	Power Quality Restorer	PQR shall be suitably mounted as per the RDSO STANDARD No. IS/RDSO-TI/0002:2023 for PQR (Annexure-1).

The circuit breakers and isolators shall be mounted in such a way that they can be manually operated conveniently by a person standing on the ground or on a concrete pedestal of suitable height.

3.7.10. BUS BARS AND CONNECTIONS

- a. The bus bar connections on the incoming side shall be as tight as possible, all similar connections in adjacent bays being informally shaped and bent to give a good appearance. The tubular aluminium bus bars shall be supported at a uniform height throughout. Wherever tubular bus bars are required to be bent, the radius of the bend shall not be less than 375 mm.
- b. All aluminium bus bar joints shall be made carefully. The contact surfaces of the bus bars and the connectors shall be cleaned vigorously either by hand with a dry coarse emery cloth or by power driven wire wheel brush. The surfaces shall be smeared with a suitable corrosion inhibiting joint compound approved by the Purchaser. The joint closed-up as soon as possible thereafter and a final light application of joint compound shall be made. Similar procedure shall be followed while connecting the equipment terminals to the bus bar by means of bi-metallic connectors.

3.7.11. CABLING

a. Laying of Cables.

All PVC cables provided outdoor shall be either laid in trenches or neatly clamped to the structures as approved by the Purchaser. If it becomes necessary to take the cable connections along the structures shall be neatly secured with proper clamping arrangement at suitable intervals. Each cable in the cable trench by on the structure shall also be provided at suitable intervals with identification labels of durable material bearing indelible engraved or punched markings to facilitate easy identification.

b. Termination of Cables.

The cables shall be terminated neatly and the cores arranged and dressed properly. Suitable terminal strips and ferrules made of PVC or other durable material shall be provided on terminals and wire ends respectively to facilitate identification. The markings on the terminals trips and ferrules shall be either engraved or punched so as to be indelible.

c. Indoor wiring.

As far as possible all cables shall be laid in the trenches/pipes provided for the purpose in the control room.

3.7.12. EARTHING

- a. The *Galvanized mild steel earth rod shall be buried in the ground at a depth of 50 cm below ground level. Where the earth flat is exposed either for connection to equipment or for crossing the cable trench, it shall be painted with two coats of red oxide zinc chromate primer to IS : 2074 or latest , CNSL based and finished, with two coats of aluminium paint (If required). Inside the control room the steel flats shall be neatly supported on teak wood blocks fixed to the wall 15 cms, above the floor level with suitable spacing from the wall face to facilitate connections of earthing leads. These shall be painted with two coats of red oxide zinc chromate primer to IS: 2074 or latest and finished with two coats of aluminium paint to IS: 2339 or latest (If required).

b. The joints on mild steel flats shall be welded type. The welds shall be treated with barium chromate before painting the welded surfaces. The connections to the various items of equipment and structures shall be made with galvanised steel bolts (16 mm dia) nuts with lock nuts or spring washers as required. The earth connections to the structural members shall be made at height not exceeding 150 mm from the ground level. The steel flats shall be bent and shaped neatly before connection to the structures or frame work of equipment. The earth flats to run along the mat shall be properly supported on the structures with galvanised steel bolts (12 mm dia), nuts with lock nuts or spring washers, as required, at suitable intervals.

Note for Galvanized MS rod:

1. *The galvanization shall be done as per RDSO specification No. ETI/OHE/13(4/84) with ACS 1 to 4 ensuring quality of zinc, base metal, surface preparation and galvanizing as per relevant standards as given in the above RDSO specification. The weight of the zinc coating to be adopted is 750 g/m².
2. *In case during installation, if galvanization is damaged due to hole drilling, welding, cutting, handling, etc., the rectification shall be done as per clause 8 of RDSO specification No. ETI/OHE/13(4/84) with ACS 1-4 (using zinc based solder/zinc based paints).

3.8. SECTION-8 INSPECTION AND TESTING

3.8.1. GENERAL

a. This chapter deals with the inspection and testing of completely erected Power Quality Compensating Equipment with all accessories and associated equipment as provided.

b. Reasonability The general tests of overall performance stipulated in tender document are only supplementary to other test on structures, foundations, equipment, components and fittings as specified in Standard specifications to be complied with. Any testing and acceptance by the Purchaser of overall performance shall be subject to general terms of warranty which shall continue to be valid.

3.8.2. INSPECTION AND TESTING

a) All the equipment, material, fittings and components will be subjected to the inspection by the Purchaser of his Representative (RDSO/RITES) either at the manufacturer works or at the Contractor's depot. The Purchaser of his representative shall have the right to be present during all the stage of manufacture and shall be afforded free of charge all reasonable facilities for inspection and testing so as to satisfy himself that the material are in accordance with specifications approved drawings, designs.

b) **Inspection and testing of the Power Quality Compensating Equipment shall be carried out as per RDSO STANDARD No. IS/RDSO-TI/0002:2023 for PQR.** All the testing equipments required for the testing of the installations supplied and erected by the successful tenderer shall be arranged by the successful tenderer during testing. As soon as power quality restorer and associated equipments are ready for inspection and testing, the contractor shall advise the Purchaser in writing. Those shall include the test which the Purchaser may like to conduct with a view to assure himself of the soundness of these equipments and their erection in compliance with these

specifications. After completion of joint testing, joint inspection report has to be prepared and has to be submitted for approval of Electrical Inspector to Government of India (EIG) (PCEE/SR). Any comments/remarks in the equipment proposed for commissioning communicated by EIG has to be rectified by the contactor before commissioning.

c) **ERECTION** All erection work will also be subjected to inspection by the Purchaser or his Representative to ensure that the work is done in accordance with the specifications and approved drawings and designs.

The decision of Sr.DEE/TRD/MDU or his successor/nominee shall be final in respect of acceptability of other wise of any material, fittings, components or equipment required for the work.

4.0 PARTICULAR SPECIFICATIONS

This work involves designing / preparation of drawings, casting of foundation, manufacture, supply, testing, Erection, commissioning of power quality restorer (also known as power quality compensating equipment) with all accessories RDSO Standard No. IS/RDSO-TI/0002:2023 for PQR or latest for Traction substation at **PLNI, GMGM, MNM, RMD and TENI** in MDU division as per detailed Schedule and its explanatory notes.

For other power supply equipment's please refer RDSO specifications and drawings and relevant IS/IEC specifications may be referred.

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